

**The Production, Circulation and
Consumption of Ceramic Vessels at Early
Neolithic Knossos, Crete.**

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Volumes I-III

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ABSTRACT

Neolithic ceramics in the Aegean have had a history of interpretation, which has seen them employed to address a series of questions, including chronology, cultural origins, technology, production, circulation and consumption. This study critically reexamines this history of interpretation and explores how it has contributed to current understanding of the production, circulation and consumption of ceramic vessels during the earlier Neolithic (c.6500-4500BC). More specifically it is argued that recent advances in the methods used to characterise variation in Neolithic ceramic assemblages have generally not been matched by increased sophistication in the ways such variation is interpreted.

In this study macroscopic and microscopic (petrography, scanning electron microscopy) analyses of Early Neolithic ceramics from Knossos have been combined in order to explore the potential limits of ceramic variation. In the methodology used, the production process is viewed as a series of necessary stages, at each of which the potter exercises choices. From clay choice and processing to vessel forming, finishing and firing, these choices may be revealed through the macroscopic examination of fabric, form and forming and finishing methods, followed by selective sampling for microscopic analysis. Thereby the pottery assemblage may be characterised in terms of its mineralogy, paste preparation and its decorative and firing technology. Additional studies of chronology and changes in site-size have also been produced.

This broad analytical programme has generated a considerable amount of new data, which forms the basis for individual studies of ceramic technology, production organisation, ceramic exchange and ceramic consumption. In the final analysis the main conclusions arising from each of these studies are compared and contrasted. In this way detailed macroscopic and microscopic analyses of ceramics are ultimately used to explore the changing ways in which the inhabitants of Knossos materially constructed their social world during the seventh, sixth and fifth millennia BC.

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ABBREVIATIONS

Ac	Aceramic
B	Burnished
B/S	Brushed/Scribble Burnished
C	Coarse (usually burnished)
C	Combed
DMP	Domestic Mode of Production
EBA	Early Bronze Age
EC	Early Chalcolithic
EM	Early Minoan
EN	Early Neolithic
F	Fine, (usually polished)
FN	Final Neolithic
I	Incised
IL	Incised Lattice
IP	Incised/Pointillé
IV	Initial Vitrification
LC	Late Chalcolithic
LN	Late Neolithic
MBA	Middle Bronze Age
MC	Middle Chalcolithic
mc	monocrystalline
MN	Middle Neolithic
NV	Non Vitrification
OES	Optical Emission Spectroscopy
P	Polished
PB	Pattern Burnished
pc	polycrystalline
R	Ripple
S	Scored
SC/R	Slashed Cordon/Rope
SEM	Scanning Electron Microscopy
TLP/NE	(almost) Total Local Production/Non Exchange
TV	Total Vitrification
V	Vitrification
VC	Vitrification (Calcareous Body)
W	Wiped

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CHAPTER ONE

INTRODUCTION

"Then it was in the first year of the excavations at Knossos came a discovery of the greatest importance in this connection: that of the Neolithic People of Crete. The far-reaching consequences that follow from this discovery cannot easily be overestimated" (Mackenzie 1906:224).

Just over one century ago excavations conducted by Arthur Evans below the then recently discovered Bronze Age palace at Knossos brought to light a deeply stratified Neolithic deposit. This was characterised by the presence of stone axes, maces, obsidian and bone tools, figurines as well as a distinctive type of hand-made Neolithic pottery, which clearly pre-dated anything else that had hitherto been discovered on Crete (Evans 1900-1). Although most of Arthur Evans' scholarly energy would inevitably be absorbed by the later Bronze Age Minoan civilisation, he nevertheless had a profound influence on the direction and development of Cretan Neolithic studies. He not only 'created the discipline', but also provided the ideas and set the questions for a whole series of subsequent scholars: chronology, typology, Anatolian cultural origins and the model of gradual growth in isolation are all research themes which begin with Arthur Evans and Duncan Mackenzie (Tomkins 2000). Since these first discoveries and over the last century further study and excavation at Knossos by a series of scholars, above all J.D. Evans¹, has added considerably more detail and definition with the result that Knossos ranks as one of the longest-inhabited, most well-defined and consequently most important Neolithic sites not just in Crete but within the entire southern Aegean.

During the last century there have been many changes in the way wider scholarship has approached the 'Neolithic phenomenon': as a chronology, a technology, a culture, an economy, a population, a social structure and most recently as a conceptual system (Whittle 1996:4). Some of these developments find expression in previous work on Neolithic Crete, others do not. While there is

¹ All subsequent references to Evans refer to J.D. Evans, unless otherwise indicated (e.g. A. Evans for Sir Arthur Evans).

no denying that giant steps have been taken in the last century of exploration, arguably there is a need to challenge the old ideas and assumptions and to formulate new questions - to rethink the Cretan Neolithic (Tomkins 2000). As Whitelaw has stressed, this rethinking can only be achieved through new studies of archaeological material (Whitelaw 1992:233-4; cf. Broodbank 1992).

Previous studies of Neolithic ceramic material from Knossos have established and refined a ceramic typology based on form and have combined stratigraphical observations with observations of variation in form and finish to establish a relative chronology, which divides the Cretan Neolithic up into three main phases, Early (EN), Middle (MN) and Late (LN) (Mackenzie 1903; Furness 1953; Evans 1964). Although primarily concerned with the establishment of a relative ceramic chronology, these studies often made comments in passing, which are relevant to study of the production, circulation and consumption of ceramic vessels. In Chapter 2 these previous approaches to Neolithic ceramics at Knossos will be assessed in the light of other studies of Neolithic ceramics from around the Aegean. This comparison suggests that most of such studies have been interested primarily in addressing issues of chronology, typology and cultural origins. More recently a number of detailed studies of specific Aegean Neolithic assemblages, most notably that of Franchthi (Vitelli 1993a), have sought to address questions of ceramic technology. Although largely based on macroscopic forms of analysis, such studies have made limited use of mineralogical and chemical techniques of analysis.

Consideration not only of the ways in which these more recent studies have sought to define and characterise ceramic variation in individual assemblages, but also of how they have interpreted this variation in terms of production, circulation and consumption raises a whole series of issues and contradictions (theoretical, methodological, analytical) which at present remain unresolved (see Chapter 2). Since previous studies of Neolithic ceramics at Knossos did not concern themselves explicitly with technological analysis, the well-excavated and well-defined Neolithic assemblage at Knossos provides an excellent opportunity to re-examine a whole series of questions concerning the production, circulation and consumption of ceramic vessels during the Neolithic.

Since this new study involves the combination of detailed macroscopic analyses with the microscopic study of selected samples both petrographically and using a scanning electron microscope (SEM), considerations of time dictate that the focus be narrowed to ceramic material from the EN phases at Knossos (ENI-II). These phases nevertheless cover a considerably longer period than the EN phase in Greece (Cretan ENI-II = Greek EN-LNI; see Appendix I). Moreover, since questions of production, circulation and consumption can only be addressed using good contextual information, study and analysis will focus on ENI-II ceramic material excavated by J.D. Evans between 1957-1960 and between 1969-1970. This new study will seek explicitly to explore the potential limits of ceramic variation within a single Neolithic assemblage by studying variation in fabric, form, finish and firing. These different dimensions of variation will be studied and characterised in such a way as to allow analysis of how variation in one dimension articulates with that in another.

Studies of the production, circulation and consumption of ceramic vessels all have the potential to inform upon each other. Thus although, as archaeologists, we tend to study each individually - and there is certainly an analytical usefulness in this approach - it is crucial that ultimately they are recombined so that it can be examined how production, circulation and consumption all inter-related in the world of the earlier Neolithic. This in turn requires the fulfilment of three key objectives:

- (1) A 'theory of material culture' with particular reference to ceramics, which not only explores the material and cognitive basis for acts of production, consumption and exchange, but which also seeks to understand how these three categories of action articulate with each other.
- (2) A framework, derived both from comparative ethnography and archaeology, which seeks to explore the ways in which 'Neolithic' societies are constituted, particularly from the three perspectives of production, consumption and exchange.

- (3) A methodology for the practical investigation of ceramic production, consumption and exchange within a single Neolithic archaeological assemblage.

Each of these objectives will be pursued in a separate chapter: Chapter 3 will focus on outlining such a 'theory of material culture', Chapter 4 will seek to build a framework within which some of the possibilities of existence in 'Neolithic societies' can be explored, while Chapter 5 will deal with aspects of methodology.

This study has generated an array of new data relevant to the study of ceramic production, consumption and exchange and Chapters 6-9 will present the results of different types of analysis beginning with petrological and mineralogical data (Chapter 6) and proceeding through form and finish (Chapter 7) and SEM data (Chapter 8) to the results of the quantitative analyses (Chapter 9). These different analyses complement each other and are presented in this way to allow the results of one to be compared and contrasted with those of another. This allows ceramic variation to be studied and characterised at a variety of levels and to be viewed from the different perspective of production, circulation and consumption. In this way the results of these different analyses provide the basis for an examination of some of the issues and problems, first identified in Chapter 2, associated with the production (Chapters 10-11), circulation (Chapter 12) and consumption (Chapter 13) of ceramic vessels at Knossos during ENI-II. Further relevant information and discussion is provided in a series of appendices, which cover chronology (Appendix I), changes in settlement size (Appendix II), geology (Appendix III), south-west Anatolian relative ceramic chronology (Appendix IV), petrographic descriptions (Appendix V), ceramic typology (Appendix VI) and the incidence of features of form and finish per fabric (Appendix VII).

In the final concluding chapter (Chapter 14) the main findings of Chapters 10-13 (production, circulation and consumption) will be restated in summary form in order that they might be compared and contrasted. Through this recombination of separate discussions of the production, circulation and consumption of ceramic vessels, it is hoped that something further can be learnt about how these three different forms of social and material action may have articulated with each other.

In this way new information will be generated regarding the changing ways in which the inhabitants of the Kephala Hill at Knossos materially constructed their social world between c.6400BC and 4500BC.

CHAPTER TWO

EARLY CERAMICS IN THE AEGEAN

2.1 Themes and Theories in Early Ceramic Studies

The human transformation of clay, through fire into ceramic has long been hailed as a significant technological leap: from Tylor and Morgan in the nineteenth century to Childe in the first half of the twentieth century, the appearance of pottery has been considered a sign of significant cultural development and an important step towards 'civilisation' (Hoopes & Barnett 1995:4; Rice 1999:3). In early studies of the Neolithic the beginning of potting was linked with other significant developments, such as the appearance of early agriculture and the development of sedentary village societies, as part of a 'Neolithic Revolution' (cf. Childe 1981; see discussion in Moore 1995:39-40). Pottery containers both facilitated the processing of cereal grains and enabled storage in sufficient quantities to feed large sedentary groups. In addition sedentary living was considered to be a prerequisite of pottery production. Thus it was that early ceramics simultaneously enabled and were enabled by early agriculture and sedentism.

2.1.1 *Ceramics, Sedentism and Agriculture*

This close synchronism between early ceramics, agriculture and sedentism long remained axiomatic. Indeed it was only when Kenyon's excavations at Jericho in the 1950s revealed the existence of a long 'Pre-Pottery Neolithic' that it began to become clear that pottery first appeared long after the development of agriculture and village communities. Since then research amongst ceramic-using 'complex' hunter-gatherers, both ethnographic and prehistoric, has made it clear that the appearance of early pottery should be 'decoupled' from deterministic associations with either agriculture or sedentism (Hoopes & Barnett 1995:2, 4-5). Thus, although there is a clear tendency for modern ethnographic pottery-producing societies to be sedentary (see Arnold 1985:109-26), the origins of pottery-production need not be so closely associated with a lack of mobility. To give just a few examples: some of the earliest pottery ever made was produced by Jomon hunter-gatherers in Japan (Aikens 1995); likewise Ertebølle Mesolithic

communities in northern Europe were using pottery centuries before the earliest appearance of domesticates (Gebauer 1995); while in both Mexico and Western Asia the opposite is true, as there domestication preceded ceramic production by millennia (Hoopes & Barnett 1995:5; see below).

That is not to say, however, that no relationship exists between early ceramic use, agriculture and sedentism, only that it is by no means a simple or singular one of cause-and-effect. Pottery production places significant demands on time and energy: ethnographic studies of modern hunter-gatherers tend to show that pottery use occurs in the context of sedentary activity, even if the group is mobile for the rest of the year (Hoopes & Barnett 1995:4; Rice 1999:23-6, 28-9). Thus sedentism, if only seasonal, may have played a significant enabling role in the appearance of early pottery.

2.1.2 Ceramics and Food Processing

Studies of early ceramics have produced a wide range of interpretations, the majority seeking to account for their origins and emergence (cf. review in Rice 1999:2-14). Traditionally these studies have focused on the obvious storage, cooking and serving capabilities of ceramic containers. To a large extent these studies may be characterised as 'adaptionist' or 'enabling' explanations (see Brown 1989:204-5, 210-11): pottery is held to have been an improvement on previous containers and in particular to have increased the adaptive potential of the pottery-using group². The advantages of pottery in this are considered to be the following (see Rice 1999:8; Hoopes & Barnett 1995:5; Arnold 1985:128-44):

- (1) Increased efficiency in processing of 'new' foods, such as cereals, by toasting or by direct/indirect boiling;
- (2) Increased efficiency of long-term storage of grains and pulses;
- (3) Improved nutrition for children, mothers and the elderly through the ability to prepare soft-cooked foods;

² For an extreme expression of the view that ceramic technology is entirely directed towards extending human adaptation to the environment see O'Brien et al. 1994, especially 264-71.

- (4) Extension to the range of food resources which could be exploited, including foods containing toxins which require long soaking and cooking, thus increasing the carrying potential of the local environment;
- (5) Reduction in the time required to oversee cooking in comparison to gourds, stone, bark or basket vessels, which require indirect stone-boiling techniques.

A close connection between pottery and cooking is also suggested by modern ethnographic studies. However, as Vitelli has stressed, "no modern ethnographic context... truly parallels the earliest contexts for pottery use" (Vitelli 1993a:214; cf. Vitelli 1989:24-5). Thus none of the earliest pottery at Franchthi shows any sign of having been used as a cooking pot (Vitelli 1989:24; 1993a:213-4; see also Section 13.3.1) nor does the earliest use of pottery suggest a focus on storage (too few pots of too small a size) (Vitelli 1989:26-7). Rather, the advantages of pottery, so obvious to modern researchers, would have not been so immediately apparent to the earliest users (cf. comments of Sassaman 1995:223-4); the culinary potential of pottery was something which had to be discovered over time and when the need arose. Indeed if traditional foods were judged to be better tasting or more socially-acceptable if cooked using pre-ceramic methods of processing, this may have actually mediated against the early use of ceramics as cooking pots (Vitelli 1993a:214-5). For Rice the popularity of culinary hypotheses illustrates the common tendency amongst Anglo-American archaeologists and anthropologists to view technology, particularly its origins, from an ethnocentric Western perspective, which sees the advantages of new technologies as self-evident to the societies which adopted them (Rice 1999:10).

2.1.3 Functional/Economic Efficiency

The failure of 'self-evident' and adaptionist hypotheses to account of the data for early pottery use has also been noted by Brown (1989:204-212). Brown has proposed an alternative hypothesis that early ceramic containers were produced to supplement or replace existing container forms which could no longer be manufactured sufficiently quickly and in sufficient quantities to cope with an increase in container demand (1989:213-222). This extra demand for containers

is held to arise from an increase in container consumption, such as might occur when new activities involving the use of containers are adopted, such as stone boiling, parching, direct heating or storage (on storage see Moore 1995). This model relies on the presumed economic superiority of ceramic containers over those made from other materials (Brown 1989:218-22): it postulates that it is quicker, easier and more cost-effective in terms of time and labour for the sedentary household to intensify production of ceramic containers, largely because pottery is held to provide greater potential for economies of scale but also because household pottery production is thought to involve low labour costs because it can easily be accommodated within the range of tasks performed by women in the household (see below on gender).

Although this model has been applied to contexts of early ceramic use (e.g. Crown & Wills 1995; Sassaman 1995; Moore 1995), it is by no means without its problems. A key assumption is that early pottery using societies will be economically optimising, that is they will perceive ceramic technology in terms of efficiencies gained in labour and energy expenditure³. This in fact seems to be highly unlikely: as Sahlins has noted, modern 'Stone Age' societies tend to be characterised by 'underproduction', an 'under-use of objective economic possibilities' and a more relaxed and flexible attitude to time, far different from the modern notions of economic efficiency and time-management (Sahlins 1974:14-27, 34-5, 41-99; Bourdieu 1977:175-8; see Chapter 4)⁴. Thus, it seems unlikely that ceramic technology would have been adopted because it was perceived to be a 'cheap' craft in economic terms. A related assumption is the notion that ceramic would be perceived immediately to be a superior container material than, for example, wood or basketry. This however is not supported by the available data for Crete and Greece. At both Knossos and Franchthi, as well as at other sites, the first ceramic containers are present in such small quantities

³ This over-emphasis on ecological constraints and possibilities seems to result in general from an over-deterministic application of ceramic ecology theory, demonstrated by heavy reliance on the work of D. Arnold (1985) (see especially Brown 1989:213-6). For a critique of this sort of application of ceramic ecology see Chapter 4.

⁴ Indeed modern ethnographic studies of hunter-gatherer societies tend to suggest that "the food quest is so successful that half the time the people seem not to know what to do with themselves" (Sahlins 1974:11).

that it is hard to resist the conclusion that a wide range of non-ceramic containers must have remained in use (see Section 13.4.2). Any replacement of non-ceramic containers must have occurred over a very long period of time. Evidence is also lacking for the co-occurrence of the first ceramic vessels with a new range of container-destructive tasks to which pottery was better suited; rather the adoption of pottery in the Aegean seems to have been accompanied by no obvious social, material or economic changes (see below; cf. also Sassaman 1995:223-4 for similar conclusions for the earliest pottery in the American Southeast).

2.1.4 Gender

The economic-efficiency model, as with many theories on the emergence of pottery, is also problematic in terms of the way it fails to deal seriously with the important social dimension to the adoption and maintenance of new technologies (cf. van der Leeuw & Torrence 1989; Sassaman 1995:235-6; see Chapters 3-4). Prominent in this is a failure to explore the issue of gender. It remains a common assumption that the first "pots were generally made by women and for women" (Childe 1981:86): compare the conclusion of Longacre that "pottery was invented by women and remained a women's technology for millennia" (1995:278) or that of Vitelli that "Neolithic potters were probably women" (Vitelli 1993a:xx).

The principal reason for this long-standing association is the assumption that early pottery production and consumption fell entirely within the range of supposedly female-gendered tasks. Thus women "as gatherers and as the individuals most closely associated with households, might also have been closer to the technologies and materials for making pottery and better able to organise the diverse tasks necessary for manufacturing ceramics" (Hoopes & Barnett 1995:6; cf. Vitelli 1993a:xx; 1995:60-1; see Chapter 4). These ideas are not without considerable ethnographic support. There is a strong link in mixed horticultural and foraging economies between female labour and wild plant gathering, daily horticultural tasks, food processing (except butchering and fire-starting), the production of clothing, textiles, basketry and leather products as well as care for infants and the elderly (see discussion and references in Crown & Wills

1995:246-7). However, as Sahlins has stressed, although the most dominant form, the "division of labour by sex is not the only economic specialisation known to primitive societies" (Sahlins 1974:79).

Studies which stress the connection between female labour and early pottery production also rely on the numerous ethnographic studies which describe female pottery production at the household level. Arnold has argued that part-time seasonal pottery production is most efficiently accomplished within the household, to which women are closely attached through the requirements of pregnancy, infant care and the sort of household tasks listed above (Arnold 1985:100-1): pottery production does not require periods of absence from the home, is a relatively safe activity to conduct in the presence of children, is monotonous and does not require excessive concentration, is compatible with cooking and requires the sort of daily attention which suits scheduling with other 'female' household activities.

In response to this Wright has argued that it is not child care responsibilities which tie women to the household and which free men to engage in activities at a distance, since within a household there are a range of alternative child care options and at any rate reproduction and child-care occupy women only at a certain stage in their life-cycle (Wright 1991:200-1; 217; see also Crown & Wills 1995:248). Moreover, in actuality pottery production is far from monotonous, is potentially dangerous (e.g. firing) and in terms of scheduling requires a rhythm of work and considerable amounts of skill, timing and concentration (Wright 1991:n.6). In other cross-cultural studies of gender and activities, pottery production is not so clearly correlated with one gender or another (see Barley 1994:61-6): it has been suggested for ethnographic studies of African potters that it might be more appropriate to draw a line not between male and female, but between fertile women and everyone else (Barley 1994:63). When males are involved their participation is usually associated with a complex division of labour and a high degree of occupational specialisation, agricultural intensification and complex technologies of production, when women are involved there tends to be a low degree of occupational specialisation and division of labour (Wright 1991:198).

It has been observed that if pottery production were simply added to this extensive range of tasks then it might amount to a "time management crisis for women" and this may serve to prevent the introduction of pottery production in mixed horticultural and foraging societies (Crown & Wills 1995:247-8). However, what is forgotten consistently in studies which emphasise gender and ceramic production, is that the production of pottery, like the production of food, is never simply the responsibility of a single individual (see Chapter 4). Rather, as Wright has emphasised, pottery production involves the co-operation of other people, such as children or the elderly, who often remain invisible in modern ethnographic studies of production (Wright 1991:198-9; Miller 1985:77). Thus household production is not simply female production, but implies the co-operation of "individuals who perform other tasks in the production sequence (e.g. procuring and processing clay, decorating finished vessels, collecting wood...)" (Wright 1991:198; cf. Miller 1985:110; cf. Barley 1994:61-6). In this way pottery production might be compared to agriculture, which similarly requires group co-operation at certain stages in the production process, whether sowing and threshing (often male-dominated) or weeding and other day-to-day activities (female-dominated) (Wright 1991:198-9).

Recognition of the potential involvement of others in early pottery production, encourages one to think beyond the cliché of female labour and early ceramic production⁵. One might speculate regarding the potential special male involvement in certain significant tasks in a production process, which might otherwise have been dominated by female labour, such as bonfire lighting; fire-lighting being potentially symbolic and transformative. Alternatively, one could argue that if early pottery production was something that was adopted from outside the community, as several have argued for the Aegean (see below), it might, as an imported technology, have been more closely associated with those, through whose social contacts beyond the community, this innovation first arrived; the most likely candidates for this being men. In a similar vein Rice has noted that if the earliest ceramics "were associated with ritual and/or shamanic

⁵ For example Vitelli makes deliberate rhetorical use of the female pronoun to refer to potters (Vitelli 1993a:xx, 4, 92), even though it is not clear whether they were male or female or both.

control of production, manufacture could have been by either sex" (Rice 1999:10 n.8).

Thus, studies of early ceramic production, which emphasise one gender over another, are likely to suffer from over-simplification and an over-emphasis on individualism. Household ceramic production is above all likely to be a group activity which could be potentially shared between males *and* females, old *and* young (Wright 1991:199, 201); the point being that the organisation of production in small-scale societies is based on the kinship mode of production, where roles are defined according to age and the life cycle and the organising principles are simultaneously public, economic and political (see Chapter 4). Studies which stress the exclusive female involvement in early pottery production also run the risk of projecting ethnographic presents, where pottery production usually has a long history and is not a 'new' technology, onto an Early Neolithic past, where pottery is something new and most likely of special value (Vitelli 1993a:214).

2.1.5 Resource Intensification/Competitive Feasting

Recent attempts to understand and explain changes in subsistence strategies and an early use of pottery among complex hunter-gatherer groups, have combined culinary and economic optimising theories for early pottery use within an overall model which asserts the importance of resource intensification (see Rice 1999:10-12; cf. Aikens 1995; Sassaman 1995). Increased sedentarisation, the introduction of more intensive methods of food procurement (e.g. agriculture) and the adoption of pottery are all understood in terms of attempts to get more out of specific resource-rich environments. Hayden has argued that while in resource-poor environments there is likely to be an ideology of communal sharing, resource-rich environments are likely to foster "economically-based competition together with the resultant socio-economic inequalities that this implies" (Hayden 1995:258). Within this context it is considered only natural that 'aggrandising individuals' with 'accumulative personalities' will emerge, who compete for power and status through the organisation of competitive feasts, featuring rare or otherwise desirable foods; such feasts may have served to create indebtedness and display status (Hayden 1995:258, 260-3). In this context there is no guarantee that

food containers will necessarily be made of ceramic, for example stone or plaster bowls appear well before pottery in the Near East (Hayden 1995:260; see below). Indeed Hayden argues that the earliest developmental phase of ceramic technology "must have represented a very laborious endeavour with many problems and failures", most likely driven by a desire to master and exploit the symbolic value of a new socially prestigious technology of transformation, which was also capable of producing more exotic container forms and/or allowed new foods to be processed (Hayden 1995:261-2).

This model has a number of attractive features:

- (1) it correctly predicts that the earliest pottery should occur in the form of food-serving vessels, such as bowls and plates, with cooking vessels only being of secondary importance;
- (2) it is able to account for the high value and symbolic importance attributed to early pottery containers (cf. Rice 1999:13-14; Vitelli 1995);
- (3) it provides a coherent, socially and economically grounded means of understanding other subsistence and material changes which may occur in such contexts;
- (4) it can easily be modified to fit 'secondary' scenarios, where ceramic technology may have been adopted through contact with ceramic-producing communities: the idea of early ceramics as a prestige technology and a socially-valued container-form helps to explain the motivation for such technology transfer. It is generally considered likely that such instances of adoption were much more widespread than cases of independent invention (Rice 1999:41-3).

The weakness of this model, at least in its present form, is the necessary link it proposes between competition and intensification of production, whether of subsistence or ceramics. In this way the model predicts a "rapid evolution toward labor-intensive, specialized production of highly decorated forms" (Hayden 1995:261). In fact the link between competition, arguably a feature of all societies, and intensification, a feature of some, is by no means necessary (see

Sections 4.2.2, 11.3). Furthermore, in the context of Anatolia, Crete and Greece, 'evolution' towards specialised production seems in fact to have been far from rapid; indeed there may be good social reasons why the possibilities for specialisation may have been restricted in early ceramic using societies, certainly early agricultural economies do not seem to be characterised by intensive-labour or economic optimisation (see below; see also Sections 4.2.2, 11.3).

2.2 Early Ceramics in Anatolia, Greece and the Aegean

2.2.1 Pre-Ceramic Clay Use

As is often the case in regions of early ceramic technology (cf. Rice 1999:37-9 'software horizon'), the appearance of ceramic containers at sites in Greece, the Aegean and Anatolia (west, south-west, south) does not represent the earliest uses of clay in this area. The period in which pottery first appears is preceded by a pre-ceramic or aceramic phase during which clay was variously used in the construction of dwellings (mudbrick, clay installations) as well as to form figurines and ornaments (beads).

In Anatolia and the Near East this phase of pre-pottery clay use was of extremely long duration. There the use of mudbrick architecture dates to the very beginning of the Neolithic (ninth millennium BC), coinciding with the inception of early agriculture: for example early mudbrick-based architecture is found at PPNA Jericho in the Levant, at Asikli Höyük, Çayönü Tepesi in south and south-east Anatolia and at Hacilar in south-west Anatolia (eighth millennium) (Joukowsky 1996:74-85; Schmandt-Besserat 1977:133-137). In Anatolia (especially the south-east) during the ninth and eighth millennia, plaster was manufactured to make floors and increasingly at the end of the ninth and into eighth millennium to make a variety of containers, often quite large, which seem to have been used for storage (see Moore 1995:45). The walls of these vessels were built up in thin layers, each being allowed to dry before the next was applied. It has been suggested that the abundance of these containers might indicate a significant increase in the need to store foodstuffs during this period (Moore 1995:45). Clay beads, figurines and geometric objects are also known from some sites in the pre-pottery period: for example at Çayönü Tepesi and Suberde (ninth-

eighth millennia BC), but not at Asikli Höyük or Aceramic Hacilar (Schmandt-Besserat 1977:138-142). House models are known from Çayönü Tepesi (Moore 1995:46). The appearance of a similar range of clay objects at around the same time and over a wide area encompassing the Levant, the Fertile Crescent and south-east Anatolia testifies to the existence of a considerable degree of interaction between communities in this region at this time; interaction which can also be glimpsed in the widespread circulation of 'exotic substances', such as 'attractive stones', shells and even metals (Wengrow 1998:784-5).

In mainland Greece, aceramic Neolithic deposits, dating to the first half of the seventh millennium BC, have been isolated at sites in Thessaly (Argissa, Gediki, Soufli Magoula, Sesklo) and at Franchthi and these have produced clay earplugs, figurines and slingshots (Demoule & Perlès 1993:365-9). On Crete clay beads and clay figurines, along with mudbrick architecture, are known from the Aceramic period (c.7000-6400BC) (Evans 1964:141-2; 1971:102, plate III; 1970b:7; Appendix I)⁶. The functions of these early clay objects in Anatolia, Greece and the Aegean were probably various and cannot be determined with certainty. However, there is a general consensus that most had some sort of symbolic significance (cf. Moore 1995:46).

The aceramic period in Greece and the Aegean, although much shorter in duration than the Anatolian aceramic, nevertheless demonstrates that both early agriculture and early villages were in existence long before the appearance of fired ceramic containers. At the Cyclops Cave (Yioura) there is possible evidence for the early (eighth millennium) domestication of animals (pigs and caprines) (Sampson 1999:21), while at Franchthi (eighth-seventh millennium) there was a probable early exploitation of plants, although these were locally available wild cereals and not domesticates (Perlès 1999a:317). The first domesticates, mainly wheat, lentils and ovicaprids "of Near Eastern origin", appear in the Initial

⁶ In addition, amongst unpublished material from the excavation of Aceramic levels (level 26) in sounding X at Knossos, a built clay feature with central pivot hole and smoothed interior, which may be part of a quern. This interesting object has an interior which appears to be smoothed and very roughly burnished. However, it should be stressed that the material from which this is made is not ceramic but resembles a mudbrick fabric and the object is part of a built feature and not a container.

Neolithic (Aceramic) phase alongside a basically 'Mesolithic' tool kit⁷; the following phase (Early Neolithic) differs entirely from the preceding one, is fully Neolithic and indistinguishable from other EN assemblages of southern Greece (Perlès 1999a:317). At Knossos domesticated sheep, goat, cattle and pig are clearly present in the very earliest layers of the Aceramic village (c.7000BC) together with a range of domesticated cereals (Jarman & Jarman 1968; Evans 1968:269-70). Thus, as has been stressed recently, it is crucial that the emergence of pottery is 'decoupled' from deterministic associations with either sedentism or agriculture (Barnett & Hoopes 1995:2). Indeed on the contrary, at Knossos, as at other sites in Greece and the Aegean, the transition from an aceramic to a ceramic Neolithic, apart from the appearance of ceramics, is generally considered to be otherwise without great social, material or ecological change (Evans 1970a; Theocharis 1973:35; Demoule & Perlès 1993:369; *contra* Weinberg 1970:571-2).

⁷ This phase also produced a few sherds of pottery, however it is not clear whether this pottery represents the first limited use of ceramic vessels or is simply intrusive from later EN levels (Perlès 1999a:317; Vitelli 1993:39).

2.2.2 Dating the Earliest Pottery

In Anatolia ceramic containers and ceramic technology first appear at approximately the same date at a large number of sites (Schmandt-Besserat 1977:149; Moore 1995:40-4)⁸. Thus the earliest ceramic layers at Çatal Höyük (level XII), Çayönü (phase II) and Mersin all have radiocarbon dates in the range of 8300-8000BP (c.7400-6900BC)⁹ (Moore 1995:40-2). These dates also compare closely with those from early ceramic sites in the northern Levant and along the Fertile Crescent (c.8300-8000BP) (Moore 1995:42-4).

In Greece and the Aegean, the earliest pottery appears sometime after this period: the earliest ceramic levels at sites in northern and southern Greece (Franchthi) and Crete (Knossos) have all been dated to around the middle of the seventh millennium BC. Thus, contrary to the claims of Moore (1995:44) that "the earliest pottery found at Knossos in Crete, at sites on the Greek mainland, and farther west... all dates around the same time [as the earliest pottery in Anatolia] or a little later", there is, in the current state of knowledge, a fairly considerable time lag of c.500-800 years between the adoption of pottery in south/south-east Anatolia and the Near East on the one hand, and in mainland Greece, Crete and the Aegean on the other.

It may ultimately prove significant that the earliest ceramic material from the Aegean coast of Anatolia and from most areas of south-west Anatolia dates only to the Anatolian LN, i.e. to no earlier than c.6500BC (see Appendix IV). Earlier EN material is known from only three sites, Kuruçay, Hacilar and Belbasi. The Belbasi ceramic assemblage, although almost certainly the earliest, is tiny and occurs in conjunction with an otherwise Mesolithic toolkit; such circumstances suggest the presence of imported vessels rather than the presence of ceramic technology. The EN material from Kuruçay is unlike that from Belbasi but closely

⁸ NB Schmandt-Besserat *inter alii* dates the Beldibi B pottery to late Palaeolithic or Mesolithic (c.8500-8000BC); however this early date is not supported by radiocarbon dating, but is based on dating of associated 'Mesolithic' lithic assemblages. As demonstrated by the new finds from the Cyclops Cave on Yioura (Sampson 1999), a Mesolithic lithic assemblage, closely comparable to that from Beldibi, was still in use up to c.6500BC. Furthermore, good parallels between the Beldibi B ceramics and Çatal Höyük XII (dated c.7000BC) have been noted (see Appendix IV; Yakar 1991:123). A pre-7000BC date for the Beldibi B ceramics is not accepted by Moore (1995), who does not include it in his survey of early Anatolian pottery.

⁹ Approximate calibrated range given by the OxCal 3 calibration programme.

resembles pottery recently excavated at Hacilar (Duru 1994; see Appendix IV). Absolute dates are only available from Kuruçay, but these indicate a date for this earliest material towards the very end of the Anatolian EN, close to the middle of the seventh millennium (see Appendix IV).

Thus the earliest date for the presence of ceramic technology in the south-west, even including this early material, seems to correspond with the earliest dates from Greece and Crete. If correct, this would mean that ceramics first appear at around the same time on both sides of the Aegean and that the time lag is rather between west/south-west Anatolia and further east. Ultimately, however, the significance of any correspondence between these dates can only be expressed cautiously, since a complete Aceramic to LN sequence, either from south-west or west-central Anatolia, has not yet been isolated and subjected to radiocarbon dating: ultimately there may prove to be earlier EN ceramics at Hacilar, Kuruçay or elsewhere. At present the Belbasi assemblage appears to be an isolated occurrence, but future discoveries could change this. In addition, almost all Neolithic material from south-west Anatolia comes from surface survey and thus at such sites it is impossible to be certain, in the absence of stratigraphical excavations, whether earlier ceramics exist buried beneath later Neolithic deposits.

2.2.3 *A Previously 'Developed' Technology?*

A striking feature of the first pottery to appear in south-west Anatolia, Greece and the Aegean, noted independently in a number of regional studies, is its 'developed form'. Thus the early pottery from the Beldibi Cave, level B (south-west Anatolia) is described as a "conspicuously evolved pottery, which does not give the impression of the beginning of a craft" (Schmandt-Besserat 1977:133). A similar judgement was passed upon the earliest pottery excavated by Duru at Kuruçay (level 13) and also at Hacilar (impressed into red plastered floors which would otherwise be dated to the Aceramic) (Duru 1994:103; see Appendix IV). The earliest (EN) pottery from Elateia (Central Greece) was considered by Weinberg (1962:167-8) to be an 'already well-developed technology' which had been brought to the site by its first settlers. The same author characterised the

earliest pottery in Greece in general as "in a tradition already long-established" (Weinberg 1970:583). Similarly, the two excavators of Neolithic Knossos, Sir Arthur Evans and John Evans, have both emphasised how the very earliest pottery at the site "bears all the marks of being the product of a fully developed tradition of potting" likely to have been introduced from elsewhere (Evans 1964:196; 1968:271; cf. A. Evans 1921:35).

It should be noted, however, that the criteria whereby each of these scholars defines 'developed' are rarely ever stated explicitly. Most seem to agree on the presence of a wide range of different forms and finishes (cf. Evans 1964:196; 1968:271; Moore 1995:40). However, it still remains possible that different individuals will view the same assemblages in different ways. Thus for the same Thessalian data it has been variously argued that the earliest pottery is developed and introduced from elsewhere (Bloedow) and that it testifies to the progressive development of a local tradition (Theocharis) (see Demoule & Perlès 1993:368). Indeed to find a region where the earliest pottery appears to be sufficiently simple to be called 'experimental' one must look at least as far east as Çatal Höyük, where the earliest pottery is "of the simplest kind", namely deep bowls and hole-mouth jars with burnished surfaces, and Cayonu, where the pottery is "simple and quite rough", with not all vessels burnished (Moore 1995:40). It should, however, be noted that Mellaart himself considered the pottery at Çatal Höyük to be a 'developed' tradition from the start (Duru 1994:103). Thus it would seem that in many cases evolutionary judgements of ceramic development reveal more about the attitude of the particular scholar concerned than about the real nature of the technology involved.

At many of the Aegean sites, tiny amounts of pottery actually first appear at the top of otherwise aceramic strata (cf. also Kuruçay and Hacilar early pottery). Thus the top of the 'aceramic' strata at each of the Thessalian aceramic sites contained a few small potsherds (Demoule & Perlès 1993:368). At Franchthi, very small quantities of pottery first appear in the grey clay 'Aceramic' stratum, although it remains a possibility that these may be intrusive (Vitelli 1993a:39). At Knossos the earliest pottery almost certainly appears at the very top of the Aceramic stratum (see Appendix I: sounding AC (stratum X), sounding X). Thus

at all these sites 'developed' pottery first appears in 'aceramic' deposits unaccompanied by other obvious material changes in a manner which otherwise suggests continuity.

2.2.4 Models for the Origins of Early Ceramics in Anatolia, Greece and the Aegean

2.2.4.1 Diffusion

The oldest and most popular model for the origin of ceramic technology in Anatolia, Greece and the Aegean considers pottery to have been first 'invented' in the Near East and then to have spread, as a fully developed technology (see above), through Anatolia to Greece and the Aegean. Thus Weinberg describes "the arrival of Neolithic potters in Greece" as "sudden and widespread" and considers the Greek ceramic Neolithic (EN) to have been an 'import' and the earliest ceramics to have been produced "in a tradition long established" by "experienced potters" (Weinberg 1965:286-7, 1970:571-2, 585). Likewise, the earliest pottery at Knossos is considered to have been developed elsewhere (see above), the implicit model being that it spread by diffusion. The diffusion theory for the origins of pottery production parallels that posited for the introduction of farming and constitutes a second wave of 'influence' after the initial introduction of the Aceramic Neolithic (Vitelli 1993a:39).

In support of the diffusion hypothesis Weinberg points to the remarkable similarity (*koine*) between the earliest pottery (Greek EN) of Thessaly and Peloponnese (1970:584 cf. 1965:287, 290): "Almost everywhere the earliest shapes are hemispherical bowls and globular, collared jars; small pierced lugs, set either horizontally or vertically, are the only form of handle. Flat bases or ring bases, varying from low to high; slightly everted lips, often separated by a groove; the beginnings of a carination at the belly; hole-mouthed jars - all these begin early, if in fact they are not present in the original repertory". Although this large *koine* disappears by the end of EN, large regional style zones continue to be a feature of EN and MN Greece (cf. Cullen 1985; Vitelli 1993b:250; Wijnen 1993:324).

Moving to the opposite side of the Aegean it is striking that at around the same time (see Appendix I) the earliest Anatolian (LN) pottery from south-west and west-central Anatolia (Hacilar-type) exhibits a similarly widespread homogeneity (Mellaart 1970a:146; Eslick 1992:81-2; see Appendix IV), which likewise did not continue into the next ceramic phase (Early Chalcolithic). These similarities are not shared with pottery from north-west Anatolia (Illipinar-type) (Wijnen 1993:325-6). An interesting and surprisingly ignored feature of this pottery is the high number of similarities in form and finish which it shares with the earliest Greek EN ceramics (see Appendix IV): here one might consider the prominent presence of hemispherical bowls, collared jars, hole-mouth jars, slightly everted rims, flat bases, ring bases, pierced lugs.

2.2.4.2 Independent Local Invention

An early case for an independent local invention of ceramic technology was made by Theocharis, who argued that crude ceramic vessels in Aceramic levels at Sesklo were the "direct and immediate antecedent" of ENI pottery at the site (Theocharis 1963; Weinberg 1970:571). For Knossos, Broodbank has similarly argued that the earliest pottery may have developed from unfired clay containers in use in the Aceramic (Broodbank 1992:49), although there is as yet no evidence for the existence of such Aceramic clay containers. Vitelli has argued for the possibility of a local invention of pottery at Franchthi by women (Vitelli 1993a:xx, 39, 1995:60-1): women as cultivators, gatherers and processors of plant foods and medicines "had expert knowledge about kinds and locations of soils, including clays; had frequent occasion to experience the properties of clay, especially its plasticity; and no doubt often witnessed and brought about the accidental transformation of clay by fire".

Recently Moore, in his review of early ceramic production in Western Asia, has argued that the development of ceramic technology was an 'indigenous phenomenon', which occurred simultaneously across a wide area, as a response to a common set of needs, in particular 'the need to store and prepare the foods obtained from farming and herding in new more effective containers and to prepare them in more varied and palatable ways, that were less damaging to

people's health and teeth" (Moore 1995:48). This combination of the cooking and economic optimisation hypotheses is subject to the same criticisms as already outlined above. Furthermore, Moore fails to reconcile the clear evidence for exchange (including ceramics) between sites in Anatolia and the Near East as well as the clear existence of widespread regional similarities in form and finish, with his notion of simultaneous independent invention (see below). Problematic also is the degree to which he seeks to generalise about what was likely to have been a complex process.

2.2.4.3 Diffusion and Local Adoption/Modification?

Although simple immigration hypotheses, such as Weinberg's original formulation of a second arrival of Neolithic settlers, have been subject to detailed critique (cf. Whittle 1996:39-44; Halstead 1996:299-301), the correspondences in chronology, form, finish and range of distribution, which can now be noted between the earliest pottery on either side of the Aegean provide strong support for the hypothesis that trans-Aegean interaction and movement played a significant part in the development of early ceramic technology in Greece and the Aegean. That said, however, more recent studies of the earliest Greek pottery, while acknowledging the strong similarities between pottery from different sites, have stressed that the subtle local differences between sites, mainly in the area of decoration, should not be overlooked (e.g. Wijnen 1993:324; see Chapter 7). Thus the similarities between contemporary Greek (EN) and west-central/south-west Anatolian (LN) ceramics should be understood in conjunction with the existence of clear local and regional differences: for example although pierced lugs feature on both sides of the Aegean, the earliest on the Anatolian coast tend to be mainly tubular and vertical, while in Greece the earliest lugs tend to be oval (see Section 7.6.3; Appendix IV). In this way it is perhaps more accurate to model the complex process of technological transfer in terms of diffusion with local adoption or modification also playing a significant part.

2.3 Early Ceramic Production, Consumption and Exchange in Anatolia, Greece and the Aegean

2.3.1 Conflicting Views on Ceramic Production and Exchange

Closely related to questions of diffusion and/or local adoption/invention is the issue of whether or to what degree pots and/or potters might have moved between settlements. This is an area of considerable confusion with hypotheses ranging from the total local production of 'utilitarian' ceramics, apparently considered unsuitable items for exchange, to the movement of ceramics between sites as prestige items within existing exchange networks. Some studies, which emphasise total local production/non-exchange (TLP/NE), have sought to explain the existence of large EN and MN regional style zones in terms of the movement or interaction of potters, within a framework which emphasises either transhumance¹⁰ (Jacobsen 1984) or exogamy (Cullen 1985:95-6). The latter relies on the earliest potters being female and envisages the widespread exchange of female marriage partners between communities. Many more ceramic studies have not even attempted to explain away the contradiction between total local production on the one hand and large regional style zones on the other, but have simply stressed local origins (e.g. Furness 1953; Evans 1964; Vitelli 1993a; Yiouni 1995, 1996a; Jones 1986; Björk 1995). By and large these studies are detailed analyses, whether stylistic, elemental or mineralogical, of individual Neolithic ceramic assemblages.

In contrast, those studies which emphasise the movement of the pots themselves tend to be in the form of more general syntheses. For example Gallis, in a general review of 'The Neolithic World', has argued that 'pottery implies the existence of an extensive network of exchange and communication already in the EN', while for MN pottery he has suggested that "it... travelled over considerable distances not merely as containers... but as objects with intrinsic value of their own" (Gallis 1996:34). Likewise Perlès, in her study of Neolithic production and exchange in Greece, has suggested a small-scale circulation of non-utilitarian ceramic vessels (1992:149). Demoule and Perlès, in their review of the Greek Neolithic, conclude that although ceramic production was mostly local, there was some restricted circulation of pots (Demoule & Perlès 1993:382, 384). Andreou, Fotiadis and Kotsakis, in their review of the Neolithic of northern Greece,

¹⁰ This hypothesis is highly problematic: there is no hard evidence to support the existence of this form of subsistence in the Greek EN or MN, nor does it seem likely that demographic and economic conditions favoured its emergence at this time (Halstead 1996:301-4).

similarly envisage a circulation of specific classes of pottery with production of ceramics in special centres (Andreou et al. 1996:559).

It is significant that these more general syntheses seem to base their discussion of ceramics on data from Thessaly (e.g. Demoule & Perlès 1993; Andreou et al. 1996), where in general detailed stylistic and analytical studies have been more favourable to the movement of ceramics (cf. Schneider et al. 1991a, 1991b)¹¹. Thus these syntheses opt for simplicity when they choose to ignore the majority of ceramic studies, which stress TLP/NE. Those general studies, which attempt to be more honest, ultimately suffer from an inability to identify or resolve the contradictions. Thus Moore, in his review of early ceramic technology in Western Asia, first reports that "most of the pottery recovered seems to have been made at the site where it was found, from local clays" (Moore 1995:46). But then later (1995:47), and in contradiction of his earlier statement, he notes that the work of Le Mièrre and Picon (1987) has demonstrated that "a proportion of the pottery made on sites across the northern Levant and northern Mesopotamia was exchanged". Apparently this movement was restricted to fine wares and most vessels were exchanged between neighbouring sites, "although a few pots were brought in from regions as much as 400km away" (Moore 1995:47). Furthermore, this exchange of ceramics seems to have begun with the production of the first ceramics and to have persisted from then on (Moore 1995:47). To this evidence from areas to the east of the Aegean, one might also consider similar conclusions regarding early ceramics from the West Mediterranean, which indicate the long-distance circulation of certain types of early ceramic vessel (cardial) which may have had high social value (see Barnett 1991, 1995).

This contradiction between the majority of analyses which emphasise (but it should be said do not prove) total or near total local production and a very small minority which stress exchange cannot simply be ignored but must be given serious consideration. Could this be a reflection of real regional differences in the production, circulation and consumption of early pottery or does the problem lie somewhere in our own handling and/or interpretation of the data? The problem of

¹¹ However even in Thessaly detailed studies of site assemblages exist which emphasise total or near total local production (see Björk 1995).

interpretation will be a central theme of this thesis and over the next chapters an attempt will be made to understand why such opposing interpretations have been generated (see especially Chapters 5, 10). In anticipation of conclusions to be drawn in future chapters, it can be noted here that the general reluctance in studies of Neolithic ceramics to identify imports or investigate the circulation of ceramic vessels results from two key areas of difficulty, the first methodological, the second theoretical.

This first area of difficulty is very basic. How does one identify and characterise local and non-local vessels within Neolithic ceramic assemblages with sufficient clarity to allow the circulation of pottery to be studied? Most studies of early pottery have been based purely on stylistic analysis (form and finish) (e.g. Wace & Thompson 1912; Kunze 1931; Weinberg 1937; Kosmopoulou 1948; Furness 1953; Weinberg 1962; Evans 1964; Blegen 1975; Phelps 1975; Lavezzi 1978; Renard 1989; Pantelidou Gophas 1995). While such studies have been able to identify the existence of large, regional style zones and have led to the construction of relative regional chronologies, generally they have been unable to identify the circulation of pottery with any sort of certainty. Thus the studies of Furness and Evans both concluded that the entire EN assemblage at Knossos was stylistically homogenous and entirely locally produced (Furness 1953:95, 103, n.16; Evans 1964:194, 1973:133), an interpretation which has encouraged the view, now widespread, that Knossos and Crete remained isolated until the very end of the Neolithic (see Chapter 12 for discussion of the isolation hypothesis). Even the detailed regional study of southern Greek Neolithic pottery by Phelps (1975) noted only a handful of possible imports at Franchthi, Elateia, Nemea, Chaironeia and Nea Makri, prompting his conclusion that "similarities of wares or traits significant enough to suggest actual imports from one place to another are not common" (Phelps 1986:371; cf. also Wace & Thompson 1912:241). Part of the problem must be the difficulty, within large regional zones of stylistic homogeneity, of recognising imports with any clarity on the basis of form and finish: as Vitelli has acknowledged, "the quantity of pottery that was exchanged within the region [Peloponnese] may have been more extensive in the earlier Neolithic than we have recognised" (cf. Vitelli 1993b:250).

Clearly form and finish on their own may not be the best criteria to investigate the potential circulation of ceramics. More recent studies, which have included macroscopic and microscopic observations of fabric (e.g. Jones 1986; Vitelli 1989, 1993a; Yiouni 1995, 1996a; Björk 1995), have in fact identified considerable variability in the fabrics present within individual site assemblages from all areas of Greece. Thus Vitelli identifies "considerably more variability within the assemblages [Franchthi, Lerna] than has usually been acknowledged" and notes the presence of "five wares defined by the raw materials" (1989:17-18). These 'wares' - or rather fabrics¹² - are consistently present at Franchthi in differing proportions: usually one is dominant with several more present in very small quantities. This pattern is repeated at Lerna to such an extent that even the minor fabrics are the same as the minor fabrics at Franchthi (Vitelli 1989:19-20). Vitelli also notes subtle differences in construction between vessels produced in the different fabrics at Franchthi (Vitelli 1989:21).

Vitelli argues that at both sites "at any given time within the earlier Neolithic, the potters were making three to five different wares [i.e. fabrics]. They chose most frequently to use one (the dominant) clay body, but occasionally chose others with ingredients from different locations and with different working properties" (Vitelli 1989:19).

However, this conclusion is by no means a necessary consequence of the data. It should be noted that the small quantities, in which these fabrics are present, could equally favour exchange; indeed some of these less frequent fabrics are actually hard to reconcile with a local provenance (e.g. 'andesite ware'). Furthermore, the existence of differences in forming and finishing between the different fabric groups indicates the maintenance of traditions of production for each fabric, which must to some extent be considered separate, and which could therefore indicate a more distant production location than simply a neighbouring household.

¹² Although originally within the type-variety system of classification the concept of ware stood for both surface treatment and paste/fabric, this definition proved problematic not least because fabric and finish refer to different stages in the production process and their combination under a single term leads to confusion. In reality the same finishing method may occur in several different fabrics, or a single fabric may be finished in a variety of ways. As a result it was proposed that ware and fabric should be separated, with the meaning of ware restricted solely to surface treatment (Rice 1976).

When one reads through other analyses of Greek Neolithic ceramics, one frequently encounters similar statements: for example,

"there was considerable diversity in the materials used by the (local) potters whose products found their way to the [Kitsos] cave" (Jones 1986:386).

or

"Petrographic analysis has shown that a variety of fabrics were used by the Makri potters" (Yiouni 1995:619);

or

"New classes of pottery now [MN] introduced [at Nea Makri] seem to have required different types of clay. The areas which had provided the clear, gritless or micaceous clay are now abandoned and potters turn to deposits providing clay of limestone composition" (Pantelidou Gophas 1995:304).

or

"The variations in the early pottery within each [Anatolian] settlement suggest that potting was done by a number of people who probably resided in separate households" (Moore 1995:46).

When taken together these statements suggest that diversity in fabric is a feature which unites all Aegean Neolithic ceramic assemblages, which have so far been studied in this way, whether northern (e.g. Makri) or southern (e.g. Franchthi), early (e.g. Nea Nikomediea) or late (e.g. Kitsos). However, they also indicate that this variation is almost always interpreted in terms of local production. Since both Vitelli and Yiouni have suggested that this pattern might prevail at all other Neolithic sites (Vitelli 1989:20; Yiouni 1995:619), the assemblage at Knossos provides an opportunity to test both of these conclusions (see Chapters 10-11). Thus one of the main questions which this thesis will seek to address is whether the EN assemblage at Knossos, contrary to the previous observations of Furness and Evans, also exhibits this pattern of fabric diversity, with some fabrics present in large quantities, others in small amounts. In addition petrographic study of the Knossos assemblage provides the opportunity to test whether all fabrics present could really have been produced simultaneously at the site at which they were

found (cf. Vitelli 1989:20; Yiouni 1995:619) or whether other interpretations, such as exchange, are possible.

The specifics of interpretation aside, there is a clear problem in the way previous studies of Greek Neolithic ceramics have failed to problematise the issue of fabric diversity. Methodological difficulties clearly play their part in this. General syntheses realise the importance of exchange, both in the theoretical model they follow (see Sections 4.2-3) and in conclusions drawn from the study of the circulation of other types of artefact (e.g. obsidian), and are thus more confident in their conclusions regarding the movement of ceramics. However, when faced with specific ceramic assemblages clearly archaeologists still struggle to define this predicted movement in terms of actual specific sherds or vessels. Chapter 5 will investigate the problems associated with characterisation of Neolithic ceramic assemblages as well as the difficulties involved in combining different types of ceramic data: here there are not only problems associated with relating macroscopic, microscopic and elemental data, but also potential difficulties involved in how one combines data based on form, finish and fabric.

However, the roots of the reluctance to tackle the issue of the circulation or non-circulation of ceramic vessels must go beyond simple problems of methodology. Methodological difficulties do not explain the enthusiasm with which studies seek to explain away all forms of variation, whether in form, finish or fabric, in terms of total or near total local production. Often anything that doesn't easily fit the 'local', usually the most common groups, is explained away as anomalous and ignored, often because it is assumed to be a product of the failure to appreciate the true diversity in local clay sources (cf. Vitelli 1993a:208). The possibility that some fabrics or some anomalies could result from the exchange of pottery between different producing communities is not always acknowledged, let alone discussed. This reluctance to consider other explanations suggests the existence of a conceptual barrier preventing further exploration of the significance of ceramic variation in all its forms¹³.

¹³ Day has suggested that there is a general tendency in studies of Neolithic Aegean ceramics to interpret scientific data in terms of what might be acceptable rather than what it might actually imply (1995a:1). One might also compare here the analogous reaction of American archaeologists in the 1930s to the conclusions of Anna Shepard's first petrographic study of Pecos pottery: her discovery that most of the pottery could not have been made locally undermined not only the prevailing interpretative models of the

To some extent this impasse may result from the survival of some rather old ideas about the Neolithic economy; in particular the old notion that Neolithic farming communities were largely self-sufficient entities, who produced all that they required and whose main focus was the production of subsistence (and surplus) for survival¹⁴. For example, although Childe recognised the existence of exchange in Neolithic societies, he described the Neolithic economy as almost entirely self-sufficing:

"The simplest food-producing community is not dependant for any necessity of life on imports obtained by barter or exchange from another group. It produces and collects all the food it needs. It relies on raw materials available in its immediate vicinity for the simplest equipment it demands" (Childe 1981:78-9, reprint of 1956 edition).

As recently as 1970, Weinberg in a review of the Neolithic in the Aegean, although noting the presence at Greek sites of Melian obsidian as evidence for "sea-borne commerce" stressed that "agriculture and the raising of domesticated animals was the real basis of their economy" (Weinberg 1970:587). More recent studies, however, have stressed how the simple self-sufficiency hypothesis fails to take account of the ample evidence for exchange and craft production (cf. Renfrew 1973:179). Indeed Gallis has recently argued that "apart from the agricultural and stock-raising economy, basic to the Neolithic way of life, systems for the exchange and distribution of goods (trade) over long distances is [sic] attested right from the EN" (Gallis 1996:34-5).

time, but also the paradigmatic validity of the direct historical approach and even challenged prejudice surrounding the capabilities of modern Pueblo people (Cordell 1991:135-139; 144-5). While several notable scholars accepted her findings, there was a general tendency to try to minimise, explain away or simply ignore the impact of her findings, with some even talking of 'archaeological heresy' (Cordell 1991:140-2).

¹⁴ This rather 'pessimistic' view of the possibilities of existence in 'Stone Age' societies has been extensively critiqued (see Sahlins 1974:1-39). Such pessimism largely arises from the emphasis placed in modern economics on economic means (especially scarcity) and the accumulation of capital: since hunter-gatherers are materially poor and must invest more energy in subsisting, they tend to be viewed as economically inefficient and thus poor. However, when judged not by modern criteria but by their own, hunter-gatherers may be viewed, both in the way that their material wants are finite and few and in the way that their technical means are unchanging and generally adequate, as the 'original affluent societies'. In this way some otherwise curious forms of economic behaviour common amongst hunter-gatherers, such as long amounts of leisure time or an inclination to consume all food at once, may be understood as expressions of a more *optimistic* attitude towards resource availability.

In such statements one can see how the emphasis in our understanding of the Neolithic economy has shifted from a focus on production, mainly of subsistence, purely for local consumption to an awareness of the important role played by exchange. In this way the reluctance to problematise the issue of ceramic exchange suggests a general failure amongst ceramic specialists to be clear about what it is they mean when they refer to the Domestic Mode of Production (DMP) in the context of the Neolithic Aegean. For example, Vitelli, when she states that one should "consider the simplest model of production for the earliest years of pottery-making, that is, *essentially household production for household consumption*" (Vitelli 1993a:208, my italics), seems to view production very much in terms of the old self-sufficiency premise. The persistence of old-fashioned ideas regarding the workings of the 'Neolithic economy' is well illustrated by the notable absence of any reference to Sahlins' *Stone Age Economics* (1974) in the bibliographies of articles, which deal with Aegean Neolithic production, consumption and exchange (e.g. Perlès 1992; Demoule & Perlès 1993; Vitelli 1993a). Indeed the most notable exception to this is the work of Halstead, who has pioneered the application of Sahlins' initial formulation of the 'Stone Age' economy to the Aegean (e.g. Halstead 1995).

2.3.2 *The Organisation of Early Ceramic Production in Greece, Crete and Anatolia: Early Ceramic Specialists?*

Studies which touch upon the organisation of early ceramic production in Greece or Anatolia tend to focus upon the contribution of individuals, almost always women. In many cases early production has been labelled as specialised and/or early potters have been considered specialists. For example Renfrew has stated that "even the simplest Neolithic village economy favoured the existence of casual and part-time specialists" (Renfrew 1972:340, cf. 1973:217; cf. similar remarks of Gallis 1996:34). Likewise for Anatolia Moore has argued that "potting was done by a number of people who probably resided in separate households. These potters possessed particular knowledge and skills and so may be regarded as specialist craftsmen, like other skilled artisans in the same community" (Moore 1995:46).

Vitelli has argued in more detail that even EN ceramic production was in the hands of individual female specialists, who were also healers or diviners (shamans), who nevertheless produced within individual households (cf. Vitelli 1995; Perlès & Vitelli 1999:102). Vitelli arrives at this conclusion through an argument which takes account of the transformative associations of fire, the potentially high symbolic value of early ceramic vessels and a perceived overproduction of pots at Franchthi (Vitelli 1993a:210; Perlès & Vitelli 1999:102). Since the total number of pots consumed at Franchthi in any single year is estimated as extremely low (c.12-13 pots/year) and since these vessels are considered to be the total output of five different local producing groups, the total output from each producing group must have been even lower, that is well within the capability of a single potter. This suggests a somewhat paradoxical¹⁵ situation, where local demand for pots was very low but nevertheless sufficient to support the consistent maintenance of five different producing groups/potters. Unfortunately further archaeological evidence in support of this hypothesis is lacking. Vitelli has also argued for specialisation in the context of MN 'Urf ware'; the shapes of which are said to be "sharply angular, with frequent contour changes, and added bases or high pedestals" and are thus considered "high-risk shapes, elegant and showy, difficult to build and even more difficult to fire successfully in the potter's initial fire" (Vitelli 1993a:215-6). In this way Vitelli argues that the producers of MN 'Urf ware' were highly skilled potters, who sought to compete with each other through innovation, experimentation and risk-taking. In contrast for LN, Vitelli has argued that production moved from the hands of specialists to non-specialists (Vitelli 1993b:252). This hypothesis of LN non-specialisation has been recently criticised and rejected by Kalogirou, who argues that LN and FN pots required as much skill and labour investment as EN-MN vessels (Kalogirou 1997).

Unfortunately, this sort of argumentation is disputable and cannot be considered to be a reasonable basis upon which to make an identification of specialisation. As has recently been emphasised regarding the general pursuit of craft specialisation in the context of the prehistoric Aegean: "we need to move

¹⁵ Equally surprising, is the absence of any further exploration or critique of this paradox.

beyond simple inferences that because processes are complex or products are finely produced, ceramic production was specialised. Both of these types of assessment are extremely difficult to justify, especially in the absence of detailed comparative ethnographic and experimental models. The dichotomisation of specialisation as against household production also over-simplifies a complex range of different production patterns and contexts." (Whitelaw et al. 1997:266). In this way previous identifications of Neolithic ceramic production organisation as specialised must be considered problematic. Many appear to make unwarranted assumptions regarding the basic ability of the 'average Neolithic potter'; all fail to justify their identifications through the use of 'detailed comparative ethnographic and experimental models', such as the DMP. In this context it is worth noting that Perlès has recently expressed doubts that the "EN production of pots can be classified as craft specialization within the traditional economic definitions" (Perlès & Vitelli 1999:101).

Thus in later chapters this thesis will attempt to explore ways in which specialisation and production organisation can be studied, both in theory and practice, before the employment of a comparative framework within which certain features of ceramic production might be situated (see Chapters 3-5). As a preliminary to this, however, it may be remarked that the idea of EN individual or household specialists appears to stand in direct contradiction of any ideal of communality and communal sharing, not only because they give individuals or households particular economic and social power, but also because it is hard to see how an emphasis on the individual could be accommodated within an ideology of the collective (see Section 4.4). In addition specialisation could be argued to represent a form of economic intensification which is out of place with evidence for the organisation of subsistence or craft production (cf. shell bead production at Franchthi discussed in Chapter 4). Some of these apparent contradictions will be explored further in Chapter 11. Early craft specialisation has been identified for other artefacts/materials and it has even been suggested that different forms of organisation accompanied the production of different artefacts in different materials (see Perlès 1992). The apparent contradiction between this conclusion and Sahlins' comment that competition (social, political) in early societies was

played out not in production but in consumption and exchange will also be explored. Finally, since some scholars have identified craft specialisation in Palaeolithic societies and have even claimed that "specialists' have always existed" (Perlès & Vitelli 1999:96), Chapter 11 will also try to understand what is actually so special about specialisation.

2.3.3 The Function of Early Ceramic Containers in Greece, Crete and Anatolia

2.3.3.1 Cooking

Vitelli has argued convincingly that ceramic vessels could not have been used for cooking until late in MN (see Vitelli 1989:22-4, 1993a:213-5). The exteriors of earlier EN and MN vessels show no sign of having been in contact with direct sources of heat. Interestingly some sherds from these earlier deposits have sooty deposits on their interiors, which may indicate the use of some form of indirect heating. However, some caution should be maintained since sometimes these soot marks extend over the breaks, i.e. the sherds burnt after breakage, which admits the possible involvement of post depositional processes. A similar situation seems to prevail at EN Nea Nikomedeia and MN Makri. Yiouni notes that although research on cooking pots suggests the benefit of using inclusions with a low coefficient of thermal expansion, such as feldspars, and although there are fabrics at both sites which appear well-suited for the manufacture of cooking vessels, there nevertheless appears to be little or no conclusive evidence to suggest that vessels produced at either site ever had any direct contact with fire (Yiouni 1995:620, 1996b:190).

Vitelli explains this failure to use pots for cooking as evidence for the persistence of pre-ceramic or Mesolithic methods of cooking, which presumably made use of other containers such as skins, wood, basketry or perhaps relied on pit cooking (Vitelli 1993:215). In this context it is perhaps worth noting the discovery in Aceramic levels at Argissa (Thessaly) of "large quantities of river pebbles which had been subjected to repeated heat and are believed to have been heating stones used in cooking" (Weinberg 1970:568). Weinberg also notes that there was no evidence from the site for the use of stone cooking vessels and thus the vessels used for cooking must have been in some sort of perishable material.

In contrast, Moore has argued that in Anatolia early ceramics performed a range of functions, one of which was cooking (Moore 1995:47), in support of which he mentions hole mouth jars with traces of soot on their exteriors. For Crete Furness has argued that the shapes of large coarse vessels at all times appear more suitable for storage than cooking (see Evans 1964:196).

2.3.3.2 Storage

The storage hypothesis is a popular one, largely because household storage within an agricultural economy is generally considered crucial to the maintenance of livelihood (cf. Halstead 1989:71). Thus for Anatolia Moore argues that early coarse wares may have been used to store foodstuffs, while some would have been technically capable of holding water (Moore 1995:47). Likewise at MN Makri, storage is considered to be one of several likely functions for early ceramic vessels (Yiouni 1995:620).

However, Vitelli has demonstrated that there are serious problems with the storage hypothesis as it stands (see Vitelli 1989:26-7). By combining an estimation of the total amount of grain required to sow one hectare, with the range in volume of EN vessels from Franchthi, Vitelli calculated that 30-65 bowls would be required at a time when she estimates that annual consumption for the whole site was 12-13. Also significant is her conclusion that there were no truly large vessels at Franchthi during EN-MN (Vitelli 1989:27). Thus while storage remains a possible function of ceramic vessels, it cannot have been their primary function (see Section 4.4.1). Vitelli's conclusions are echoed by Yiouni, who in a separate calculation for EN Nea Nikomedeia, concluded that "the storage capacity of the Nea Nikomedeia pots was not enough for the annual crop production" and that "containers made from perishable materials and/or storage pits were also used" (Yiouni 1996b:192). The first dedicated ceramic storage jars gradually come into use during the course of the Greek LN (Cullen & Keller 1990; Perlès 1992:144).

2.3.3.3 Display/Serving

This is the most favoured interpretation of how earlier Neolithic ceramic vessels were consumed. For Anatolia, Moore has argued that much of the earliest

pottery consists of fine 'tableware' (Moore 1995:47). For Greece Halstead has argued that the investment of time and skill in the production of fine tableware¹⁶ emphasises the importance and formality of acts of commensality (Halstead 1999:80). Vitelli too suggests that the majority of vessels would have been appropriate as serving vessels on public occasions or ceremonies of social negotiation, which involved feasting (1993a:215-6): relative paucity of closed shapes and of cups or goblets, which prompts her to speculate that liquids may have been served in non-ceramic containers. In addition some shapes, such as Greek MN pedestalled bowls seem to have been designed specifically to display their contents (Vitelli 1993a:215-6). Vitelli has even gone so far as to suggest that different ceremonies called for different pots made from different ingredients with different surface appearance (and different makers), however there is no evidence to suggest that modern archaeological fabric divisions correlate with different patterns of ancient consumption.

In general accounts of consumption tend to emphasise that early pottery performed a variety of functions (cf. Moore 1995:47; Yiouni 1995:620; 1996b:185). Certainly early ceramic vessels could potentially have been used for a wide range of tasks involving serving, storage and perhaps occasionally cooking (indirect heating). However of these three, storage and cooking seem to be under-represented and may constitute secondary or rarer uses than serving/display. Many large EN-MN vessels appear to have large diameters but are not particularly deep (unlike a Bronze Age pithos), a design which seems to facilitate shared access to the contents of the vessel; other smaller bowl, mug and cup types would work well as the eating/drinking shapes of individuals.

2.3.4 Changing Levels of Consumption and the Value of Early Ceramic Vessels

Two recent attempts to estimate the level at which the earliest ceramic vessels were consumed have both concluded that in the earliest phase of ceramic use in Greece relatively few ceramic vessels were in circulation at any one time. Thus for EN Franchthi Vitelli has estimated that 12-13 pots per year were

¹⁶ As noted by Sherratt (1991), the presence of flat bases on many early vessels implies the existence of flat surfaces - literally tables - upon which they could stand.

consumed over the entire site, while for EN Nea Nikomedeia Yiouni has produced a higher estimate of 25-90 pots per year over the excavated area (Vitelli 1989:26; Yiouni 1996b:181-5). By combining this with the evidence for high labour investment in production Vitelli has argued that even these small quantities of pottery levels were probably valued, possibly because "their scarcity, novelty, and perhaps function might well have made them precious" (Vitelli 1993a:39).

This hypothesis seems plausible, although one might note in passing that it is hard to reconcile the idea that early vessels were highly valued with an insistence that they were nevertheless not exchanged between communities (cf. Vitelli 1989). It is equally hard to reconcile Moore's conclusion that it was the 'functional potential' of early pottery in Anatolia which contributed to its early development (Moore 1995:48) with his earlier suggestion that fine wares were exchanged between sites because of their desirability (Moore 1995:47). Moore goes on to draw an explicit contrast "between the essentially practical role that early pottery served in Western Asia and the symbolic and social importance that Vitelli has ascribed to the earliest pots at Franchthi Cave in Greece." (Moore 1995:48). Although regional differences in consumption seem more than likely, the contrast here seems rather to be between different archaeological interpretations¹⁷: Moore describes the earliest Anatolian contexts of ceramic-use as containing 'few potsherds' (Moore 1995:48), a situation actually very similar to that for EN Greece. This example further emphasises the necessity of prioritising issues of data interpretation.

2.3.5 Early Ceramics and Other Non-Ceramic Containers

Some time ago Childe suggested that the earliest pots were imitations (skeuomorphs) of vessels made from natural forms such as gourds, bladders, skins, baskets even human skulls, and that the earliest decorations helped to reinforce connections between ceramic vessels and earlier materials (Childe 1981:86). This comment has recently been echoed by Rice, who notes that in many areas of the world the earliest pottery mimics the shape of containers made

¹⁷ Other interpretations of the same evidence have been offered. For example Goren et al. (1993:33-40) have argued that the earliest Neolithic pottery in the southern Levant had a dual functional-symbolic role with decorated fine pottery serving a ritual function.

from other, usually perishable materials: gourds are particularly favoured, but similar forms (skeuomorphs) have been noted, such as birchbark bags, animal skin bags, baskets and soapstone bowls (see Rice 1999:7). In addition, as noted by Vitelli, the low numbers of early vessels in circulation and their limited or non-use in cooking and storage, demands the continued production of a range of containers in perishable materials. Thus the ongoing relationship between ceramic containers and other container types cannot be ignored and should play a part in studies of ceramic consumption (see Section 13.4).

Summary

Studies of Neolithic ceramics should provide a unique and clear perspective on how the Neolithic economy worked, however at present there exists instead considerable confusion and contradiction. Detailed ceramic studies continue to affirm that ceramic production was conducted by the household for the household with almost all production local to the place of consumption. However more general syntheses have long stressed the importance of exchange. It was argued that detailed studies of ceramic assemblages struggle to recognise examples of ceramic exchange for two reasons one methodological, one theoretical. Early ceramic studies which rely purely on observation of form and finish are likely to struggle to identify imports in situations where regional zones of stylistic similarity are large and the range of forms and finishes limited. Studies that also observe variation in fabric always identify considerable variation in fabric within single site assemblages and this would seem to be a more promising methodology through which to identify examples of ceramic exchange. Unfortunately, however, variation in fabric is almost always interpreted in terms of local production, even in those cases where the case for non-local production and thus exchange seems hard to deny (e.g. 'Andesite Ware' at EN Franchthi; see Chapter 11). Such examples raise the issue of interpretation and moreover suggest the influence of a conceptual barrier, forcing studies to interpret scientific data in terms of what might be acceptable rather than what it might actually imply. Thus, at present most ceramic studies simply affirm with no great conviction an old

formulation of the Neolithic household and Neolithic self-sufficiency, at a time when more general syntheses favour one which emphasises the importance of exchange (i.e. the DMP).

In this chapter exploration of this important contradiction has revealed a series of problems not only in how ceramic variation is characterised, but also in how this characterisation is then interpreted. In order to seek a solution to this contradiction, the exploration, characterisation and interpretation of ceramic variation will form a central part of this thesis. Since ceramic diversity would appear to be a feature of all Neolithic sites (Vitelli 1989:20; Yiouni 1995:619), the EN assemblage at Knossos provides an ideal opportunity to explore some of the issues and contradictions raised in this chapter. For example petrographic study of fabric should be able to demonstrate whether this assemblage is entirely locally produced, as Furness and Evans have suggested, or whether at least some vessels could have been produced elsewhere.

Detailed characterisation of ceramic variation will also allow some of the other, more long-standing research questions to be addressed.

(1) *The Adoption of Ceramic Technology:*

How should we explain the appearance of ceramic technology on the western, eastern and southern margins of the Aegean at approximately the same time? How should we model this process of invention and/or adoption? Did the introduction of ceramic vessels really revolutionise the processing or storage of food? Does the introduction of ceramics testify to competitive feasting or resource intensification?

(2) *The Organisation of Early Ceramic Production:*

Was ceramic production really restricted and specialised from the very moment of its introduction into the Aegean? How was early ceramic production organised? Was it an individual, high-status or specifically gendered pursuit?

(3) *The Consumption of Early Ceramic Vessels:*

How were early ceramic vessels consumed? How were early ceramic vessels and ceramic technology valued? What was the relationship between ceramic and non-ceramic containers?

Finally and in addition to these more general issues, re-study of the EN assemblage at Knossos offers the opportunity of addressing more specific issues associated with the interpretation of EN Knossos. As noted above, previous studies of EN ceramics have consistently identified and emphasised homogeneity in vessel form and finish over this long ceramic phase (EN = c.1500 years; see Appendix I). These studies have used this conclusion to infer the existence of technological homogeneity and have consequently identified only one (limestone tempered) fabric. As a consequence more general studies of Neolithic Crete have consistently emphasised Knossos' isolation, not only from the rest of the island but also from the rest of the Aegean; some have even claimed that Knossos was the only permanent site on Crete at this time (see Section 12.1 for further discussion of the Knossian Isolation Hypothesis).

CHAPTER TWO

EARLY CERAMICS IN THE AEGEAN

2.1 Themes and Theories in Early Ceramic Studies

The human transformation of clay, through fire into ceramic has long been hailed as a significant technological leap: from Tylor and Morgan in the nineteenth century to Childe in the first half of the twentieth century, the appearance of pottery has been considered a sign of significant cultural development and an important step towards 'civilisation' (Hoopes & Barnett 1995:4; Rice 1999:3). In early studies of the Neolithic the beginning of potting was linked with other significant developments, such as the appearance of early agriculture and the development of sedentary village societies, as part of a 'Neolithic Revolution' (cf. Childe 1981; see discussion in Moore 1995:39-40). Pottery containers both facilitated the processing of cereal grains and enabled storage in sufficient quantities to feed large sedentary groups. In addition sedentary living was considered to be a prerequisite of pottery production. Thus it was that early ceramics simultaneously enabled and were enabled by early agriculture and sedentism.

2.1.1 *Ceramics, Sedentism and Agriculture*

This close synchronism between early ceramics, agriculture and sedentism long remained axiomatic. Indeed it was only when Kenyon's excavations at Jericho in the 1950s revealed the existence of a long 'Pre-Pottery Neolithic' that it began to become clear that pottery first appeared long after the development of agriculture and village communities. Since then research amongst ceramic-using 'complex' hunter-gatherers, both ethnographic and prehistoric, has made it clear that the appearance of early pottery should be 'decoupled' from deterministic associations with either agriculture or sedentism (Hoopes & Barnett 1995:2, 4-5). Thus, although there is a clear tendency for modern ethnographic pottery-producing societies to be sedentary (see Arnold 1985:109-26), the origins of pottery-production need not be so closely associated with a lack of mobility. To give just a few examples: some of the earliest pottery ever made was produced by Jomon hunter-gatherers in Japan (Aikens 1995); likewise Ertebølle Mesolithic

communities in northern Europe were using pottery centuries before the earliest appearance of domesticates (Gebauer 1995); while in both Mexico and Western Asia the opposite is true, as there domestication preceded ceramic production by millennia (Hoopes & Barnett 1995:5; see below).

That is not to say, however, that no relationship exists between early ceramic use, agriculture and sedentism, only that it is by no means a simple or singular one of cause-and-effect. Pottery production places significant demands on time and energy: ethnographic studies of modern hunter-gatherers tend to show that pottery use occurs in the context of sedentary activity, even if the group is mobile for the rest of the year (Hoopes & Barnett 1995:4; Rice 1999:23-6, 28-9). Thus sedentism, if only seasonal, may have played a significant enabling role in the appearance of early pottery.

2.1.2 Ceramics and Food Processing

Studies of early ceramics have produced a wide range of interpretations, the majority seeking to account for their origins and emergence (cf. review in Rice 1999:2-14). Traditionally these studies have focused on the obvious storage, cooking and serving capabilities of ceramic containers. To a large extent these studies may be characterised as 'adaptionist' or 'enabling' explanations (see Brown 1989:204-5, 210-11): pottery is held to have been an improvement on previous containers and in particular to have increased the adaptive potential of the pottery-using group¹⁸. The advantages of pottery in this are considered to be the following (see Rice 1999:8; Hoopes & Barnett 1995:5; Arnold 1985:128-44):

- (1) Increased efficiency in processing of 'new' foods, such as cereals, by toasting or by direct/indirect boiling;
- (2) Increased efficiency of long-term storage of grains and pulses;
- (3) Improved nutrition for children, mothers and the elderly through the ability to prepare soft-cooked foods;

¹⁸ For an extreme expression of the view that ceramic technology is entirely directed towards extending human adaptation to the environment see O' Brien et al. 1994, especially 264-71.

- (4) Extension to the range of food resources which could be exploited, including foods containing toxins which require long soaking and cooking, thus increasing the carrying potential of the local environment;
- (5) Reduction in the time required to oversee cooking in comparison to gourds, stone, bark or basket vessels, which require indirect stone-boiling techniques.

A close connection between pottery and cooking is also suggested by modern ethnographic studies. However, as Vitelli has stressed, "no modern ethnographic context... truly parallels the earliest contexts for pottery use" (Vitelli 1993a:214; cf. Vitelli 1989:24-5). Thus none of the earliest pottery at Franchthi shows any sign of having been used as a cooking pot (Vitelli 1989:24; 1993a:213-4; see also Section 13.3.1) nor does the earliest use of pottery suggest a focus on storage (too few pots of too small a size) (Vitelli 1989:26-7). Rather, the advantages of pottery, so obvious to modern researchers, would have not been so immediately apparent to the earliest users (cf. comments of Sassaman 1995:223-4); the culinary potential of pottery was something which had to be discovered over time and when the need arose. Indeed if traditional foods were judged to be better tasting or more socially-acceptable if cooked using pre-ceramic methods of processing, this may have actually mediated against the early use of ceramics as cooking pots (Vitelli 1993a:214-5). For Rice the popularity of culinary hypotheses illustrates the common tendency amongst Anglo-American archaeologists and anthropologists to view technology, particularly its origins, from an ethnocentric Western perspective, which sees the advantages of new technologies as self-evident to the societies which adopted them (Rice 1999:10).

2.1.3 Functional/Economic Efficiency

The failure of 'self-evident' and adaptionist hypotheses to account of the data for early pottery use has also been noted by Brown (1989:204-212). Brown has proposed an alternative hypothesis that early ceramic containers were produced to supplement or replace existing container forms which could no longer be manufactured sufficiently quickly and in sufficient quantities to cope with an increase in container demand (1989:213-222). This extra demand for containers

is held to arise from an increase in container consumption, such as might occur when new activities involving the use of containers are adopted, such as stone boiling, parching, direct heating or storage (on storage see Moore 1995). This model relies on the presumed economic superiority of ceramic containers over those made from other materials (Brown 1989:218-22): it postulates that it is quicker, easier and more cost-effective in terms of time and labour for the sedentary household to intensify production of ceramic containers, largely because pottery is held to provide greater potential for economies of scale but also because household pottery production is thought to involve low labour costs because it can easily be accommodated within the range of tasks performed by women in the household (see below on gender).

Although this model has been applied to contexts of early ceramic use (e.g. Crown & Wills 1995; Sassaman 1995; Moore 1995), it is by no means without its problems. A key assumption is that early pottery using societies will be economically optimising, that is they will perceive ceramic technology in terms of efficiencies gained in labour and energy expenditure¹⁹. This in fact seems to be highly unlikely: as Sahlins has noted, modern 'Stone Age' societies tend to be characterised by 'underproduction', an 'under-use of objective economic possibilities' and a more relaxed and flexible attitude to time, far different from the modern notions of economic efficiency and time-management (Sahlins 1974:14-27, 34-5, 41-99; Bourdieu 1977:175-8; see Chapter 4)²⁰. Thus, it seems unlikely that ceramic technology would have been adopted because it was perceived to be a 'cheap' craft in economic terms. A related assumption is the notion that ceramic would be perceived immediately to be a superior container material than, for example, wood or basketry. This however is not supported by the available data for Crete and Greece. At both Knossos and Franchthi, as well as at other sites, the first ceramic containers are present in such small quantities

¹⁹ This over-emphasis on ecological constraints and possibilities seems to result in general from an over-deterministic application of ceramic ecology theory, demonstrated by heavy reliance on the work of D. Arnold (1985) (see especially Brown 1989:213-6). For a critique of this sort of application of ceramic ecology see Chapter 4.

²⁰ Indeed modern ethnographic studies of hunter-gatherer societies tend to suggest that "the food quest is so successful that half the time the people seem not to know what to do with themselves" (Sahlins 1974:11).

that it is hard to resist the conclusion that a wide range of non-ceramic containers must have remained in use (see Section 13.4.2). Any replacement of non-ceramic containers must have occurred over a very long period of time. Evidence is also lacking for the co-occurrence of the first ceramic vessels with a new range of container-destructive tasks to which pottery was better suited; rather the adoption of pottery in the Aegean seems to have been accompanied by no obvious social, material or economic changes (see below; cf. also Sassaman 1995:223-4 for similar conclusions for the earliest pottery in the American Southeast).

2.1.4 Gender

The economic-efficiency model, as with many theories on the emergence of pottery, is also problematic in terms of the way it fails to deal seriously with the important social dimension to the adoption and maintenance of new technologies (cf. van der Leeuw & Torrence 1989; Sassaman 1995:235-6; see Chapters 3-4). Prominent in this is a failure to explore the issue of gender. It remains a common assumption that the first "pots were generally made by women and for women" (Childe 1981:86): compare the conclusion of Longacre that "pottery was invented by women and remained a women's technology for millennia" (1995:278) or that of Vitelli that "Neolithic potters were probably women" (Vitelli 1993a:xx).

The principal reason for this long-standing association is the assumption that early pottery production and consumption fell entirely within the range of supposedly female-gendered tasks. Thus women "as gatherers and as the individuals most closely associated with households, might also have been closer to the technologies and materials for making pottery and better able to organise the diverse tasks necessary for manufacturing ceramics" (Hoopes & Barnett 1995:6; cf. Vitelli 1993a:xx; 1995:60-1; see Chapter 4). These ideas are not without considerable ethnographic support. There is a strong link in mixed horticultural and foraging economies between female labour and wild plant gathering, daily horticultural tasks, food processing (except butchering and fire-starting), the production of clothing, textiles, basketry and leather products as well as care for infants and the elderly (see discussion and references in Crown & Wills

1995:246-7). However, as Sahlins has stressed, although the most dominant form, the "division of labour by sex is not the only economic specialisation known to primitive societies" (Sahlins 1974:79).

Studies which stress the connection between female labour and early pottery production also rely on the numerous ethnographic studies which describe female pottery production at the household level. Arnold has argued that part-time seasonal pottery production is most efficiently accomplished within the household, to which women are closely attached through the requirements of pregnancy, infant care and the sort of household tasks listed above (Arnold 1985:100-1): pottery production does not require periods of absence from the home, is a relatively safe activity to conduct in the presence of children, is monotonous and does not require excessive concentration, is compatible with cooking and requires the sort of daily attention which suits scheduling with other 'female' household activities.

In response to this Wright has argued that it is not child care responsibilities which tie women to the household and which free men to engage in activities at a distance, since within a household there are a range of alternative child care options and at any rate reproduction and child-care occupy women only at a certain stage in their life-cycle (Wright 1991:200-1; 217; see also Crown & Wills 1995:248). Moreover, in actuality pottery production is far from monotonous, is potentially dangerous (e.g. firing) and in terms of scheduling requires a rhythm of work and considerable amounts of skill, timing and concentration (Wright 1991:n.6). In other cross-cultural studies of gender and activities, pottery production is not so clearly correlated with one gender or another (see Barley 1994:61-6): it has been suggested for ethnographic studies of African potters that it might be more appropriate to draw a line not between male and female, but between fertile women and everyone else (Barley 1994:63). When males are involved their participation is usually associated with a complex division of labour and a high degree of occupational specialisation, agricultural intensification and complex technologies of production, when women are involved there tends to be a low degree of occupational specialisation and division of labour (Wright 1991:198).

It has been observed that if pottery production were simply added to this extensive range of tasks then it might amount to a "time management crisis for women" and this may serve to prevent the introduction of pottery production in mixed horticultural and foraging societies (Crown & Wills 1995:247-8). However, what is forgotten consistently in studies which emphasise gender and ceramic production, is that the production of pottery, like the production of food, is never simply the responsibility of a single individual (see Chapter 4). Rather, as Wright has emphasised, pottery production involves the co-operation of other people, such as children or the elderly, who often remain invisible in modern ethnographic studies of production (Wright 1991:198-9; Miller 1985:77). Thus household production is not simply female production, but implies the co-operation of "individuals who perform other tasks in the production sequence (e.g. procuring and processing clay, decorating finished vessels, collecting wood...)" (Wright 1991:198; cf. Miller 1985:110; cf. Barley 1994:61-6). In this way pottery production might be compared to agriculture, which similarly requires group co-operation at certain stages in the production process, whether sowing and threshing (often male-dominated) or weeding and other day-to-day activities (female-dominated) (Wright 1991:198-9).

Recognition of the potential involvement of others in early pottery production, encourages one to think beyond the cliché of female labour and early ceramic production²¹. One might speculate regarding the potential special male involvement in certain significant tasks in a production process, which might otherwise have been dominated by female labour, such as bonfire lighting; fire-lighting being potentially symbolic and transformative. Alternatively, one could argue that if early pottery production was something that was adopted from outside the community, as several have argued for the Aegean (see below), it might, as an imported technology, have been more closely associated with those, through whose social contacts beyond the community, this innovation first arrived; the most likely candidates for this being men. In a similar vein Rice has noted that if the earliest ceramics "were associated with ritual and/or shamanic

²¹ For example Vitelli makes deliberate rhetorical use of the female pronoun to refer to potters (Vitelli 1993a:xx, 4, 92), even though it is not clear whether they were male or female or both.

control of production, manufacture could have been by either sex" (Rice 1999:10 n.8).

Thus, studies of early ceramic production, which emphasise one gender over another, are likely to suffer from over-simplification and an over-emphasis on individualism. Household ceramic production is above all likely to be a group activity which could be potentially shared between males *and* females, old *and* young (Wright 1991:199, 201); the point being that the organisation of production in small-scale societies is based on the kinship mode of production, where roles are defined according to age and the life cycle and the organising principles are simultaneously public, economic and political (see Chapter 4). Studies which stress the exclusive female involvement in early pottery production also run the risk of projecting ethnographic presents, where pottery production usually has a long history and is not a 'new' technology, onto an Early Neolithic past, where pottery is something new and most likely of special value (Vitelli 1993a:214).

2.1.5 Resource Intensification/Competitive Feasting

Recent attempts to understand and explain changes in subsistence strategies and an early use of pottery among complex hunter-gatherer groups, have combined culinary and economic optimising theories for early pottery use within an overall model which asserts the importance of resource intensification (see Rice 1999:10-12; cf. Aikens 1995; Sassaman 1995). Increased sedentarisation, the introduction of more intensive methods of food procurement (e.g. agriculture) and the adoption of pottery are all understood in terms of attempts to get more out of specific resource-rich environments. Hayden has argued that while in resource-poor environments there is likely to be an ideology of communal sharing, resource-rich environments are likely to foster "economically-based competition together with the resultant socio-economic inequalities that this implies" (Hayden 1995:258). Within this context it is considered only natural that 'aggrandising individuals' with 'accumulative personalities' will emerge, who compete for power and status through the organisation of competitive feasts, featuring rare or otherwise desirable foods; such feasts may have served to create indebtedness and display status (Hayden 1995:258, 260-3). In this context there is no guarantee that

food containers will necessarily be made of ceramic, for example stone or plaster bowls appear well before pottery in the Near East (Hayden 1995:260; see below). Indeed Hayden argues that the earliest developmental phase of ceramic technology "must have represented a very laborious endeavour with many problems and failures", most likely driven by a desire to master and exploit the symbolic value of a new socially prestigious technology of transformation, which was also capable of producing more exotic container forms and/or allowed new foods to be processed (Hayden 1995:261-2).

This model has a number of attractive features:

- (1) it correctly predicts that the earliest pottery should occur in the form of food-serving vessels, such as bowls and plates, with cooking vessels only being of secondary importance;
- (2) it is able to account for the high value and symbolic importance attributed to early pottery containers (cf. Rice 1999:13-14; Vitelli 1995);
- (3) it provides a coherent, socially and economically grounded means of understanding other subsistence and material changes which may occur in such contexts;
- (4) it can easily be modified to fit 'secondary' scenarios, where ceramic technology may have been adopted through contact with ceramic-producing communities: the idea of early ceramics as a prestige technology and a socially-valued container-form helps to explain the motivation for such technology transfer. It is generally considered likely that such instances of adoption were much more widespread than cases of independent invention (Rice 1999:41-3).

The weakness of this model, at least in its present form, is the necessary link it proposes between competition and intensification of production, whether of subsistence or ceramics. In this way the model predicts a "rapid evolution toward labor-intensive, specialized production of highly decorated forms" (Hayden 1995:261). In fact the link between competition, arguably a feature of all societies, and intensification, a feature of some, is by no means necessary (see

Sections 4.2.2, 11.3). Furthermore, in the context of Anatolia, Crete and Greece, 'evolution' towards specialised production seems in fact to have been far from rapid; indeed there may be good social reasons why the possibilities for specialisation may have been restricted in early ceramic using societies, certainly early agricultural economies do not seem to be characterised by intensive-labour or economic optimisation (see below; see also Sections 4.2.2, 11.3).

2.2 Early Ceramics in Anatolia, Greece and the Aegean

2.2.1 Pre-Ceramic Clay Use

As is often the case in regions of early ceramic technology (cf. Rice 1999:37-9 'software horizon'), the appearance of ceramic containers at sites in Greece, the Aegean and Anatolia (west, south-west, south) does not represent the earliest uses of clay in this area. The period in which pottery first appears is preceded by a pre-ceramic or aceramic phase during which clay was variously used in the construction of dwellings (mudbrick, clay installations) as well as to form figurines and ornaments (beads).

In Anatolia and the Near East this phase of pre-pottery clay use was of extremely long duration. There the use of mudbrick architecture dates to the very beginning of the Neolithic (ninth millennium BC), coinciding with the inception of early agriculture: for example early mudbrick-based architecture is found at PPNA Jericho in the Levant, at Asikli Höyük, Çayönü Tepesi in south and south-east Anatolia and at Hacilar in south-west Anatolia (eighth millennium) (Joukowsky 1996:74-85; Schmandt-Besserat 1977:133-137). In Anatolia (especially the south-east) during the ninth and eighth millennia, plaster was manufactured to make floors and increasingly at the end of the ninth and into eighth millennium to make a variety of containers, often quite large, which seem to have been used for storage (see Moore 1995:45). The walls of these vessels were built up in thin layers, each being allowed to dry before the next was applied. It has been suggested that the abundance of these containers might indicate a significant increase in the need to store foodstuffs during this period (Moore 1995:45). Clay beads, figurines and geometric objects are also known from some sites in the pre-pottery period: for example at Çayönü Tepesi and Suberde (ninth-

eighth millennia BC), but not at Asikli Höyük or Aceramic Hacilar (Schmandt-Besserat 1977:138-142). House models are known from Çayönü Tepesi (Moore 1995:46). The appearance of a similar range of clay objects at around the same time and over a wide area encompassing the Levant, the Fertile Crescent and south-east Anatolia testifies to the existence of a considerable degree of interaction between communities in this region at this time; interaction which can also be glimpsed in the widespread circulation of 'exotic substances', such as 'attractive stones', shells and even metals (Wengrow 1998:784-5).

In mainland Greece, aceramic Neolithic deposits, dating to the first half of the seventh millennium BC, have been isolated at sites in Thessaly (Argissa, Gediki, Soufli Magoula, Sesklo) and at Franchthi and these have produced clay earplugs, figurines and slingshots (Demoule & Perlès 1993:365-9). On Crete clay beads and clay figurines, along with mudbrick architecture, are known from the Aceramic period (c.7000-6400BC) (Evans 1964:141-2; 1971:102, plate III; 1970b:7; Appendix I)²². The functions of these early clay objects in Anatolia, Greece and the Aegean were probably various and cannot be determined with certainty. However, there is a general consensus that most had some sort of symbolic significance (cf. Moore 1995:46).

The aceramic period in Greece and the Aegean, although much shorter in duration than the Anatolian aceramic, nevertheless demonstrates that both early agriculture and early villages were in existence long before the appearance of fired ceramic containers. At the Cyclops Cave (Yioura) there is possible evidence for the early (eighth millennium) domestication of animals (pigs and caprines) (Sampson 1999:21), while at Franchthi (eighth-seventh millennium) there was a probable early exploitation of plants, although these were locally available wild cereals and not domesticates (Perlès 1999a:317). The first domesticates, mainly wheat, lentils and ovicaprids "of Near Eastern origin", appear in the Initial

²² In addition, amongst unpublished material from the excavation of Aceramic levels (level 26) in sounding X at Knossos, a built clay feature with central pivot hole and smoothed interior, which may be part of a quern. This interesting object has an interior which appears to be smoothed and very roughly burnished. However, it should be stressed that the material from which this is made is not ceramic but resembles a mudbrick fabric and the object is part of a built feature and not a container.

Neolithic (Aceramic) phase alongside a basically 'Mesolithic' tool kit²³; the following phase (Early Neolithic) differs entirely from the preceding one, is fully Neolithic and indistinguishable from other EN assemblages of southern Greece (Perlès 1999a:317). At Knossos domesticated sheep, goat, cattle and pig are clearly present in the very earliest layers of the Aceramic village (c.7000BC) together with a range of domesticated cereals (Jarman & Jarman 1968; Evans 1968:269-70). Thus, as has been stressed recently, it is crucial that the emergence of pottery is 'decoupled' from deterministic associations with either sedentism or agriculture (Barnett & Hoopes 1995:2). Indeed on the contrary, at Knossos, as at other sites in Greece and the Aegean, the transition from an aceramic to a ceramic Neolithic, apart from the appearance of ceramics, is generally considered to be otherwise without great social, material or ecological change (Evans 1970a; Theocharis 1973:35; Demoule & Perlès 1993:369; *contra* Weinberg 1970:571-2).

²³ This phase also produced a few sherds of pottery, however it is not clear whether this pottery represents the first limited use of ceramic vessels or is simply intrusive from later EN levels (Perlès 1999a:317; Vitelli 1993:39).

2.2.2 Dating the Earliest Pottery

In Anatolia ceramic containers and ceramic technology first appear at approximately the same date at a large number of sites (Schmandt-Besserat 1977:149; Moore 1995:40-4)²⁴. Thus the earliest ceramic layers at Çatal Höyük (level XII), Çayönü (phase II) and Mersin all have radiocarbon dates in the range of 8300-8000BP (c.7400-6900BC)²⁵ (Moore 1995:40-2). These dates also compare closely with those from early ceramic sites in the northern Levant and along the Fertile Crescent (c.8300-8000BP) (Moore 1995:42-4).

In Greece and the Aegean, the earliest pottery appears sometime after this period: the earliest ceramic levels at sites in northern and southern Greece (Franchthi) and Crete (Knossos) have all been dated to around the middle of the seventh millennium BC. Thus, contrary to the claims of Moore (1995:44) that "the earliest pottery found at Knossos in Crete, at sites on the Greek mainland, and farther west... all dates around the same time [as the earliest pottery in Anatolia] or a little later", there is, in the current state of knowledge, a fairly considerable time lag of c.500-800 years between the adoption of pottery in south/south-east Anatolia and the Near East on the one hand, and in mainland Greece, Crete and the Aegean on the other.

It may ultimately prove significant that the earliest ceramic material from the Aegean coast of Anatolia and from most areas of south-west Anatolia dates only to the Anatolian LN, i.e. to no earlier than c.6500BC (see Appendix IV). Earlier EN material is known from only three sites, Kuruçay, Hacilar and Belbasi. The Belbasi ceramic assemblage, although almost certainly the earliest, is tiny and occurs in conjunction with an otherwise Mesolithic toolkit; such circumstances suggest the presence of imported vessels rather than the presence of ceramic technology. The EN material from Kuruçay is unlike that from Belbasi but closely

²⁴ NB Schmandt-Besserat *inter alii* dates the Beldibi B pottery to late Palaeolithic or Mesolithic (c.8500-8000BC); however this early date is not supported by radiocarbon dating, but is based on dating of associated 'Mesolithic' lithic assemblages. As demonstrated by the new finds from the Cyclops Cave on Yioura (Sampson 1999), a Mesolithic lithic assemblage, closely comparable to that from Beldibi, was still in use up to c.6500BC. Furthermore, good parallels between the Beldibi B ceramics and Çatal Höyük XII (dated c.7000BC) have been noted (see Appendix IV; Yakar 1991:123). A pre-7000BC date for the Beldibi B ceramics is not accepted by Moore (1995), who does not include it in his survey of early Anatolian pottery.

²⁵ Approximate calibrated range given by the OxCal 3 calibration programme.

resembles pottery recently excavated at Hacilar (Duru 1994; see Appendix IV). Absolute dates are only available from Kuruçay, but these indicate a date for this earliest material towards the very end of the Anatolian EN, close to the middle of the seventh millennium (see Appendix IV).

Thus the earliest date for the presence of ceramic technology in the south-west, even including this early material, seems to correspond with the earliest dates from Greece and Crete. If correct, this would mean that ceramics first appear at around the same time on both sides of the Aegean and that the time lag is rather between west/south-west Anatolia and further east. Ultimately, however, the significance of any correspondence between these dates can only be expressed cautiously, since a complete Aceramic to LN sequence, either from south-west or west-central Anatolia, has not yet been isolated and subjected to radiocarbon dating: ultimately there may prove to be earlier EN ceramics at Hacilar, Kuruçay or elsewhere. At present the Belbasi assemblage appears to be an isolated occurrence, but future discoveries could change this. In addition, almost all Neolithic material from south-west Anatolia comes from surface survey and thus at such sites it is impossible to be certain, in the absence of stratigraphical excavations, whether earlier ceramics exist buried beneath later Neolithic deposits.

2.2.3 A Previously 'Developed' Technology?

A striking feature of the first pottery to appear in south-west Anatolia, Greece and the Aegean, noted independently in a number of regional studies, is its 'developed form'. Thus the early pottery from the Beldibi Cave, level B (south-west Anatolia) is described as a "conspicuously evolved pottery, which does not give the impression of the beginning of a craft" (Schmandt-Besserat 1977:133). A similar judgement was passed upon the earliest pottery excavated by Duru at Kuruçay (level 13) and also at Hacilar (impressed into red plastered floors which would otherwise be dated to the Aceramic) (Duru 1994:103; see Appendix IV). The earliest (EN) pottery from Elateia (Central Greece) was considered by Weinberg (1962:167-8) to be an 'already well-developed technology' which had been brought to the site by its first settlers. The same author characterised the

earliest pottery in Greece in general as "in a tradition already long-established" (Weinberg 1970:583). Similarly, the two excavators of Neolithic Knossos, Sir Arthur Evans and John Evans, have both emphasised how the very earliest pottery at the site "bears all the marks of being the product of a fully developed tradition of potting" likely to have been introduced from elsewhere (Evans 1964:196; 1968:271; cf. A. Evans 1921:35).

It should be noted, however, that the criteria whereby each of these scholars defines 'developed' are rarely ever stated explicitly. Most seem to agree on the presence of a wide range of different forms and finishes (cf. Evans 1964:196; 1968:271; Moore 1995:40). However, it still remains possible that different individuals will view the same assemblages in different ways. Thus for the same Thessalian data it has been variously argued that the earliest pottery is developed and introduced from elsewhere (Bloedow) and that it testifies to the progressive development of a local tradition (Theocharis) (see Demoule & Perlès 1993:368). Indeed to find a region where the earliest pottery appears to be sufficiently simple to be called 'experimental' one must look at least as far east as Çatal Höyük, where the earliest pottery is "of the simplest kind", namely deep bowls and hole-mouth jars with burnished surfaces, and Cayonu, where the pottery is "simple and quite rough", with not all vessels burnished (Moore 1995:40). It should, however, be noted that Mellaart himself considered the pottery at Çatal Höyük to be a 'developed' tradition from the start (Duru 1994:103). Thus it would seem that in many cases evolutionary judgements of ceramic development reveal more about the attitude of the particular scholar concerned than about the real nature of the technology involved.

At many of the Aegean sites, tiny amounts of pottery actually first appear at the top of otherwise aceramic strata (cf. also Kuruçay and Hacilar early pottery). Thus the top of the 'aceramic' strata at each of the Thessalian aceramic sites contained a few small potsherds (Demoule & Perlès 1993:368). At Franchthi, very small quantities of pottery first appear in the grey clay 'Aceramic' stratum, although it remains a possibility that these may be intrusive (Vitelli 1993a:39). At Knossos the earliest pottery almost certainly appears at the very top of the Aceramic stratum (see Appendix I: sounding AC (stratum X), sounding X). Thus

at all these sites 'developed' pottery first appears in 'aceramic' deposits unaccompanied by other obvious material changes in a manner which otherwise suggests continuity.

2.2.4 Models for the Origins of Early Ceramics in Anatolia, Greece and the Aegean

2.2.4.1 Diffusion

The oldest and most popular model for the origin of ceramic technology in Anatolia, Greece and the Aegean considers pottery to have been first 'invented' in the Near East and then to have spread, as a fully developed technology (see above), through Anatolia to Greece and the Aegean. Thus Weinberg describes "the arrival of Neolithic potters in Greece" as "sudden and widespread" and considers the Greek ceramic Neolithic (EN) to have been an 'import' and the earliest ceramics to have been produced "in a tradition long established" by "experienced potters" (Weinberg 1965:286-7, 1970:571-2, 585). Likewise, the earliest pottery at Knossos is considered to have been developed elsewhere (see above), the implicit model being that it spread by diffusion. The diffusion theory for the origins of pottery production parallels that posited for the introduction of farming and constitutes a second wave of 'influence' after the initial introduction of the Aceramic Neolithic (Vitelli 1993a:39).

In support of the diffusion hypothesis Weinberg points to the remarkable similarity (*koine*) between the earliest pottery (Greek EN) of Thessaly and Peloponnese (1970:584 cf. 1965:287, 290): "Almost everywhere the earliest shapes are hemispherical bowls and globular, collared jars; small pierced lugs, set either horizontally or vertically, are the only form of handle. Flat bases or ring bases, varying from low to high; slightly everted lips, often separated by a groove; the beginnings of a carination at the belly; hole-mouthed jars - all these begin early, if in fact they are not present in the original repertory". Although this large *koine* disappears by the end of EN, large regional style zones continue to be a feature of EN and MN Greece (cf. Cullen 1985; Vitelli 1993b:250; Wijnen 1993:324).

Moving to the opposite side of the Aegean it is striking that at around the same time (see Appendix I) the earliest Anatolian (LN) pottery from south-west and west-central Anatolia (Hacilar-type) exhibits a similarly widespread homogeneity (Mellaart 1970a:146; Eslick 1992:81-2; see Appendix IV), which likewise did not continue into the next ceramic phase (Early Chalcolithic). These similarities are not shared with pottery from north-west Anatolia (Illipinar-type) (Wijnen 1993:325-6). An interesting and surprisingly ignored feature of this pottery is the high number of similarities in form and finish which it shares with the earliest Greek EN ceramics (see Appendix IV): here one might consider the prominent presence of hemispherical bowls, collared jars, hole-mouth jars, slightly everted rims, flat bases, ring bases, pierced lugs.

2.2.4.2 Independent Local Invention

An early case for an independent local invention of ceramic technology was made by Theocharis, who argued that crude ceramic vessels in Aceramic levels at Sesklo were the "direct and immediate antecedent" of ENI pottery at the site (Theocharis 1963; Weinberg 1970:571). For Knossos, Broodbank has similarly argued that the earliest pottery may have developed from unfired clay containers in use in the Aceramic (Broodbank 1992:49), although there is as yet no evidence for the existence of such Aceramic clay containers. Vitelli has argued for the possibility of a local invention of pottery at Franchthi by women (Vitelli 1993a:xx, 39, 1995:60-1): women as cultivators, gatherers and processors of plant foods and medicines "had expert knowledge about kinds and locations of soils, including clays; had frequent occasion to experience the properties of clay, especially its plasticity; and no doubt often witnessed and brought about the accidental transformation of clay by fire".

Recently Moore, in his review of early ceramic production in Western Asia, has argued that the development of ceramic technology was an 'indigenous phenomenon', which occurred simultaneously across a wide area, as a response to a common set of needs, in particular 'the need to store and prepare the foods obtained from farming and herding in new more effective containers and to prepare them in more varied and palatable ways, that were less damaging to

people's health and teeth" (Moore 1995:48). This combination of the cooking and economic optimisation hypotheses is subject to the same criticisms as already outlined above. Furthermore, Moore fails to reconcile the clear evidence for exchange (including ceramics) between sites in Anatolia and the Near East as well as the clear existence of widespread regional similarities in form and finish, with his notion of simultaneous independent invention (see below). Problematic also is the degree to which he seeks to generalise about what was likely to have been a complex process.

2.2.4.3 Diffusion and Local Adoption/Modification?

Although simple immigration hypotheses, such as Weinberg's original formulation of a second arrival of Neolithic settlers, have been subject to detailed critique (cf. Whittle 1996:39-44; Halstead 1996:299-301), the correspondences in chronology, form, finish and range of distribution, which can now be noted between the earliest pottery on either side of the Aegean provide strong support for the hypothesis that trans-Aegean interaction and movement played a significant part in the development of early ceramic technology in Greece and the Aegean. That said, however, more recent studies of the earliest Greek pottery, while acknowledging the strong similarities between pottery from different sites, have stressed that the subtle local differences between sites, mainly in the area of decoration, should not be overlooked (e.g. Wijnen 1993:324; see Chapter 7). Thus the similarities between contemporary Greek (EN) and west-central/south-west Anatolian (LN) ceramics should be understood in conjunction with the existence of clear local and regional differences: for example although pierced lugs feature on both sides of the Aegean, the earliest on the Anatolian coast tend to be mainly tubular and vertical, while in Greece the earliest lugs tend to be oval (see Section 7.6.3; Appendix IV). In this way it is perhaps more accurate to model the complex process of technological transfer in terms of diffusion with local adoption or modification also playing a significant part.

2.3 Early Ceramic Production, Consumption and Exchange in Anatolia, Greece and the Aegean

2.3.1 Conflicting Views on Ceramic Production and Exchange

Closely related to questions of diffusion and/or local adoption/invention is the issue of whether or to what degree pots and/or potters might have moved between settlements. This is an area of considerable confusion with hypotheses ranging from the total local production of 'utilitarian' ceramics, apparently considered unsuitable items for exchange, to the movement of ceramics between sites as prestige items within existing exchange networks. Some studies, which emphasise total local production/non-exchange (TLP/NE), have sought to explain the existence of large EN and MN regional style zones in terms of the movement or interaction of potters, within a framework which emphasises either transhumance²⁶ (Jacobsen 1984) or exogamy (Cullen 1985:95-6). The latter relies on the earliest potters being female and envisages the widespread exchange of female marriage partners between communities. Many more ceramic studies have not even attempted to explain away the contradiction between total local production on the one hand and large regional style zones on the other, but have simply stressed local origins (e.g. Furness 1953; Evans 1964; Vitelli 1993a; Yiouni 1995, 1996a; Jones 1986; Björk 1995). By and large these studies are detailed analyses, whether stylistic, elemental or mineralogical, of individual Neolithic ceramic assemblages.

In contrast, those studies which emphasise the movement of the pots themselves tend to be in the form of more general syntheses. For example Gallis, in a general review of 'The Neolithic World', has argued that 'pottery implies the existence of an extensive network of exchange and communication already in the EN', while for MN pottery he has suggested that "it... travelled over considerable distances not merely as containers... but as objects with intrinsic value of their own" (Gallis 1996:34). Likewise Perlès, in her study of Neolithic production and exchange in Greece, has suggested a small-scale circulation of non-utilitarian ceramic vessels (1992:149). Demoule and Perlès, in their review of the Greek Neolithic, conclude that although ceramic production was mostly local, there was some restricted circulation of pots (Demoule & Perlès 1993:382, 384). Andreou, Fotiadis and Kotsakis, in their review of the Neolithic of northern Greece,

²⁶ This hypothesis is highly problematic: there is no hard evidence to support the existence of this form of subsistence in the Greek EN or MN, nor does it seem likely that demographic and economic conditions favoured its emergence at this time (Halstead 1996:301-4).

similarly envisage a circulation of specific classes of pottery with production of ceramics in special centres (Andreou et al. 1996:559).

It is significant that these more general syntheses seem to base their discussion of ceramics on data from Thessaly (e.g. Demoule & Perlès 1993; Andreou et al. 1996), where in general detailed stylistic and analytical studies have been more favourable to the movement of ceramics (cf. Schneider et al. 1991a, 1991b)²⁷. Thus these syntheses opt for simplicity when they choose to ignore the majority of ceramic studies, which stress TLP/NE. Those general studies, which attempt to be more honest, ultimately suffer from an inability to identify or resolve the contradictions. Thus Moore, in his review of early ceramic technology in Western Asia, first reports that "most of the pottery recovered seems to have been made at the site where it was found, from local clays" (Moore 1995:46). But then later (1995:47), and in contradiction of his earlier statement, he notes that the work of Le Mièrre and Picon (1987) has demonstrated that "a proportion of the pottery made on sites across the northern Levant and northern Mesopotamia was exchanged". Apparently this movement was restricted to fine wares and most vessels were exchanged between neighbouring sites, "although a few pots were brought in from regions as much as 400km away" (Moore 1995:47). Furthermore, this exchange of ceramics seems to have begun with the production of the first ceramics and to have persisted from then on (Moore 1995:47). To this evidence from areas to the east of the Aegean, one might also consider similar conclusions regarding early ceramics from the West Mediterranean, which indicate the long-distance circulation of certain types of early ceramic vessel (cardial) which may have had high social value (see Barnett 1991, 1995).

This contradiction between the majority of analyses which emphasise (but it should be said do not prove) total or near total local production and a very small minority which stress exchange cannot simply be ignored but must be given serious consideration. Could this be a reflection of real regional differences in the production, circulation and consumption of early pottery or does the problem lie somewhere in our own handling and/or interpretation of the data? The problem of

²⁷ However even in Thessaly detailed studies of site assemblages exist which emphasise total or near total local production (see Björk 1995).

interpretation will be a central theme of this thesis and over the next chapters an attempt will be made to understand why such opposing interpretations have been generated (see especially Chapters 5, 10). In anticipation of conclusions to be drawn in future chapters, it can be noted here that the general reluctance in studies of Neolithic ceramics to identify imports or investigate the circulation of ceramic vessels results from two key areas of difficulty, the first methodological, the second theoretical.

This first area of difficulty is very basic. How does one identify and characterise local and non-local vessels within Neolithic ceramic assemblages with sufficient clarity to allow the circulation of pottery to be studied? Most studies of early pottery have been based purely on stylistic analysis (form and finish) (e.g. Wace & Thompson 1912; Kunze 1931; Weinberg 1937; Kosmopoulou 1948; Furness 1953; Weinberg 1962; Evans 1964; Blegen 1975; Phelps 1975; Lavezzi 1978; Renard 1989; Pantelidou Gophas 1995). While such studies have been able to identify the existence of large, regional style zones and have led to the construction of relative regional chronologies, generally they have been unable to identify the circulation of pottery with any sort of certainty. Thus the studies of Furness and Evans both concluded that the entire EN assemblage at Knossos was stylistically homogenous and entirely locally produced (Furness 1953:95, 103, n.16; Evans 1964:194, 1973:133), an interpretation which has encouraged the view, now widespread, that Knossos and Crete remained isolated until the very end of the Neolithic (see Chapter 12 for discussion of the isolation hypothesis). Even the detailed regional study of southern Greek Neolithic pottery by Phelps (1975) noted only a handful of possible imports at Franchthi, Elateia, Nemea, Chaironeia and Nea Makri, prompting his conclusion that "similarities of wares or traits significant enough to suggest actual imports from one place to another are not common" (Phelps 1986:371; cf. also Wace & Thompson 1912:241). Part of the problem must be the difficulty, within large regional zones of stylistic homogeneity, of recognising imports with any clarity on the basis of form and finish: as Vitelli has acknowledged, "the quantity of pottery that was exchanged within the region [Peloponnese] may have been more extensive in the earlier Neolithic than we have recognised" (cf. Vitelli 1993b:250).

Clearly form and finish on their own may not be the best criteria to investigate the potential circulation of ceramics. More recent studies, which have included macroscopic and microscopic observations of fabric (e.g. Jones 1986; Vitelli 1989, 1993a; Yiouni 1995, 1996a; Björk 1995), have in fact identified considerable variability in the fabrics present within individual site assemblages from all areas of Greece. Thus Vitelli identifies "considerably more variability within the assemblages [Franchthi, Lerna] than has usually been acknowledged" and notes the presence of "five wares defined by the raw materials" (1989:17-18). These 'wares' - or rather fabrics²⁸ - are consistently present at Franchthi in differing proportions: usually one is dominant with several more present in very small quantities. This pattern is repeated at Lerna to such an extent that even the minor fabrics are the same as the minor fabrics at Franchthi (Vitelli 1989:19-20). Vitelli also notes subtle differences in construction between vessels produced in the different fabrics at Franchthi (Vitelli 1989:21).

Vitelli argues that at both sites "at any given time within the earlier Neolithic, the potters were making three to five different wares [i.e. fabrics]. They chose most frequently to use one (the dominant) clay body, but occasionally chose others with ingredients from different locations and with different working properties" (Vitelli 1989:19).

However, this conclusion is by no means a necessary consequence of the data. It should be noted that the small quantities, in which these fabrics are present, could equally favour exchange; indeed some of these less frequent fabrics are actually hard to reconcile with a local provenance (e.g. 'andesite ware'). Furthermore, the existence of differences in forming and finishing between the different fabric groups indicates the maintenance of traditions of production for each fabric, which must to some extent be considered separate, and which could therefore indicate a more distant production location than simply a neighbouring household.

²⁸ Although originally within the type-variety system of classification the concept of ware stood for both surface treatment and paste/fabric, this definition proved problematic not least because fabric and finish refer to different stages in the production process and their combination under a single term leads to confusion. In reality the same finishing method may occur in several different fabrics, or a single fabric may be finished in a variety of ways. As a result it was proposed that ware and fabric should be separated, with the meaning of ware restricted solely to surface treatment (Rice 1976).

When one reads through other analyses of Greek Neolithic ceramics, one frequently encounters similar statements: for example,

"there was considerable diversity in the materials used by the (local) potters whose products found their way to the [Kitsos] cave" (Jones 1986:386).

or

"Petrographic analysis has shown that a variety of fabrics were used by the Makri potters" (Yiouni 1995:619);

or

"New classes of pottery now [MN] introduced [at Nea Makri] seem to have required different types of clay. The areas which had provided the clear, gritless or micaceous clay are now abandoned and potters turn to deposits providing clay of limestone composition" (Pantelidou Gophas 1995:304).

or

"The variations in the early pottery within each [Anatolian] settlement suggest that potting was done by a number of people who probably resided in separate households" (Moore 1995:46).

When taken together these statements suggest that diversity in fabric is a feature which unites all Aegean Neolithic ceramic assemblages, which have so far been studied in this way, whether northern (e.g. Makri) or southern (e.g. Franchthi), early (e.g. Nea Nikomediea) or late (e.g. Kitsos). However, they also indicate that this variation is almost always interpreted in terms of local production. Since both Vitelli and Yiouni have suggested that this pattern might prevail at all other Neolithic sites (Vitelli 1989:20; Yiouni 1995:619), the assemblage at Knossos provides an opportunity to test both of these conclusions (see Chapters 10-11). Thus one of the main questions which this thesis will seek to address is whether the EN assemblage at Knossos, contrary to the previous observations of Furness and Evans, also exhibits this pattern of fabric diversity, with some fabrics present in large quantities, others in small amounts. In addition petrographic study of the Knossos assemblage provides the opportunity to test whether all fabrics present could really have been produced simultaneously at the site at which they were

found (cf. Vitelli 1989:20; Yiouni 1995:619) or whether other interpretations, such as exchange, are possible.

The specifics of interpretation aside, there is a clear problem in the way previous studies of Greek Neolithic ceramics have failed to problematise the issue of fabric diversity. Methodological difficulties clearly play their part in this. General syntheses realise the importance of exchange, both in the theoretical model they follow (see Sections 4.2-3) and in conclusions drawn from the study of the circulation of other types of artefact (e.g. obsidian), and are thus more confident in their conclusions regarding the movement of ceramics. However, when faced with specific ceramic assemblages clearly archaeologists still struggle to define this predicted movement in terms of actual specific sherds or vessels. Chapter 5 will investigate the problems associated with characterisation of Neolithic ceramic assemblages as well as the difficulties involved in combining different types of ceramic data: here there are not only problems associated with relating macroscopic, microscopic and elemental data, but also potential difficulties involved in how one combines data based on form, finish and fabric.

However, the roots of the reluctance to tackle the issue of the circulation or non-circulation of ceramic vessels must go beyond simple problems of methodology. Methodological difficulties do not explain the enthusiasm with which studies seek to explain away all forms of variation, whether in form, finish or fabric, in terms of total or near total local production. Often anything that doesn't easily fit the 'local', usually the most common groups, is explained away as anomalous and ignored, often because it is assumed to be a product of the failure to appreciate the true diversity in local clay sources (cf. Vitelli 1993a:208). The possibility that some fabrics or some anomalies could result from the exchange of pottery between different producing communities is not always acknowledged, let alone discussed. This reluctance to consider other explanations suggests the existence of a conceptual barrier preventing further exploration of the significance of ceramic variation in all its forms²⁹.

²⁹ Day has suggested that there is a general tendency in studies of Neolithic Aegean ceramics to interpret scientific data in terms of what might be acceptable rather than what it might actually imply (1995a:1). One might also compare here the analogous reaction of American archaeologists in the 1930s to the conclusions of Anna Shepard's first petrographic study of Pecos pottery: her discovery that most of the pottery could not have been made locally undermined not only the prevailing interpretative models of the

To some extent this impasse may result from the survival of some rather old ideas about the Neolithic economy; in particular the old notion that Neolithic farming communities were largely self-sufficient entities, who produced all that they required and whose main focus was the production of subsistence (and surplus) for survival³⁰. For example, although Childe recognised the existence of exchange in Neolithic societies, he described the Neolithic economy as almost entirely self-sufficing:

"The simplest food-producing community is not dependant for any necessity of life on imports obtained by barter or exchange from another group. It produces and collects all the food it needs. It relies on raw materials available in its immediate vicinity for the simplest equipment it demands" (Childe 1981:78-9, reprint of 1956 edition).

As recently as 1970, Weinberg in a review of the Neolithic in the Aegean, although noting the presence at Greek sites of Melian obsidian as evidence for "sea-borne commerce" stressed that "agriculture and the raising of domesticated animals was the real basis of their economy" (Weinberg 1970:587). More recent studies, however, have stressed how the simple self-sufficiency hypothesis fails to take account of the ample evidence for exchange and craft production (cf. Renfrew 1973:179). Indeed Gallis has recently argued that "apart from the agricultural and stock-raising economy, basic to the Neolithic way of life, systems for the exchange and distribution of goods (trade) over long distances is [sic] attested right from the EN" (Gallis 1996:34-5).

time, but also the paradigmatic validity of the direct historical approach and even challenged prejudice surrounding the capabilities of modern Pueblo people (Cordell 1991:135-139; 144-5). While several notable scholars accepted her findings, there was a general tendency to try to minimise, explain away or simply ignore the impact of her findings, with some even talking of 'archaeological heresy' (Cordell 1991:140-2).

³⁰ This rather 'pessimistic' view of the possibilities of existence in 'Stone Age' societies has been extensively critiqued (see Sahlins 1974:1-39). Such pessimism largely arises from the emphasis placed in modern economics on economic means (especially scarcity) and the accumulation of capital: since hunter-gatherers are materially poor and must invest more energy in subsisting, they tend to be viewed as economically inefficient and thus poor. However, when judged not by modern criteria but by their own, hunter-gatherers may be viewed, both in the way that their material wants are finite and few and in the way that their technical means are unchanging and generally adequate, as the 'original affluent societies'. In this way some otherwise curious forms of economic behaviour common amongst hunter-gatherers, such as long amounts of leisure time or an inclination to consume all food at once, may be understood as expressions of a more *optimistic* attitude towards resource availability.

In such statements one can see how the emphasis in our understanding of the Neolithic economy has shifted from a focus on production, mainly of subsistence, purely for local consumption to an awareness of the important role played by exchange. In this way the reluctance to problematise the issue of ceramic exchange suggests a general failure amongst ceramic specialists to be clear about what it is they mean when they refer to the Domestic Mode of Production (DMP) in the context of the Neolithic Aegean. For example, Vitelli, when she states that one should "consider the simplest model of production for the earliest years of pottery-making, that is, *essentially household production for household consumption*" (Vitelli 1993a:208, my italics), seems to view production very much in terms of the old self-sufficiency premise. The persistence of old-fashioned ideas regarding the workings of the 'Neolithic economy' is well illustrated by the notable absence of any reference to Sahlins' *Stone Age Economics* (1974) in the bibliographies of articles, which deal with Aegean Neolithic production, consumption and exchange (e.g. Perlès 1992; Demoule & Perlès 1993; Vitelli 1993a). Indeed the most notable exception to this is the work of Halstead, who has pioneered the application of Sahlins' initial formulation of the 'Stone Age' economy to the Aegean (e.g. Halstead 1995).

2.3.2 *The Organisation of Early Ceramic Production in Greece, Crete and Anatolia: Early Ceramic Specialists?*

Studies which touch upon the organisation of early ceramic production in Greece or Anatolia tend to focus upon the contribution of individuals, almost always women. In many cases early production has been labelled as specialised and/or early potters have been considered specialists. For example Renfrew has stated that "even the simplest Neolithic village economy favoured the existence of casual and part-time specialists" (Renfrew 1972:340, cf. 1973:217; cf. similar remarks of Gallis 1996:34). Likewise for Anatolia Moore has argued that "potting was done by a number of people who probably resided in separate households. These potters possessed particular knowledge and skills and so may be regarded as specialist craftsmen, like other skilled artisans in the same community" (Moore 1995:46).

Vitelli has argued in more detail that even EN ceramic production was in the hands of individual female specialists, who were also healers or diviners (shamans), who nevertheless produced within individual households (cf. Vitelli 1995; Perlès & Vitelli 1999:102). Vitelli arrives at this conclusion through an argument which takes account of the transformative associations of fire, the potentially high symbolic value of early ceramic vessels and a perceived overproduction of pots at Franchthi (Vitelli 1993a:210; Perlès & Vitelli 1999:102). Since the total number of pots consumed at Franchthi in any single year is estimated as extremely low (c.12-13 pots/year) and since these vessels are considered to be the total output of five different local producing groups, the total output from each producing group must have been even lower, that is well within the capability of a single potter. This suggests a somewhat paradoxical³¹ situation, where local demand for pots was very low but nevertheless sufficient to support the consistent maintenance of five different producing groups/potters. Unfortunately further archaeological evidence in support of this hypothesis is lacking. Vitelli has also argued for specialisation in the context of MN 'Urf ware'; the shapes of which are said to be "sharply angular, with frequent contour changes, and added bases or high pedestals" and are thus considered "high-risk shapes, elegant and showy, difficult to build and even more difficult to fire successfully in the potter's initial fire" (Vitelli 1993a:215-6). In this way Vitelli argues that the producers of MN 'Urf ware' were highly skilled potters, who sought to compete with each other through innovation, experimentation and risk-taking. In contrast for LN, Vitelli has argued that production moved from the hands of specialists to non-specialists (Vitelli 1993b:252). This hypothesis of LN non-specialisation has been recently criticised and rejected by Kalogirou, who argues that LN and FN pots required as much skill and labour investment as EN-MN vessels (Kalogirou 1997).

Unfortunately, this sort of argumentation is disputable and cannot be considered to be a reasonable basis upon which to make an identification of specialisation. As has recently been emphasised regarding the general pursuit of craft specialisation in the context of the prehistoric Aegean: "we need to move

³¹ Equally surprising, is the absence of any further exploration or critique of this paradox.

beyond simple inferences that because processes are complex or products are finely produced, ceramic production was specialised. Both of these types of assessment are extremely difficult to justify, especially in the absence of detailed comparative ethnographic and experimental models. The dichotomisation of specialisation as against household production also over-simplifies a complex range of different production patterns and contexts." (Whitelaw et al. 1997:266). In this way previous identifications of Neolithic ceramic production organisation as specialised must be considered problematic. Many appear to make unwarranted assumptions regarding the basic ability of the 'average Neolithic potter'; all fail to justify their identifications through the use of 'detailed comparative ethnographic and experimental models', such as the DMP. In this context it is worth noting that Perlès has recently expressed doubts that the "EN production of pots can be classified as craft specialization within the traditional economic definitions" (Perlès & Vitelli 1999:101).

Thus in later chapters this thesis will attempt to explore ways in which specialisation and production organisation can be studied, both in theory and practice, before the employment of a comparative framework within which certain features of ceramic production might be situated (see Chapters 3-5). As a preliminary to this, however, it may be remarked that the idea of EN individual or household specialists appears to stand in direct contradiction of any ideal of communality and communal sharing, not only because they give individuals or households particular economic and social power, but also because it is hard to see how an emphasis on the individual could be accommodated within an ideology of the collective (see Section 4.4). In addition specialisation could be argued to represent a form of economic intensification which is out of place with evidence for the organisation of subsistence or craft production (cf. shell bead production at Franchthi discussed in Chapter 4). Some of these apparent contradictions will be explored further in Chapter 11. Early craft specialisation has been identified for other artefacts/materials and it has even been suggested that different forms of organisation accompanied the production of different artefacts in different materials (see Perlès 1992). The apparent contradiction between this conclusion and Sahlins' comment that competition (social, political) in early societies was

played out not in production but in consumption and exchange will also be explored. Finally, since some scholars have identified craft specialisation in Palaeolithic societies and have even claimed that "specialists' have always existed" (Perlès & Vitelli 1999:96), Chapter 11 will also try to understand what is actually so special about specialisation.

2.3.3 The Function of Early Ceramic Containers in Greece, Crete and Anatolia

2.3.3.1 Cooking

Vitelli has argued convincingly that ceramic vessels could not have been used for cooking until late in MN (see Vitelli 1989:22-4, 1993a:213-5). The exteriors of earlier EN and MN vessels show no sign of having been in contact with direct sources of heat. Interestingly some sherds from these earlier deposits have sooty deposits on their interiors, which may indicate the use of some form of indirect heating. However, some caution should be maintained since sometimes these soot marks extend over the breaks, i.e. the sherds burnt after breakage, which admits the possible involvement of post depositional processes. A similar situation seems to prevail at EN Nea Nikomedeia and MN Makri. Yiouni notes that although research on cooking pots suggests the benefit of using inclusions with a low coefficient of thermal expansion, such as feldspars, and although there are fabrics at both sites which appear well-suited for the manufacture of cooking vessels, there nevertheless appears to be little or no conclusive evidence to suggest that vessels produced at either site ever had any direct contact with fire (Yiouni 1995:620, 1996b:190).

Vitelli explains this failure to use pots for cooking as evidence for the persistence of pre-ceramic or Mesolithic methods of cooking, which presumably made use of other containers such as skins, wood, basketry or perhaps relied on pit cooking (Vitelli 1993:215). In this context it is perhaps worth noting the discovery in Aceramic levels at Argissa (Thessaly) of "large quantities of river pebbles which had been subjected to repeated heat and are believed to have been heating stones used in cooking" (Weinberg 1970:568). Weinberg also notes that there was no evidence from the site for the use of stone cooking vessels and thus the vessels used for cooking must have been in some sort of perishable material.

In contrast, Moore has argued that in Anatolia early ceramics performed a range of functions, one of which was cooking (Moore 1995:47), in support of which he mentions hole mouth jars with traces of soot on their exteriors. For Crete Furness has argued that the shapes of large coarse vessels at all times appear more suitable for storage than cooking (see Evans 1964:196).

2.3.3.2 Storage

The storage hypothesis is a popular one, largely because household storage within an agricultural economy is generally considered crucial to the maintenance of livelihood (cf. Halstead 1989:71). Thus for Anatolia Moore argues that early coarse wares may have been used to store foodstuffs, while some would have been technically capable of holding water (Moore 1995:47). Likewise at MN Makri, storage is considered to be one of several likely functions for early ceramic vessels (Yiouni 1995:620).

However, Vitelli has demonstrated that there are serious problems with the storage hypothesis as it stands (see Vitelli 1989:26-7). By combining an estimation of the total amount of grain required to sow one hectare, with the range in volume of EN vessels from Franchthi, Vitelli calculated that 30-65 bowls would be required at a time when she estimates that annual consumption for the whole site was 12-13. Also significant is her conclusion that there were no truly large vessels at Franchthi during EN-MN (Vitelli 1989:27). Thus while storage remains a possible function of ceramic vessels, it cannot have been their primary function (see Section 4.4.1). Vitelli's conclusions are echoed by Yiouni, who in a separate calculation for EN Nea Nikomedeia, concluded that "the storage capacity of the Nea Nikomedeia pots was not enough for the annual crop production" and that "containers made from perishable materials and/or storage pits were also used" (Yiouni 1996b:192). The first dedicated ceramic storage jars gradually come into use during the course of the Greek LN (Cullen & Keller 1990; Perlès 1992:144).

2.3.3.3 Display/Serving

This is the most favoured interpretation of how earlier Neolithic ceramic vessels were consumed. For Anatolia, Moore has argued that much of the earliest

pottery consists of fine 'tableware' (Moore 1995:47). For Greece Halstead has argued that the investment of time and skill in the production of fine tableware³² emphasises the importance and formality of acts of commensality (Halstead 1999:80). Vitelli too suggests that the majority of vessels would have been appropriate as serving vessels on public occasions or ceremonies of social negotiation, which involved feasting (1993a:215-6): relative paucity of closed shapes and of cups or goblets, which prompts her to speculate that liquids may have been served in non-ceramic containers. In addition some shapes, such as Greek MN pedestalled bowls seem to have been designed specifically to display their contents (Vitelli 1993a:215-6). Vitelli has even gone so far as to suggest that different ceremonies called for different pots made from different ingredients with different surface appearance (and different makers), however there is no evidence to suggest that modern archaeological fabric divisions correlate with different patterns of ancient consumption.

In general accounts of consumption tend to emphasise that early pottery performed a variety of functions (cf. Moore 1995:47; Yiouni 1995:620; 1996b:185). Certainly early ceramic vessels could potentially have been used for a wide range of tasks involving serving, storage and perhaps occasionally cooking (indirect heating). However of these three, storage and cooking seem to be under-represented and may constitute secondary or rarer uses than serving/display. Many large EN-MN vessels appear to have large diameters but are not particularly deep (unlike a Bronze Age pithos), a design which seems to facilitate shared access to the contents of the vessel; other smaller bowl, mug and cup types would work well as the eating/drinking shapes of individuals.

2.3.4 Changing Levels of Consumption and the Value of Early Ceramic Vessels

Two recent attempts to estimate the level at which the earliest ceramic vessels were consumed have both concluded that in the earliest phase of ceramic use in Greece relatively few ceramic vessels were in circulation at any one time. Thus for EN Franchthi Vitelli has estimated that 12-13 pots per year were

³² As noted by Sherratt (1991), the presence of flat bases on many early vessels implies the existence of flat surfaces - literally tables - upon which they could stand.

consumed over the entire site, while for EN Nea Nikomedeia Yiouni has produced a higher estimate of 25-90 pots per year over the excavated area (Vitelli 1989:26; Yiouni 1996b:181-5). By combining this with the evidence for high labour investment in production Vitelli has argued that even these small quantities of pottery levels were probably valued, possibly because "their scarcity, novelty, and perhaps function might well have made them precious" (Vitelli 1993a:39).

This hypothesis seems plausible, although one might note in passing that it is hard to reconcile the idea that early vessels were highly valued with an insistence that they were nevertheless not exchanged between communities (cf. Vitelli 1989). It is equally hard to reconcile Moore's conclusion that it was the 'functional potential' of early pottery in Anatolia which contributed to its early development (Moore 1995:48) with his earlier suggestion that fine wares were exchanged between sites because of their desirability (Moore 1995:47). Moore goes on to draw an explicit contrast "between the essentially practical role that early pottery served in Western Asia and the symbolic and social importance that Vitelli has ascribed to the earliest pots at Franchthi Cave in Greece." (Moore 1995:48). Although regional differences in consumption seem more than likely, the contrast here seems rather to be between different archaeological interpretations³³: Moore describes the earliest Anatolian contexts of ceramic-use as containing 'few potsherds' (Moore 1995:48), a situation actually very similar to that for EN Greece. This example further emphasises the necessity of prioritising issues of data interpretation.

2.3.5 Early Ceramics and Other Non-Ceramic Containers

Some time ago Childe suggested that the earliest pots were imitations (skeuomorphs) of vessels made from natural forms such as gourds, bladders, skins, baskets even human skulls, and that the earliest decorations helped to reinforce connections between ceramic vessels and earlier materials (Childe 1981:86). This comment has recently been echoed by Rice, who notes that in many areas of the world the earliest pottery mimics the shape of containers made

³³ Other interpretations of the same evidence have been offered. For example Goren et al. (1993:33-40) have argued that the earliest Neolithic pottery in the southern Levant had a dual functional-symbolic role with decorated fine pottery serving a ritual function.

from other, usually perishable materials: gourds are particularly favoured, but similar forms (skeuomorphs) have been noted, such as birchbark bags, animal skin bags, baskets and soapstone bowls (see Rice 1999:7). In addition, as noted by Vitelli, the low numbers of early vessels in circulation and their limited or non-use in cooking and storage, demands the continued production of a range of containers in perishable materials. Thus the ongoing relationship between ceramic containers and other container types cannot be ignored and should play a part in studies of ceramic consumption (see Section 13.4).

Summary

Studies of Neolithic ceramics should provide a unique and clear perspective on how the Neolithic economy worked, however at present there exists instead considerable confusion and contradiction. Detailed ceramic studies continue to affirm that ceramic production was conducted by the household for the household with almost all production local to the place of consumption. However more general syntheses have long stressed the importance of exchange. It was argued that detailed studies of ceramic assemblages struggle to recognise examples of ceramic exchange for two reasons one methodological, one theoretical. Early ceramic studies which rely purely on observation of form and finish are likely to struggle to identify imports in situations where regional zones of stylistic similarity are large and the range of forms and finishes limited. Studies that also observe variation in fabric always identify considerable variation in fabric within single site assemblages and this would seem to be a more promising methodology through which to identify examples of ceramic exchange. Unfortunately, however, variation in fabric is almost always interpreted in terms of local production, even in those cases where the case for non-local production and thus exchange seems hard to deny (e.g. 'Andesite Ware' at EN Franchthi; see Chapter 11). Such examples raise the issue of interpretation and moreover suggest the influence of a conceptual barrier, forcing studies to interpret scientific data in terms of what might be acceptable rather than what it might actually imply. Thus, at present most ceramic studies simply affirm with no great conviction an old

formulation of the Neolithic household and Neolithic self-sufficiency, at a time when more general syntheses favour one which emphasises the importance of exchange (i.e. the DMP).

In this chapter exploration of this important contradiction has revealed a series of problems not only in how ceramic variation is characterised, but also in how this characterisation is then interpreted. In order to seek a solution to this contradiction, the exploration, characterisation and interpretation of ceramic variation will form a central part of this thesis. Since ceramic diversity would appear to be a feature of all Neolithic sites (Vitelli 1989:20; Yiouni 1995:619), the EN assemblage at Knossos provides an ideal opportunity to explore some of the issues and contradictions raised in this chapter. For example petrographic study of fabric should be able to demonstrate whether this assemblage is entirely locally produced, as Furness and Evans have suggested, or whether at least some vessels could have been produced elsewhere.

Detailed characterisation of ceramic variation will also allow some of the other, more long-standing research questions to be addressed.

(1) *The Adoption of Ceramic Technology:*

How should we explain the appearance of ceramic technology on the western, eastern and southern margins of the Aegean at approximately the same time? How should we model this process of invention and/or adoption? Did the introduction of ceramic vessels really revolutionise the processing or storage of food? Does the introduction of ceramics testify to competitive feasting or resource intensification?

(2) *The Organisation of Early Ceramic Production:*

Was ceramic production really restricted and specialised from the very moment of its introduction into the Aegean? How was early ceramic production organised? Was it an individual, high-status or specifically gendered pursuit?

(3) *The Consumption of Early Ceramic Vessels:*

How were early ceramic vessels consumed? How were early ceramic vessels and ceramic technology valued? What was the relationship between ceramic and non-ceramic containers?

Finally and in addition to these more general issues, re-study of the EN assemblage at Knossos offers the opportunity of addressing more specific issues associated with the interpretation of EN Knossos. As noted above, previous studies of EN ceramics have consistently identified and emphasised homogeneity in vessel form and finish over this long ceramic phase (EN = c.1500 years; see Appendix I). These studies have used this conclusion to infer the existence of technological homogeneity and have consequently identified only one (limestone tempered) fabric. As a consequence more general studies of Neolithic Crete have consistently emphasised Knossos' isolation, not only from the rest of the island but also from the rest of the Aegean; some have even claimed that Knossos was the only permanent site on Crete at this time (see Section 12.1 for further discussion of the Knossian Isolation Hypothesis

CHAPTER THREE

THE SOCIAL SIGNIFICANCE OF MATERIAL CULTURE

3.1 Production, Consumption, Exchange

Production, consumption and exchange provide three different perspectives on the human relationship with the material world and as such subsume an enormous range of activities involving people and objects. As archaeologists we tend to divide different activities into each of these three categories: for example acts of manufacture or technical acts are production, acts of use are consumption, acts of giving and receiving are exchange. However, it is too easily forgotten that this division is largely an analytical convenience and the imposition of a division of activities, although high-lighting important differences, actually obscures the close relationship between these three types of activity; after all no activity can ever truly take place in isolation from another. What links these three analytical abstractions are social practices and it is the nature of their articulation that is central to any enquiry into production, circulation and consumption. In this way the entire flow of this thesis is directed towards the elucidation of the changing nature of the relationship between certain people (inhabitants of Crete) and certain things (ceramic vessels) during a certain period of time (Early Neolithic). Put in these simple terms, the boundaries between our archaeological classification of activities into production, consumption and exchange dissolve and what becomes more important is an understanding of the social significance of material culture.

3.2 Style, Technology, Function:

Past Approaches to the Social Significance of Material Culture

One way to begin thinking about this is to consider some of the ways in which archaeologists have previously sought to understand the social significance of material culture. Exhaustive coverage of all areas of debate within such a general topic would be neither appropriate nor possible within the confines of this thesis. Rather the discussion will address only those issues considered necessary and relevant to the current enquiry. More specifically, this section aims to understand and critique some of the ways in which ceramic studies have

understood (or failed to understand) the social significance inherent in material acts. It is hoped that in the process this discussion will provide some practical illustrations of the relationship between people, values and objects.

For quite some considerable time the relationship between people and material culture was understood in terms of three separate components, technology, style and function (e.g. Braun 1983; Bronitsky 1986; see discussion in Dietler & Herbich 1998:236-244). Technology was viewed as external to and separable from the social sphere; those studies which did address the relationship between the technological and the social tended to study either the *effects* of technology on society or what messages technological behaviours might be communicating (Lemonnier 1993:2). The reasons for this separation are not hard to find: past approaches to ceramic technology have tended to view technology, with environment, as acting as powerful constraints on the ability of potters to exercise choice (e.g. Matson 1965; D. Arnold 1985). These constraints are assumed to take three different forms (Gosselain 1998:80):

1	Ecological: - climate enforces changes in scheduling, tools and facilities (e.g. Rice 1987:315-6); - physical/chemical properties of raw materials demand specific processing techniques (e.g. D. Arnold 1985:20-32); - fuel availability promotes or hinders certain firing technologies (e.g. D. Arnold 1985:214; P. Arnold 1991:59-60);
2	Material: - the difficulty of transforming clay raw materials into finished vessels effectively limits the potter to a single production sequence: choices made at one stage of production condition the choices available at other stages.
3	Functional Optimisation: - since ceramic vessels have a range of functions, such as liquid storage, cooking, serving, they are thus subject to a variety of stresses, such as thermal shock or abrasion, which necessitate that different vessels have different physical properties, such as waterproofing or thermal conductivity. The need for functional optimisation is therefore considered to be a guiding influence over various stages of production, from raw material selection, to vessel forming or finishing (e.g. Braun 1983; Bronitsky 1986).

Figure 3.1 Supposed Ecological, Material, Functional Constraints on Ceramic Production

(after Gosselain 1998:80)

With such an array of constraints on their action, potters appeared not to have the ability to exercise choice. This denial of choice effectively wrested control over key stages of the production process out of the hands of potters, making technological decisions appear passive and predetermined by natural (material, ecological) or functional criteria (Van der Leeuw 1993:238-9; Gosselain 1998:80-1; Livingstone Smith 2000:21). This denial of the possibility of human agency led to ceramic studies which emphasised description of technology over its explanation (Van der Leeuw 1993:239). It has even been argued that ceramic technology might be better studied within a framework derived from materials science and engineering than anything that archaeology or anthropology could provide (Kingery 1987:99). In this way with social aspects of technology excluded it became possible to "build a discourse much closer to that of hard science and... draw universal laws of interpretation" (Livingstone Smith 2000:21).

In contrast to technology, style was considered to have a significant social component. Thus, for example, in her examination of the relationship between ceramic style and ceramic technology, Wright argued for a distinction between the two, describing style as the "transmission of traits with specific cultural meanings" and technology as the transmission of traits "that are culturally-neutral" (Wright 1985:23). In this way style came to be defined rather negatively as those aspects of material patterning which remain after function and technology have been accounted for; in this way ceramic style came to be viewed narrowly in terms of variation in form and finish (Dietler & Herbich 1998:237). Despite this narrow definition, style itself has been understood in a variety of ways, as passive reflector of social behaviour and social values, as a cost effective communication device or as an active tool in strategies of social action (see discussion in Dietler & Herbich 1998:238-44; Dietler & Herbich 1994:460-1).

The category of function was generally viewed in similar terms to technology, in that it referred to techniques or objects which were considered utilitarian or 'culturally-neutral', in other words activities or things for which a social function could not be claimed. Thus, Dunnell defined function as "manifest in those forms that directly affect the Darwinian fitness of populations in which

they occur" (Dunnell 1978:199 quoted Miller 1985:52-3), i.e. function was seen in evolutionary terms as part of adaptation. While definitions of style tended to vary, they all tended to have the general sense of that which relates most closely to social or cultural factors, with the result that style tended to be defined negatively and narrowly in terms of what remained after the apparently non-social categories of technology and function had been accounted for (Dietler & Herbich 1998:237). Thus, in ceramic studies style tended to be sought in only the most obviously manipulable stages of ceramic production and became practically synonymous with decoration: after all meaningful variation or style could only reside in those few areas where the potter was considered able to exercise choice between equally viable alternatives³⁴. In this way a view of cultural choice was emphasised which saw it as a superficial or surface phenomenon.

This view of technology, style and function, despite its enduring popularity (e.g. D. Arnold 1985) has actually proved to relate very poorly to what is known about actual situations of pottery production and consumption (Livingstone Smith 2000:22). For example:

"Virtually all known prehistoric techniques of pottery-making, and most ethnographically-observed ones, have a rather wide tolerance for the clays and other raw materials, so that almost any of those techniques could probably be implemented almost anywhere, if need be by introducing a few minor modifications... *The non-availability of the appropriate raw material(s) turns out to be only very rarely the limiting constraint in the manufacture of pottery*" (Van der Leeuw 1993:239).

This *potential* freedom to act has been well illustrated by Van der Leeuw's exploration of the relationship between technique and form, in which it becomes clear that ceramic traditions, whether ethnographic or archaeological, can achieve the same basic form (e.g. globular pots) by employing a variety of basic techniques, from paddle and anvil to coiling, in an even greater variety of combinations (Van der Leeuw 1993; see also Gosselain 1998:87-91). When the sequence of actions, which make up a particular forming tradition, are subject to detailed analysis, it becomes clear that no two traditions are perfectly identical.

³⁴ cf. definitions of style in terms of conscious choice in David et al. 1988.

1	Controlling the shape of the vessel: 'a dynamic equilibrium between potter and material';
2	Avoiding collapse/deformation;
3	Keeping vessel in a fixed position;
4	Maintaining access to different parts of the vessel;
5	Speed with which vessels can be completed: how many interruptions required?
6	How great a range of shapes can be made using the same basic forming method?

Figure 3.2 Some of the Major Constructional Problems Posed By Forming (after Van der Leeuw 1993:243)

Thus the basic problems posed by forming (see Figure 3.2) can be solved by a wide range of different techniques (Van der Leeuw 1993:256; Mahias 1993:157-65). The acknowledgement of this potential range of available options restores the crucial elements of choice and control back to potters, revealing them to be *active* employers of different techniques of production, not passive components of ecological and material determinism. Thus within certain ecological and material limits potters enjoy considerable room for manoeuvre and this manoeuvring would appear to be socially informed. This resurrection of human agency is critical to a more meaningful appreciation of technological change: change no longer need be viewed as a simple human response to changes in subsistence or local ecology.

These practical examples also force a reconsideration of the relationship between technology, style and function. Style, if located wherever there is a potential choice between equally viable alternatives, actually emerges, not as a separate category confined simply to decoration, but as a fundamental feature of both technology and function. Thus previous attempts which seek to form discrete categories of style, technology and function have more recently come to be viewed as misguided (see especially discussions by Dietler & Herbich 1989; 1998:236-244; Gosselain 1998:81-3; Lemonnier 1993:10-11; Pfaffenberger 1992:502-7) or even meaningless (e.g. Latour 1993), although, it has been suggested recently that provided the limitations of these distinctions are borne in mind, they may nevertheless retain an analytical usefulness (see Lemonnier 1993:10).

Regarding style, however, Lemonnier's optimism seems misplaced; in their review of archaeological approaches to style, Dietler and Herbich note that "style has a variety of meanings for archaeologists, although these are often somewhat ambiguously treated and are rarely very clearly or consistently defined" (Dietler & Herbich 1998:237; 236-44). Style therefore means different things to different people, who inevitably identify it and interpret its significance in different ways. This ambiguity may misdirect interpretation. Consequently within this thesis, unless appropriate to the presentation of previous scholarship, a conscious attempt will be made to avoid using the term style whenever a more accurate term is available: for example the characterisation of certain forms of vessel variation as stylistic (e.g. decoration) will be eschewed in favour of labels which are less resonant, but more specific and descriptive (e.g. form, finish).

The concept of function as 'culturally-neutral' Darwinian adaptedness has also suffered when exposed to critical examination (see Pfaffenberger 1992:494-502). Miller has elegantly demonstrated that the range of forms produced by Dangwara potters in India, although divisible into different functional categories, such as cooking, serving, liquid storage/transfer etc., cannot simply be explained as satisfying the demands of ecological necessity or functional optimisation (Miller 1985:54-74). While some 'specific' forms, such as the *chhapa* (ritual pot) or the *nagara* (musical pot) seem to perform their tasks well enough, others such as the *divaniya* (oil lamp) seemed less well-designed:

"If the *divaniya*, used almost entirely as an oil lamp, is compared to lamps in other regions, it is found to possess neither elongation, nor partial closure, nor any form of provision for the wick. Indeed the wick was often observed to slide beneath the surface of the fuel and extinguish itself" (Miller 1985:57).

A similar lack of efficiency can be seen in other forms more closely associated with subsistence, such as cooking pots. Miller notes that although some (e.g. Braun 1983) have argued that the size of vessel orifice, as a restriction at the mouth, should co-vary with frequency of access and the need to secure the contents, in reality Dangwara cooking pots

"exhibit a relationship between function and neck size precisely opposite to what might have been expected. It is the rarely used *jhawaliya*, associated with meat,

that has the largest mouth and neck diameter, while the more commonly used pots have a smaller diameter" (Miller 1985:60).

Miller concludes that the range of forms exhibited by Dangwara pottery does not represent the evolution of forms adapted to their environment (see Miller 1985:64-5). Indeed much observed variability has little relation to the range of functions or to notions of efficiency, rather the wide range of vessels is characterised by a 'massive redundancy' of form. In other words the entire typology could, if viewed purely in terms of functional necessity, be replaced by a couple of basic forms³⁵. As a result it becomes clear that function does *not* constitute a natural, necessary, 'culturally-neutral' environment to which an object is adapted, rather function is dependent upon the *social* creation of that environment through a set of social choices (Miller 1985:54-5; Pfaffenberger 1992:496-502): i.e. functional categories are very much socially-created categories, with biological necessity only serving to set their most extreme limits.

Several points of importance arise from these practical examples. Above all, it would appear that potters enjoy a theoretical range of technological options during the production sequence, from which they actively make choices. These technological choices only partly relate to environmental/material conditions and should rather be viewed in terms of a 'mediation' between social factors and material or ecological demands (Lemonnier 1993:10; Van der Leeuw 1993:261). This perspective on technology is very much that of the French 'Techniques et Culture' school, which, through the development of an anthropological perspective on technology, stresses that techniques are first and foremost social productions:

"Any technique, in any society,... be it a mere gesture or a simple artefact, is always the physical rendering of mental schemas learned through tradition and concerned with how things work, are to be made, and to be used...

But the logic and coherence of this technological knowledge... are not related solely to the physical phenomena that are set in motion by a given technique... In short, the mental processes that underlie and direct our actions on the material world are embedded in a broader, symbolic system" (Lemonnier 1993:3).

³⁵ This redundancy in form only further increases when one considers the range of forms also available in non-ceramic media, such as metal or glass (Miller 1985:65-7).

A similar view can be found in the work of Lechtman:

"In asking what is the cultural component of technology, we are also asking what can technology tell us about culture? We must be concerned not only with the bodies of skill and knowledge..., not only with the materials, processes, and products of technology, but also with what technologies express. If we claim that technologies are totally integrated systems that manifest cultural choices and values, what is the nature of that manifestation and how can we read it?" (Lechtman 1977:3-4).

Both these approaches stress that techniques and technological choices are not merely governed by a mediation of material considerations and social factors, but support and in turn are supported by 'culturally accepted rules' or 'mental schemas' 'embedded in broader symbolic systems'; in other words technologies are embedded within an underlying set of social values (Lechtman 1977:10; Dobres & Hoffman 1994:218). The consistent re-enactment of these systems of values through acts of production (and it should be said also through acts of consumption and exchange) thus provides meaning and structure for the actors involved and may also similarly structure other technologies practised within the same social context³⁶: in this way "technological acts, whether mundane or spectacular, are a fundamental medium through which social relationships, power structures, worldviews and social production and reproduction are expressed and defined" (Dobres and Hoffman 1994:212).

In a similar way to technology, function can be more accurately characterised, not as pure environmental adaptation, but as a set of socially-constructed categories formed by the exercise of choice (Miller 1985). Like technology these choices may be viewed as a mediation between social factors and biological, ecological or material necessity. Thus, for example, indiscriminate applications of utilitarian/non-utilitarian distinctions to ancient material culture may now be seen as misguided, since these are functional distinctions constructed in our world and are not necessarily applicable to those of the past (for Aegean Neolithic examples cf. Perlès 1992; Perlès & Vitelli 1999). Likewise, attempts to

³⁶ Dobres & Hoffman (1994:218) cite as an example of this Lechtman's detailed study of pre-Hispanic metallurgy, which in its final interpretation made links to key cultural and ideological values and demonstrated the existence of similar set of structuring principles.

demonstrate that ancient potters were necessarily guided in the selection of raw materials by a desire to optimize functional performance may also be misguided (see Chapters 4, 5).

These basic points together reveal something fundamental about the social significance of material culture. If producers and consumers of material culture can be recast as active agents making socially-informed decisions about how to produce and use objects, then it becomes clear that the social significance of these objects resides not so much in the 'style' of the objects themselves, but in the ways in which they reveal human choices made during activities of production, consumption or exchange³⁷. The recognition of this important distinction between objects and techniques - defined as "those human actions that result in the production or utilisation of things" - is of the utmost analytical and methodological importance, principally because it highlights the crucial importance of techniques in the relationship between people and things, but also because techniques can be archaeologically comprehended via the study of the objects themselves and the contexts in which they were produced and consumed (Dietler & Herbich 1998:235-6; Chapter 5).

3.3 Habitus and Material Culture

Several recent studies, all concerned in some way with the relationship between material culture and society, have independently argued that the interactive nature of this relationship between material activities (whether acts of production, consumption or exchange), systems of values and people, can be best understood within a framework derived from Bourdieu's theory of practice (Miller 1985:11-2; Dobres & Hoffman 1994:214; Dietler & Herbich 1998:244-8; cf. Bourdieu 1977). Bourdieu has argued that over time people develop 'dispositions' to act in certain ways through the influence of the material and social conditions

³⁷ This broader more socially-contingent view of technology has been discussed in more detail elsewhere (see Dobres & Hoffmann 1994; Lemonnier 1993; Pfaffenberger 1992; Van der Leeuw 1993) and has been applied to ceramic technology (see Gosselain 1998; Livingstone-Smith 2000; Sillar 2000). It should be noted, however, that this perspective has not yet achieved widespread acceptance in ceramic studies and examples can be still found of what Livingstone Smith has termed the 'techno-functionalist approach' (e.g. O'Brien et al. 1994; see Livingstone Smith 2000:22; Gosselain 1998:79).

(structures) within which they live (see Bourdieu 1977:72-95). These "systems of durable, transposable dispositions", or what Bourdieu has called *habitus*, act as

"structured structures predisposed to function as structuring structures, that is as principles of the generation and structuring of practices and representations which can be objectively "regulated" and "regular" without in any way being the product of obedience to rules" (Bourdieu 1977:72).

In other words these 'systems of dispositions' (*habitus*), which structure future activity, are themselves constructed through the influence of past material and social conditions on past actions. *Habitus* is therefore a system of practical knowledge and may be described as a "practical evaluation of the likelihood of success of a *given action* in a *given situation*... [which] brings into play a whole body of wisdom, sayings, commonplaces, ethical precepts ("that's not for the likes of us")" (Bourdieu 1977:77 my italics). Thus *habitus* not only defines what actions are possible within a given situation, what Bourdieu calls the "objective potentialities in the situation", but is also very much defined by past actions in past situations: i.e. "in short, the *habitus*, the product of history, produces individual and collective practices, and hence history, in accordance with the schemes engendered by history" (Bourdieu 1977:78, 82).

In this way one can see how *habitus*/practical knowledge exists in a dialectical relationship with action and situation. As Bourdieu has put it,

"the virtuoso finds in the *opus operatum* new triggers and new supports for the *modus operandi* from which they arise, so that his discourse continuously feeds off itself like a train bringing along its own rails"(Bourdieu 1977:79).

The dialectical aspect of this arrangement is crucial. If one ignores it then one reduces the relationship between the different social agencies "to the logical formula enabling any one of them to be derived from any other" (Bourdieu 1977:83). In this way actors are not reduced to mechanistic schema where practice is viewed to be determined by antecedent conditions, but nor can they be reconstructed as far-sighted infinitely creative manipulators of their own action operating in an utterly free-willed manner. Rather actors operate within a "system of objective potentialities, immediately inscribed in the present, things to do or not to do, to say or not to say, in relation to a *forthcoming* reality, which... puts

itself forward with an urgency and a claim to existence excluding all deliberation" (Bourdieu 1977:76). Thus individuals act within their own terms and in accordance with their hitherto accumulated wisdom. In this way practice theory allows one to view the relationship, whether in activities of production, consumption or exchange, between the choices made by individuals, the actions which result and the material and social conditions within which these choices and actions take place.

Another important aspect of habitus is that it generates patterned activities which appear to be consciously regulated, but whose performance is largely subconscious, since the 'orchestration of habitus' produces a natural common-sense world 'endowed with objectivity' (see Bourdieu 1977:79-80): habitus action is habitual action. However, although this world is subconsciously constructed and reconstructed by individuals, the circumstances of its constitution, including practical knowledge, are shared with others, so that one might talk of a 'homogenising' of habitus: that is one that is shared by others, who have acquired practical knowledge in similar circumstances operating within similar material and social environments.

It is in fact this subconscious element of habitus which is so important to the study of past actions from material remains. Since such material action is habitual or unconscious it appears to be entirely natural and beyond question; as Bourdieu has put it "it goes without saying because it comes without saying" (Bourdieu 1977:167). However since even at this habitual level material action reproduces social values and social relations, these processes of naturalisation and socialisation conceal a potentially rich source for the study of the reproduction and transformation of social values and relations (cf. Miller 1985:11-12, 67, 191-3). Indeed it has been argued that realisation of this undermines the validity of anthropological studies which base their conclusions solely on what people say about their objects, rather than including also what the objects say about the people (Miller 1985:197-8)

3.3.1 The Material Basis of Habitus: Knowledge, Memory, Objectification

Through its emphasis on the learning process, practice theory provides the key to understanding the social significance of material culture (see Bourdieu

1977:87-95). People acquire practical knowledge (*habitus*) about the material world through their practical experience of it. The very re-constitution of this material world relies on the success of this learning process: the world of objects not only frames future action, but is also at the same time constituted by it. For example, when we enter a room, its contents and their arrangement provide us with information as to how to behave. In this way we are socialised by our material surroundings, which we ourselves have created (see Gosden 1994:10-12; Miller 1985:204-5).

This practical knowledge of the material world is not randomly acquired but is structured by social systems of classification which have their own internal logic or rationale. Successful acquisition of practical knowledge therefore relies on the observation of this *rationale* behind actions (Bourdieu 1977:87-8). In this way "techniques are first and foremost social productions" (Lemonnier 1993:3) because they are formed through the *habitus*, that is they are learnt socially, both through observation of their performance by others and through practical attempts to reproduce them by the learner (cf. Dietler & Herbich 1998:246). The reason that techniques appear to be embedded within broader systems of 'cultural values' is because these social systems of classification provide the rationale or internal logic behind these actions. Thus the key to understanding acts of production, consumption and exchange is an awareness of the potential social values or social systems of classification which might structure such activities and simultaneously be reproduced by them (see Chapter 4). For example acts of production may be organised in different ways according to different values. If one can characterise in detail how production is organised then one should be able to glimpse the principles and values which underlie it.

In his study of potters in southern Cameroon Gosselain demonstrated that of the different stages in the manufacture of ceramic vessel, only forming methods show any correspondence to social boundaries (see Gosselain 1998:91-9)³⁸. This correspondence was explained by detailed consideration of the learning process.

³⁸ Unfortunately, this connection between social boundaries and forming methods is not so strong in other ethnographic studies and thus cannot be understood to be a 'general' or 'universal' feature of ceramic systems. For example, in his study of twentieth century East Cretan potters, Day has shown that it is not so much forming methods but choice of raw materials which serve to express such boundaries (Day, forthcoming).

In his case study the transfer of technical knowledge occurs in two stages. In the first the apprentice assists the teacher with one of the stages in the production process e.g. procuring and processing raw materials or building the firing structure. In doing so the apprentice learns the materials, the different transformation processes and the taboos to be respected. In other words he learns the rationale behind the production process. The second phase is more formal and involves the learning of methods of forming. Here the teacher will work beside the apprentice pointing out failures and mistakes and may even take the hands of apprentice to demonstrate correct gestures and postures. As a result such techniques become integrated in the apprentice as motor habits. This second stage may take from anything between 2-3 months to even a year before these techniques are naturalised and habitual. In this way the acquisition of technological knowledge, especially in pre-modern societies, is usually significantly more practical than verbal (Pfaffenberger 1992:507-8).

In this way in small-scale pre-modern societies, such as those of the Early Neolithic, it is largely through habitual action that social values and social systems of classification are maintained. One way of understanding this process is to think about time. It has been recognised that modern concepts of time and memory are a product of relatively recent political, historical and economic developments and as such need not correspond to ancient approaches to time and the transmission of knowledge (cf. Shanks & Tilley 1987:118-136). Shanks and Tilley offer a distinction between chronological/abstract time, that is time that is measured and objective, and human/substantial time, that is time that is experienced and subjective (1987:125ff). They argue that the former is confined to modern capitalism, while the latter is a feature of societies outside the capitalist system. In such non-capitalist societies experienced time is on a human scale, not purely successive and potentially looking both forward and back.

This cyclical form of time has been described by Zimmerman as:

"sacred, with traditional peoples seeing it as periodically regenerating itself *ad infinitum*. Truths were revealed in mythical times, specifically at creation.. The aim is thus to arrange one's life so that these sacred acts can be experienced as often as possible. By executing an act as it was done originally, with the ritual

passed down faithfully from generation to generation, one can actually project oneself into that 'same primordial mythical moment'" (1987:44).

Communities which view time in this way pass on knowledge in quite different ways to our modern chronologically-driven society. Rowlands has drawn a useful distinction between modern memory systems, which tie memory to linear conceptions of time, where knowledge can be seen as a sequence of events traceable back through time, and memory systems which are objectified in the production and consumption of objects (Rowlands 1993:149-50). Under the latter system production (and consumption) may be seen as a deliberate act of recreation, dynamically linking present with past via the reproduction of past knowledge and techniques, situating the producer in a timeless state which is at once past, present and future. In this way such acts of production reflect a desire to emphasise common memory, ancestry or ownership. Objects thus produced are therefore very much defined and determined by knowledge and techniques resulting from past acts of production; however such objects are also the means by which this knowledge and these techniques are reproduced and themselves will form the past models for future acts of production. Objects are therefore neither passive nor conservative in the way they reflect traditional forms of knowledge, but *active* because the activities behind their production and consumption allow traditional forms of knowledge to be reproduced, contested and re-defined, dynamically linking past and present as well as directing future activity (cf. Miller 1985:204-5).

A good example of how objects objectify values, ideas or even people is provided by the work of David et al. among the Mafa and Bulahay of northern Cameroon (see David et al. 1988). In their study the decoration of pottery is understood by analogy to the decoration of the person: pots may be assimilated to persons and represent human and other spirits. In this way ceramic vessels become powerful items invested with spiritual powers of protection. As a result they note a clear link between pottery decoration and symbolic structures.

And so, within such societies acts of production (and consumption), along with the artefacts and individuals associated with them, are *the* means through which traditional forms of knowledge are maintained. Individuals alone, however,

do not constitute stable mechanisms for the transfer of knowledge over countless generations. Rather, such individuals are not thinking and acting alone but are operating within a set of ideas and values which exist and are reproduced within human groups. It is therefore the *shared* reproduction of practical knowledge that provides the stable mechanism for its continued maintenance.

3.4 Continuity and Change: Doxa, Orthodoxy and Heterodoxy

The appreciation on the one hand that there are a range of possibilities available to the actor, but on the other that these possibilities are not infinite, but materially and socially restricted, is fundamental to a reconstruction of past action which allows for continuity of practice but which also leaves room for strategic action and importantly change. This modelling of change as arising from the actions of individuals and groups crucially re-locates change from the generalised level of systems and subsystems (see Barrett 1994:2-5, 157-164) back to the level both at which it is effected and, importantly, at which it can be most effectively studied by archaeologists. The material residues of the past more directly represent actions of individuals and groups than they do the interaction of systems and subsystems. Change from a generalised perspective appears as a *fait accompli*, divorced from the actions and choices of individuals. However, when change is viewed in terms of habitus, it becomes clear that it depends upon past perceptions of the possibility for change or innovation and these perceptions are conditioned by habitus as a "matrix of perceptions, appreciations and actions" (Bourdieu 1977:82-3). In this way continuity and change can only be understood within a wider complex social and material context (see van der Leeuw & Torrence 1989:1-14).

One way of thinking about continuity and change is to adopt Bourdieu's distinction between doxa, orthodoxy and heterodoxy (see Bourdieu 1977:159-171). Doxa are beliefs in certain social values which are seemingly 'natural' and uncontested, part of the very fabric of existence:

"doing one's duty as a man means conforming to the social order and this is fundamentally a question of respecting rhythms, keeping pace, not falling out of line... These various ways of reasserting solidarity contain an implicit

definition of the virtue conformity, the opposite of which is the desire to stand apart from others" (1977:161).

Doxa are therefore 'common-sense' social constructions operating at an unconscious level³⁹. In contrast, orthodoxy or heterodoxy implies the "awareness and recognition of the possibility of different or antagonistic beliefs" (Bourdieu 1977:164). Such beliefs are more open to modification and are thus most open to non-conformity and more liable to change. The more fully certain social values are reproduced in the actions of individuals and thus the more stable these values are, then the greater the extent of the field of doxa, i.e. of that which is taken for granted, and the lesser the opportunities for change. Within such societies "the established cosmological and political order is perceived not as arbitrary, i.e. as one possible order among others, but as a self-evident and natural order, which goes without saying and therefore goes unquestioned, the agents' aspirations have the same limits as the objective conditions of which they are product" (Bourdieu 1977:165-6). In this way the potential of a society to change can be seen to be related to the success with which its values are played out in the actions of its individuals. One might argue that one of the reasons for the stability and longevity of earlier Neolithic communities in the Aegean, is the success with which they reproduce the social values which underpin their existence (see Chapter 4).

This perspective on change, which views it not as an event but as a continuous process of reproduction, provides a new angle on the idea of tradition and innovation (see also van der Leeuw & Torrence 1989:1-14). If tradition is defined simply as a shared body of information and practice, then it would seem to equate to shared knowledge, shared values and shared practices, some of which may be doxa, others of which may be contestable. In this way it is wrong to talk of tradition restricting innovation and change. Rather if the potential of a society to change depends on the unconscious performance of its constitutive values through the actions of individuals, then it is those individuals who restrict or promote innovation (cf. van der Leeuw & Torrence 1989:10). In this way, although tradition often appears to be fixed, because it depends on the ongoing

³⁹ Recognition of the existence of this form of belief only serves to emphasise how supposed 'common-sense' archaeological interpretations are more likely to be products of the modern world than any world of the past (cf. Miller 1985:51; Edmonds 1999).

actions of individuals for its reproduction it therefore is always malleable. As a result of this non-innovation - or the deliberate resistance of individuals to change - can be seen to be as dynamic and as interesting as innovation (cf. Sørensen 1989). Furthermore, this perspective suggests that the only way in which continuity and change can be understood is through the study of the material and social context within which the strategic actions of individuals and groups took place (Barrett 1994:3; cf. van der Leeuw & Torrence 1989:7-8, 11-13).

The concept of doxa helps to explain why potters, although theoretically able to employ a wide range of different techniques (see above), tend to remain loyal to whatever sequence of techniques they first learnt or first adopted. As Mahias has noted, once a successful solution to the problems posed by ceramic production has been found "the potter cannot change it and he becomes a prisoner of this solution, which now appears to be the only one possible, the most 'natural'" (Mahias 1993:165). This reluctance to change can be seen to derive from the very habitual nature of these techniques. They are so normal, so natural and therefore produced so unconsciously that they pass into the realm of doxa - that which is uncontested and incontestable.

3.5 Producing Categories

"Pottery exhibits a plasticity and flexibility that does not end with the sheer number of categories created from the clay itself, but is subject to complex manipulation thereafter" (Miller 1985:140).

It has long been understood that the process of classification, whereby we as humans cope with and make use of our surroundings, is always informed by certain aims or problems, however conscious or unconsciously expressed (see Hill & Evans 1972). By grouping similar entities and by relying on the principle that such similarity is not accidental, we are able to solve the problem of, and make sense of, the otherwise bewildering bombardment of information which we receive every second. Classification is thus a fundamental human response; a deliberate way of solving the basic problems posed by everyday existence. At the heart of the whole process lies grouping, where the similarity or difference of different entities is assessed, through an assessment of their different

characteristics or attributes. Since different criteria of selection will produce different groupings of attributes, there can be no such thing as a 'best' or 'universally useful' typology (Hill & Evans 1972:250). This feature of classification helps to explain why the classifications employed by producers and consumers tend to differ. For example within a small sample of producers and consumers of pottery in a modern Indian village, many ceramic forms may be given a variety of names (Miller 1985:41). Previous approaches to style (see above), which viewed style as communicating cultural identity, have generally paid insufficient attention to this important distinction between the social context of production and the social context of consumption and have tended to explain the creation of a ceramic vessel/material style solely on the basis of observations of consumption (see Dietler & Herbich 1994:461-70). However, the use of objects in one context need not necessarily imply the adoption of the system of values, within which the object was originally produced (Pfaffenberger 1992:511-2).

Recognition of the potential variability of social classifications of material culture has prompted archaeologists into adopting a very cautious approach to the types (e.g. ceramic vessel typologies), which they identify in past archaeological assemblages: the order identified by the analyst is usually not considered to have necessarily had any sort of past significance (cf. Hill & Evans 1972). However, this has recently been seen as an unnecessary retreat into relativism, engendered to a large extent by a failure to situate human agency and social values at the heart of processes of social reproduction (see discussion in Barrett 1991:202-3). As Miller has argued, "producers cannot be disestablished as the creators of the order under study and such order cannot be reduced merely to the hypotheses of the analyst" (Miller 1985:10-11, see also 50, 169-70; cf. Barrett 1991:201-4).

In other words, acts of production *create and recreate order*, order which is not natural or timeless, but social and contingent. In this way production of material culture can be reconsidered as the production of material categories, which embody elements of the social order of the world within which they are created (Miller 1985:10-11; cf. Barrett 1991:201-3). Bourdieu makes a similar point when he argues that social systems of classification are not just cognitive schema but represent *practical* knowledge: i.e. they do not simply exist in the

mind, but are produced and reproduced through practice (see Bourdieu 1977:97-109). In this way material culture is created and interpreted by people and therefore embodies the organisational principles of *social* systems of categorisation.

The ways in which different stages in the production process contribute to the production of material categories have been studied in detail by Miller (1985:34-50). After exploring the possibility that the use of certain techniques might in some way determine the resultant shapes and thus the resultant categories, he concludes that

"techniques do not determine the form of the distinctions used in creating the pottery series. Rather, certain 'dimensions' may be viewed as having been selected, and used as a focus for differentiation, exploiting particular aspects of the production process" (1985:49).

These dimensions of variability are measurable from the vessels themselves and frequently correspond to the dimensions of variability used by archaeologists to construct object typologies, such as rim form and body profile (Miller 1985:162). It is the integrated and coherent selection of these particular dimensions, as well as certain redundant similarities, which incorporate a certain object within a particular social system of categorisation and thus making it recognisable as the product of a certain producer (Miller 1985:49, 162)⁴⁰. In this way the process of human categorisation can be understood to work in terms of contextually-based properties of variation and 'fuzzy' logic, rather than discrete logical classes (Miller 1985:8-9). And so, since both the procedures and criteria of selection of the modern archaeologist can be understood to operate in a similar way (Miller 1985:162, 202), it becomes more likely that the material object categories recognised by the archaeologist will have some sort of relevance to the social context within which they were first created⁴¹.

However, identifying past material categories is one thing, understanding how they might have related to past social classifications, be they of the producer

⁴⁰ This distinction between 'dimensions of differentiation' and redundant similarities echoes the distinction drawn in classification studies between essential and inessential attributes (Rice 1987:276).

⁴¹ NB Nevertheless considerable caution is required in making this link. This link cannot be assumed but must be explored as a possibility through contextual study (cf. comments of Barrett 1991:203-4).

or of the consumer, is another matter. Miller has clearly demonstrated that different social classifications of material categories can be understood as dependent on the contexts within which these categories are produced, exchanged and consumed (see Miller 1985:10-11, 161-83; cf. Kempton 1981:123, 127, 138; Dietler & Herbich 1994:466-70). Thus, understanding of past processes of material categorisation and classification requires a commitment to assembling detailed contextual information. This commitment requires the exploration of the sorts of material and social possibilities and constraints active upon those individuals and groups who produced and consumed the categories in question (see Chapter 4 for more details). As an example of how information about social and economic context can help in understanding past classifications, one might consider Miller's case study of a single Dangwara village. Here there appeared to be a correlation between the degree of separation between producers and consumers (large with a minority of producers and a majority of consumers) and the degree of difference between classifications of producers and of consumers (high, with the possibility of entirely different terminology) (Miller 1985:50; see also Appadurai 1986:41).

In this way, in similar past contexts of specialised ceramic production it would be reasonable to expect that similar varieties in classification might have existed. If so, then one might argue in an opposite scenario, where producers are also very much consumers (e.g. the DMP, see Chapter 4) and thus the degree of separation between the two close to non-existent, that the gap between classifications of production and classifications of consumption might be considerably diminished or even non-existent. In such cases material categories of production might have a much closer relationship to the categories in which objects were consumed.

Much insight can also be gained through the detailed characterisation of some of the formal properties exhibited by a system of material categories, a characterisation that can then be further interpreted through reference to a series of contextual possibilities (cf. similar comments of Miller 1985:198-9, 201). One significant form of variation is in the degree of formal order exhibited by a system of categories: systems may be characterised as *informal*, where the variety of

forms or finishes within a single production tradition is very high and where typologies are very extensive and difficult to subsume into a simple order, or *formal*, where the variety of forms or finishes is low and where typologies are simple with low variation and often remarkably consistent between sites (Miller 1985:199-200). Some of the potentials of this distinction will be pursued further in Chapter 12 in the context of EN Knossos. Here, however, it is necessary only to sound a note of caution: since it is quite possible for different objects or categories to represent the same concepts (Miller 1985:201), this sort of formal variation can only be assessed in terms of possibilities and only in the light of additional detailed contextual information (see Chapter 4; cf. Barrett 1991:203-4).

3.6 Consuming Categories: Frames and Strategy

If in their production material categories embody elements of the social order of the world within which they are created, then so in their consumption do they contribute to the construction of the consumer's identity, as well as situating the consumer in relation to a series of social values, social categories and social knowledge which together make up the social environment. Regarding ceramics in particular, Miller has suggested that one significant way in which material categories act, is as 'frames' (see Miller 1985:181-2, 204-5). Through the presence of certain material categories, people are directed or cued into appropriate behaviour. This behaviour in turn acts to re-define the significance of the particular material category involved. In certain instances, such as ritual action, this can be explicit, conscious and symbolic: here one might consider the concern expressed by Dangwara villagers for the presence of the right sort of vessel in a wedding ceremony (Miller 1985:180). More often however the cues are subconsciously given and received. As already noted, the very habitual, mundane nature of most material actions naturalises them to the point at which they are scarcely noticed. That is not to say such actions are meaningless, on the contrary material culture continues to act as a frame for action which, although without conscious consideration or intention, is nevertheless embedded within systems of social values and social relationships. This feature helps to explain why, in

ethnographic studies of producers and consumers, function often acts as a label for form but without implications of functional efficiency (cf. Miller 1985:67). Indeed the very functionality of pottery (container, transporter, server and framer) makes it particularly suited to the role of framing action, while its concrete nature makes it suitable for the objectification of social values and concepts (Miller 1985:204).

The dualism between conscious and unconscious in the ways material culture and material categories work has the potential to reveal something important about consumption, namely that the consumption of goods can be seen to be both symbolic and instrumental (cf. Miller 1995b:239). In this way interpretations of consumption can take place on two levels: on one level they can concern themselves with the significance of conscious or symbolic expressions of desire, while on the other they can consider how material culture acts at a more unconscious level in articulating and maintaining social values and social relationships. Both levels, however, can be understood in the same way. As has been emphasised consistently in this chapter, material culture is reproduced through the active intervention of human agency, which at any particular moment must be credited with a rationalisation of its interests with respect to its actions, whether these interests are consciously or unconsciously expressed. Action, whether that of individuals or groups, is therefore always to some extent strategic or calculated (cf. Bourdieu 1977:171):

"the pursuit of reputation in the eyes of others is the overriding preoccupation of human life, although the means by which reputation is to be achieved are extraordinarily various" (Harre 1979:3 cited by Miller 1985:184-5).

In this way through acts of consumption individuals and groups define their reputation, their identity and their status. However, in addition to the expression of social relations, acts of consumption act more subtly to express certain social values. In this way consumption can be understood not only as a focus for sending social-messages but also as a means of receiving them (Appadurai 1986:31).

In order, however, for these processes to take place acts of consumption must have meaning and value. One way of thinking about this is to trace acts of consumption back to demand. Here it is important to recognise that this demand

does not derive from universal human psychological desires, but rather is itself a function of social practices and social classifications (Appadurai 1986:29-31). Demand is thus socially constructed and a variety of social practices and classifications structure the world within which demand is created. As a result demand for goods or services is liable to significant variation in space and time. One consequence of this is that acts of consumption must be understood to be active and specific, the recognition of which demands a commitment in consumption studies to the study of social context (see Miller 1995a:31-3, 1995b:269, 276-9).

Although the rules of consumption are to a large extent context specific, certain generalisations are nevertheless possible regarding the role of material culture in consumption. First and foremost, through Bourdieu's concept of symbolic capital, it is possible to see that economic calculation on the part of individuals or groups goes far beyond simple material goods or wealth but rather extends "to *all* the goods material and symbolic, without distinction, that present themselves as *rare* and worthy of being sought after in a particular social formation" (Bourdieu 1977:178, see pp.171-83). It is through the accumulation, display and exchange of material and symbolic capital that individuals or groups define their identities and negotiate status or reputation. Such acts, however, especially in small-scale kin-based societies, do not exist in isolation, but are fundamentally historical: in this way, acts of consumption and exchange represent "a heritage of commitments and debts of honour, a capital of rights and duties built up in the course of successive generations and providing an additional source of strength which can be called upon when extraordinary situations break in upon the daily routine" (Bourdieu 1977:178, 178-9; Chapter 4). Indeed, Bourdieu has argued that in agricultural societies, where a short ploughing and harvesting period and limited technical resources conspire to demand collective labour, symbolic capital, in the form of prestige and renown attached to a family, may perhaps be the most valuable form of accumulation (Bourdieu 1977:179). In such societies the two most important means of conserving or increasing reputation through the acquisition of symbolic capital are blood vengeance and marriage (see Bourdieu 1977:180-2).

The broader systems of social values or consumption rules, within which acts of consumption and exchange are embedded (see Bourdieu 1977:182-3) give meaning and render power to symbolic capital. Through certain mechanisms (e.g. taboos, sumptuary legislation) such systems will also direct action towards certain material categories and away from others and may even encourage over-investment in categories, which have no obvious worth when placed in a calculation based on adaptation and the production of subsistence:

"practice never ceases to conform to economic calculation even when it gives every appearance of disinterestedness by departing from the logic of interested calculation (in the narrow sense) and playing for stakes that are non-material and not easily quantified" (Bourdieu 1977:177).

These 'rules of the game' thus direct activity, but importantly also allow some room for manoeuvre and negotiation (see Bourdieu 1977:10-15; cf. Appadurai 1986:17). In this way the world of objects or material categories within past societies is created and recreated by strategic action embedded within a social system of rules and categories. This world is therefore significantly constructed, contextual and contingent.

3.7 Categories, Commodities, Classifications: Exchange and the Construction of Value

One way to break into this contextual world of objects and values is to look at how value is constructed in relation to objects. Value itself can be understood not as an inherent property of objects, but rather as a human judgement made about them (see Appadurai 1986:3-4). In general that which is rare or difficult to access is considered valuable; this difficulty is overcome through the act of exchange, in which the value of objects is reciprocally determined. In this way value is not absolute and fixed to the object, but rather is negotiable and defined on the basis of a real or imaginary exchange. As such it is exchange that "sets the parameters of utility and scarcity, rather than the other way round, and exchange that is the source of value" (Appadurai 1986:4).

It has been argued that when an object is selected for exchange it becomes commoditised, a commodity being defined as any thing intended for exchange, (see Appadurai 1986:6-16; Kopytoff 1986:64-90). This very broad definition of

commodity subsumes other forms of exchange such as barter and gift-exchange. Appadurai argues that barter exchange is a particular form of commodity exchange, where money does not play a direct role and where the circulation of things is most divorced from social or political values (Appadurai 1986:10-11). Regarding gift-exchange, he argues that a tendency to romanticise 'pre-capitalist' societies has led to a failure to recognise the degree to which such societies are equally calculative, impersonal and self-aggrandising. In this way gift-exchange, as reciprocal, sociable and spontaneous, has been falsely opposed to commodity exchange, as profit-oriented and self-centred, since both share the important characteristic of calculation (cf. Bourdieu 1977:4-9, 171-183; Appadurai 1986:11-12).

Crucial to this view of objects as commodities, is the recognition that things may move in and out of the commodity state (Kopytoff 1986). Kopytoff has illustrated this through a discussion of slavery as social transformation (see 1986:64-5). When taken, slaves lose their previous identity and become commodities. However, once acquired, slaves become re-socialised: over time they may develop a new social identity and new statuses or alternatively they may resist re-socialisation by retaining their identity in hidden practices, material culture and speech. Nevertheless at any time slaves may be converted back into commodities for resale. In this example human beings are commoditised, then withdrawn but with always the potential for future re-commoditisation. The same is equally true for objects and Kopytoff demonstrates that movements in and out of the commodity state can be fast or slow, reversible or terminal, adhering to social-norms or deviating sharply from them (1986:68-87).

Kopytoff has drawn a very useful distinction between the "drive inherent in every exchange system toward optimum commoditisation - the drive to extend the fundamentally seductive idea of exchange to as many items as the existing exchange technology will comfortably allow" and, singularisation, that is the natural inclination of all cultures towards discrimination and restriction of portions of their material and social environment (Kopytoff 1986:72-7). This tension between the drive to commoditisation and the need for singularisation can be seen in all societies. In general small-scale societies tend to restrict and simplify

commoditisation, with their systems of social values largely directing and enclosing economic transactions and providing the need for discrimination. The drive to commoditisation is effectively curtailed both by social values and by the inadequacies of the technology of exchange, in particular the absence of a well-developed system of money. In contrast, in commercialised, monetised and highly commoditised societies, such as our own, 'publicly recognised commoditization operates side by side with innumerable schemes of valuation and singularization devised by individuals, social categories and groups, and these schemes stand in unresolvable conflict with public commoditization as well as with another' (Kopytoff 1986:79-80, 87-8).

An example of the drive to commoditisation is the universal acceptance of money when introduced into non-monetised societies (Kopytoff 1986:72). Examples of extreme resistance to commoditisation abound in particular in premodern societies⁴², exemplified in processes of diversion such as sacralisation and the creation of 'enclaved' or 'terminal commodities' (see Appadurai 1986:17, 22-9; Kopytoff 1986:73-7). In small-scale societies where the flow of commodities is restricted, this restriction of equivalences and exchange to a "stable universe of commodities" acts to protect and reproduce status systems (Appadurai 1986:25): in such systems valuables play the role of tokens through which status is conventionally reproduced (see also Chapter 11). Important also in the context of restrictions upon commoditisation is the notion of 'inalienability'. Within certain forms of exchange, where the exchange above all represents the creation or maintenance of a specific social relationship between the two transactors (e.g. gift exchange), the transactors, their social relationship and the exchange object may become so intimately associated as to render the object symbolic of the successful continuation of that relationship and thus unfit for further exchange (inalienable) (see Thomas 1991:14-22). In this way gifts are inalienable things which move between people who are mutually entangled in an array of rights and obligations (Thomas 1991:14).

⁴² NB modern Western resistance to the commoditisation of people demonstrates that resistance to commoditisation is also a feature of more complex 'commoditised' societies (Kopytoff 1986:84-7).

In this way what emerges is that the exchangeability of things within any specific context is not defined by time so much as by general social conventions and values and sometimes also the more specific personal associations of the object and owner (Kopytoff 1986:68; Appadurai 1986:13-17; Thomas 1991:20-1). These social classifications not only vary from context to context, but may also vary between the two parties within a single transaction: thus Appadurai suggests that rather than speaking of shared standards of value, it is better to view exchanges as taking place within *regimes of value*, which acknowledge that the degree of value coherence may be highly variable from situation to situation and from commodity to commodity (see 1986:14-15). In this way exchange may take place within a single regime of value or between differing regimes. Moreover different regimes of value may exist within any one society: Kopytoff quotes the example of the Tiv of central Nigeria, who maintain three spheres of exchange (subsistence items, prestige items, rights-in-people), each with its own set of rules and values (1986:71).

A distinction, consistently drawn in archaeological studies of ancient spheres of exchange, has been that between luxury and utilitarian⁴³ goods (cf. Perlès 1992 for the Neolithic Aegean). Such distinctions are highly problematic (see discussion in Smith 1999:113-4), not least because they require the imposition of modern social categories upon an unknown ancient situation. For example most studies of Neolithic pottery assume that painted pottery had a high value (cf. Mellaart 1970b). However the indifference of modern Indian Dangwara villagers to painted pottery (Miller 1985:98) should caution against a simplistic imposition of modern Western aesthetics. Appadurai has suggested that luxury goods be viewed not so much *in contrast* to necessary goods, but as "goods whose principal use is *rhetorical* and *social*, goods that are simply *incarnated signs*" (see Appadurai 1986:38, 38-41). Here the necessity to which luxury goods respond is fundamentally political and as such constitutes a 'special register' of consumption, which is manifested by special restrictions, complexity of acquisition, complex

⁴³ As Thomas has argued (1991:11-12), early 'Frazerian' ethnographies of 'savage commerce' emphasised pre-modern exchange as primarily or entirely the exchange of utilitarian values; only later through the polemical critique of Malinowski was the role of ceremony and the exchange of luxuries within such 'primitive' systems recognised.

social message-sending, specialised knowledge as a prerequisite for appropriate consumption, high degree of association between the consumption of luxury goods and the body, person and personality. That is not to say, however, that the exchange of more ordinary goods in any way lacking in strategy or calculation. Rather all exchanges reflect and constitute social relations of various forms (positive and negative, equal and unequal) between individuals and groups (Thomas 1991:7-8).

In his discussion of luxury and ordinary goods, Appadurai points to an important distinction between complex and small-scale societies (see Appadurai 1986:39). In early complex societies the links between luxury and ordinary goods mostly involve the production process: luxury goods tend to have more complex production sequences. In contrast, in less complex societies:

"the connection between luxury goods and goods from other registers of use may involve not the ripples of a complex set of production milieux and forms but critically, the domains of exchange and consumption" (Appadurai 1986:39).

Appadurai also notes that in such societies trade in luxuries may provide a durable framework for the conduct of exchange in other goods (1986-39-40; cf. Smith 1999).

The social arena in which objects are consumed and exchanged also plays its part in defining commodities. The consumption or performance of objects on certain special or ceremonial occasions may often be central to their meaning (cf. Gosden & Marshall 1999:174-5). Marriages may provide the principal occasion on which women are commoditised, while at auctions objects, which normally are considered inappropriate commodities, may become commoditised (Appadurai 1986:15). The competitive nature of auctions and the part they can play in the negotiation of status (cf. art auctions, futures markets) provide a modern example of a common social phenomenon (cf. the medieval trade in relics, the *kula* of Oceania, the potlach) which Appadurai has termed tournaments of value (see Appadurai 1986:21-2, 50-56). Although exchange activities can take place on a variety of occasions, whether regularised and foreseen or opportunistic and by chance, it is during certain special occasions, at special times and in special places

that exchanges can have the greatest impact in the strategic and competitive negotiation of power, value and status (tournaments of value) by individuals and groups. On such occasions the objects exchanged act as tokens of value, essentially as signs in a system of status, which can be transformed into other media only by a complex set of steps and only in certain circumstances (Appadurai 1986:50).

3.8 Cultural Biographies of Objects

In this way one can argue, with Appadurai (1986) and Kopytoff (1986), that rather than searching for the distinction between commodities and things, one should focus on studying the *commodity-potential* of all things through the total trajectory of their existence from production through exchange to consumption (Appadurai 1986:13). In this way objects, like persons, are not what they are made, but what they become in their social lives (Thomas 1991:4):

"even though from a *theoretical* point of view it is human actors which encode things with significance, from a *methodological* point of view it is the things-in-motion that illuminate their human and social context" (Appadurai 1986:5).

By focusing in this way on objects rather than on the forms or functions of exchange, it becomes possible to argue that that which creates the link between exchange and value is politics or strategy. Bourdieu's notion of habitus allows one to see the relationship between humans and objects to be viewed as dynamic, with humans as knowledgeable actors dynamically creating/recreating, using and redefining material culture with objects being both the means by which this is achieved and also the frames which guide future activity (see Miller 1985). In this way society constructs people in just the same way as it constructs objects (Kopytoff 1986:90).

The idea that objects have biographies is a particularly useful one since it acts as a metaphor for the re-unification of the three main activities which lie behind the social significance of material culture, namely production, circulation and consumption (see Gosden & Marshall 1999; Tite 1999). During its life an object may be understood to accumulate knowledge at key points in its life (see Appadurai 1986:41-3). Thus, immediately following production an object is likely

to reflect, at least to its producer, a fairly standardised set of technical practices as well as a series of social values surrounding its place within a system of material categories. Once an object is exchanged it acquires both value and biography. During its life such an object may increase in value and may acquire an ever more lengthy biography, depending on the number of times it is transacted, the contexts within which it is consumed and the status of the individuals through whose hands it passes. In this way the significance of an object at any one moment in its life may be derived from the persons and events with which it has been associated (Kopytoff 1986; Helms 1993:146-159; Gosden & Marshall 1999). If so then this in turn presupposes that objects acquire oral narratives documenting the individuals and events which have played a role in the life of the object. In this way past exchanges, preserved in oral narrative, maintain the value of such an object. Thus the object itself, on certain specific occasions of its consumption, may act as a cue for a story which simultaneously enhances the value of the object and the reputation of the owner/storyteller (Helms 1993:160-70). Kopytoff has suggested that within small-scale societies individual social identities are relatively stable and unambiguous with changes in them conditioned more by 'cultural rules' than by 'biographical idiosyncrasies' (see Kopytoff 1986:89). Drastic or unusual changes in status or identity, which defy existing social classifications, be they in object or person are likely to result in either being taken out of circulation, whether sacralised, isolated or cast out: "What one glimpses through the biographies of both people and things in these societies is, above all, the social system and the collective understandings on which it rests."

Conclusions

It is therefore clear that material culture plays an active role in the reproduction of social relations and social values. In this way the knowledge and techniques which lie behind the production, circulation and consumption of ceramic vessels can thus be understood in terms of social and material possibilities and constraints (cf. Mahias 1993:162). Acts of production create and recreate social categories, which once they enter the world of consumption and exchange become subject to different classifications, are transformed through different

estimations of value and acquire different oral biographies (cf. Miller 1985:13). Through this ongoing dialectic process people define and are defined by their material surroundings. Thus the integrated study of production, consumption and exchange has the potential to reveal something about how these material worlds were socially constituted. In this way one might define the aim of material culture studies as the achievement of a

"model capable of representing the complex nature of the interaction between social strategy and artefactual variability and change. It is inevitable that some of this sophistication should be lost with the formation of the archaeological record, but this loss should be regarded as such, rather than minimised by starting with a limited social theory more compatible with the paucity of evidence" (Miller 1985:4).

Realisation of the complex nature of this process forces one to acknowledge the importance of context. Thus in the next chapter an attempt will be made to outline some of the potential conditions, material and social, within which objects might have been produced, consumed and exchanged in small-scale pre-modern societies, comparable to those of the Neolithic Aegean.

CHAPTER FOUR

CONSTRUCTING AN INTERPRETATIVE FRAMEWORK

"It is unlikely that a realistic general understanding... [of material culture] will come easily or that such an understanding will produce some handy simple formula of ready utility to archaeologists... Rather, we must be prepared to commit ourselves to face squarely the complexity of the phenomenon and to commit ourselves to a rigorous long-term pursuit of the anthropological study of material culture" (Dietler & Herbich 1998:234-5).

"An understanding of the variability of material objects... is inseparable from an understanding of those forces which create social variability" (Miller 1985:1-2).

4.1 Typology, Analogy and Interpretative Frameworks

As anthropology and ethnoarchaeology have made abundantly clear, the relationship between the material and the social is one of extraordinary complexity. As Dean Arnold has noted,

"Once an ethnoarchaeologist gets into the thick of a culture through participant-observation and begins examining the cognitive and behavioural variation of potters, for example, the complexities of ceramic production are mind-boggling and seem to defy generalization" (D. Arnold 1992:324).

For the prehistoric archaeologist, faced with archaeological contexts where understanding can no longer be guided by non-material forms of testimony, this sort of realisation might seem to suggest the futility of interpretation. Although anthropology and ethnoarchaeology can provide us with countless cautionary tales, how can we apply this sort of context-specific information to archaeological examples without simply projecting an ethnographic case study into the past?⁴⁴

4.1.1 Typological Models

The way in which anthropologists and archaeologists have sought to resolve this dilemma has been mainly through the search for cultural universals or ideal types (see discussion in Miller 1985:5, 161). Through the study of specific anthropological and ethnographic examples, a wide range of different typologies have been generated, which claim to define different forms of human behaviour,

⁴⁴ cf. comments of Miller (1985:198, 203).

such as forms of social organisation (cf. Fried 1967; Service 1975) modes of production (cf. van der Leeuw 1977; Peacock 1982) or exchange (Renfrew 1975). Neoevolutionary theories of social evolution assert that in cases of pristine development, cultures will pass through a series of stages, from simple to complex, with each stage representing a characteristic set of economic, social and political relationships: e.g. band, tribe, chiefdom, state. Likewise typologies of production organisation, although often employing a variety of dimensions of variability (scale, intensity, degree of specialisation, degree of elite involvement etc.), all move from simple to complex forms, beginning with non-specialised production within the domestic group or household, the so-called Domestic Mode of Production (DMP) (see Costin 1991:6-9). Unsurprisingly, different modes of production are often said to correspond to different stages of social evolution: in this way 'simple' 'egalitarian' 'Stone Age' societies, including those of the Neolithic Aegean, are thought to have produced under the DMP (Sahlins 1974; Halstead 1981). It is a common belief that these stages actually reflect a reality: societies are in equilibrium and when change takes place in one sphere, such as economy, it triggers wholesale change in other spheres so that society moves as a unit to the next stage.

One of the perceived advantages of this approach was that each type was thought to have a distinctive archaeological signature, consisting of a checklist of traits. All one needed to do was to identify the presence of these certain traits in the archaeological record and one could flesh out the rest of the data with an already developed body of anthropological theory. In this way typology may be termed a top-down approach, since it approaches the material record from a higher level of generalisation; its premise being that this sort of generalisation is both possible and useful. Unfortunately, however, the validity of such approaches is called into doubt when attempts are made to see beyond their generalising facade. Thus, when supposedly 'simple' societies are examined in detail through such criteria of complexity as size, variety of specialised roles and the number of mechanisms needed to make them function, it becomes clear that the simple-complex distinction is itself too simple: for example, when later Pleistocene and early Post-Glacial hunter-gatherers, such as the Jomon, are assessed using these

more detailed criteria, they emerge as complex socio-economic entities (see Price 1981:56-63). Likewise, when modes of production are examined in more detail serious weaknesses appear. For example a recent ethnographic study of domestic production among 'nonspecialised traditional potters' in Veracruz (Mexico), although seeking to construct a 'middle-range theory' for domestic ceramic production, actually found that the range of production behaviours was 'startling', forcing the conclusion that "models of pottery-making that ignore this degree of variability may provide very narrow interpretations of the past" (P. Arnold 1991:60).

The existence of considerable variety within types undermines the basic premise of typologies, that ancient situations will always cluster neatly around idealised types. What becomes clear is that to attempt the grouping of this variety in terms of one type of organisation is not only extraordinarily reductive in the way it condemns diversity, complexity and variety to a limited number of stereotypes, but also risks imposing modern ethnographic scenarios upon quite different past situations. Simple applications of idealised modes of production may actually obscure more than they reveal. Thus for example, the levels of production output measured by P. Arnold (1991) amongst the Veracruz potters, supposedly working within the DMP, are far higher than the output estimated for early potters in the Neolithic Aegean (see Chapter 2) and therefore suggests a quite different social and economic context. Costin, in her detailed review of craft specialisation has argued that we must move beyond typologies and work at a greater level of detail: "while typologies are important for their organisational value, what is more basic for archaeological studies is our ability to distinguish among parameter values... and to understand why different parameter values occur under different social, economic, political and environmental conditions" (Costin 1991:9; cf. Barrett 1994:2-5, 32-7). In this way, the potential complexity of the relationship between the material and social worlds is not something to be simplified and generalised, but rather embraced as a rich source of information about past societies (Miller 1985:1-2)

4.1.2 Ceramic Ecology

Within ceramic studies an alternative response to the dilemma of interpretation has been the development of the field of ceramic ecology, which posits that there exists an underlying ecological structure to the complexity of ceramic technology. This approach, most notably through the work of Dean Arnold (see D. Arnold 1985), has produced a rich and extremely useful database of information on the relationship between modern ethnographic potters and their ecological environment. Unfortunately, however, there has been a tendency amongst practitioners to use ceramic ecology as a set of universal rules for the interpretation of archaeological potters. Thus D. Arnold has suggested that "one of the ways to circumvent the problem of the limitation of analogy is to build a ceramic theory based upon the unique physical and chemical characteristics of the ceramics themselves" (D. Arnold 1992:334). However, this sort of application of ceramic ecology imposes an abstract set of rules, which can *in extremis* amount to a form of ecological determinism. Arguably one can view ceramic ecology in reverse. The many examples of environmental constraints can in many cases be reinterpreted as instances of dynamic innovation by potters to cope with extreme conditions: compare, for example, the elaborate methods devised to dry pottery in areas of heavy rainfall or the ways Alaskan Inuit have overcome harsh arctic environments to maintain pottery as a minor craft for centuries (Brown 1989:204). In fact, these examples are extreme exceptions; as has already been emphasised (see Chapter 3; van der Leeuw 1993), most potters have operated in an environment which allowed them a wide range of potential solutions to the task of ceramic production. And so, far from circumventing the problem of analogy, the application of ceramic ecology as a set of cultural universals comprises yet another example of how analogy can be misused. That is not to say, however, that ceramic ecology is without use. Rather the problem lies in the way ceramic ecology has been employed to construct a culturally-universal, and therefore ahistorical interpretative framework: here ceramic ecology has been allowed to develop from a heuristic device to become the 'reality' of a given situation.

It is widely recognised that nothing will ever be *proven* about the past using ethnographic analogy (see references in Barrett & Fewster 1998:848). However explicit recognition of this is not the problem but rather the solution: as

long as ethnographic analogy, whether through typological models or ceramic ecology, is always presented not as proof, but rather in terms of potential possibilities or constraints on existence, then it remains a powerful tool in the exploration of past societies (see Barrett & Fewster 1998). Thus a commitment to the potential complexity of the material and social world, far from emphasising the futility of the archaeological exercise, is the key to further understanding. As Miller has emphasised, since material culture acts to constitute social relations at the level of the habitual and mundane (cf. Chapter 3) it may be less open to explicit refutation and confrontation and thus detailed study of material culture may be a powerful means of understanding social relations, equal or even superior to direct enquiry as a form of investigation (Miller 1985:11-12, 67, 191-3, 197-8).

In this way Arnold's many examples and calculations, such as average distance of production location to clay or temper source, provide an extremely useful indication of some of the ecological *possibilities* and *constraints* on the activity of potters. They do not in themselves, however, constitute the sort of generalised cross-cultural rules demanded by Middle-Range Theory, nor are they the only constraints and possibilities active upon potters. In Chapter 3 it was argued that social and cultural constraints and possibilities also play their part and an understanding of acts of production, consumption and exchange is not possible without an exploration of this social, political and economic context. Within ceramic studies of production there is widespread agreement that study must proceed beyond the *what* to the *why* and *how* (Stark 1985:172; Rice 1987:17; Arnold, P. 1991:2). For example, Costin has proposed a similarly integrated contextual approach to the study of production organisation, suggesting that production should be characterised in terms of context (social, political, economic), concentration (spatial relationship between producers and consumers, distribution), scale (size, composition of production unit) and intensity (efficiency, risk, scheduling) (Costin 1991:11-18). These four parameters can be studied through different categories of archaeological data and through a variety of analytical techniques (see Costin 1991:18-43; Chapter 5).

Since the point of contextual analysis is that it relates apparently disparate sources of evidence to make each the context for the other (Miller 1985:201), one

of the clear advantages of approaching ceramic material culture from the three different angles of production, consumption and exchange is that each generates a separate picture of the social significance of material culture which at a later stage can be compared, contrasted and finally incorporated with the other two to generate a detailed picture of the socially-significant lives of ceramic vessels. In Chapter 2 a contextual approach was taken to previous studies of early ceramics in the Aegean and Anatolia: by bringing these different interpretations together it proved possible to identify particular areas of difficulty and contradiction. In the next section (as well as in subsequent chapters) a similar approach will be taken: the body of anthropological theory generated around the DMP model will be outlined and its specific application to the Neolithic Aegean compared and contrasted both with the original model and with the archaeological data. This section will focus in particular on outlining the sorts of social processes and structures which might play a part in the production, circulation and consumption of material culture in such societies. In the process a series of themes and concepts will be generated which will form the basis of discussion in Chapters 10-13. In this way, through the careful characterisation of archaeological data alongside a structured use of ethnographic analogy, it is hoped that an understanding can be gained of some of the social and material possibilities and constraints active upon activities of production, consumption and exchange within communities of the Aegean in the earlier Neolithic.

4.2 The Domestic Mode of Production (DMP)

Household production purely for household consumption, as demanded by the self-sufficiency hypothesis originally proposed for Neolithic societies (see Chapter 2), can in reality only exist as an abstract theoretical impossibility:

"the domestic mode of production can only be "a disarray lurking in the background", always present and never happening. It never really happens that the household by itself manages the economy, for by itself the domestic stranglehold on production could only arrange for the expiration of society. Almost every

family living solely by its own means sooner or later discovers it has not the means to live" (Sahlins 1974:101).

The reasons for the basic inviability of the individual household have their origins in a number of features common to 'primitive societies; namely that in general and by nature the DMP is characterised by underproduction oriented only towards the production of livelihood, which leaves the isolated household at risk of extinction due to its own varying productivity, itself a result of fluctuations in available labour and/or potential environmental failure (see Sahlins 1974:41-99 for more detailed discussion).

4.2.1 The Definition of the Household as a Social and Economic Unit (see Sahlins 1974:74-9)

It should be stressed that the concept of the 'household' or 'domestic group' may not always equate to modern notions of the nuclear family. Family may cover a variety of specific forms and at times the immediate family may be submerged in a variety of more extended kin groupings (e.g. polygamy, matrilocal, patrilocal). In addition households in some communities may be composed not just of families, but also of people of a certain age or status⁴⁵. That said, in most societies the institution of marriage does establish, even in a general way, a social and economic domestic group - the household - "constituted to produce the local conception of livelihood" (Sahlins 1974:79). Within this group the principal relations of production are generally structured by the inner relationships between man and woman, young and old. Through the pooling of goods and services within the household, and particularly the daily ritual of commensality, the household simultaneously identifies and constitutes itself as a unit and differentiates itself from other households within the community (Sahlins 1974:94-5).

4.2.2 Underproduction, Under-Use of Resources and Household Failure (see Sahlins 1974:41-74, 82-99)

⁴⁵ In this way individual identity in such communities may be constructed upon a variety of criteria and may be manifest in the simultaneous membership of a series of overlapping groupings, based variously on immediate family, kin, age, gender and status.

Through a series of examples Sahlins demonstrates that a singular feature of 'primitive societies' is that their exploitation of productive resources, such as subsistence, always falls far short of what could in theory be possible with their available technologies. Thus, for example, ethnographic studies of slash-and-burn agriculture, which have estimated the potential carrying-capacity of land under cultivation and compared this to actual population figures, have revealed a considerable degree of underproduction. This under-exploitation of resources extends also to labour: although comparative ethnography suggests that some societies work harder, longer or more productively than others, none of these societies ever make full use of the potential labour available. In some cases, such as !Kung Bushmen or Bemba chiefdoms, there is a potentially problematic economic imbalance between 'the indolence of youth and industry of elders' (Sahlins 1974:53). Such a curtailment of the potential lifetime working span must arise out of specific social or cultural values and circumstance rather than out of any desire for economic optimisation. Ethnographic studies of the normal working days and weeks of men and women in 'primitive' agricultural societies, although suggesting considerable variation in the way different tasks are organised between the sexes, always indicate an 'unstrenuous' programme of activity with numerous periods of leisure, which is perhaps only modified during busier periods of the agricultural calendar, such as harvesting (Sahlins 1974:56-68). Thus labour in such societies does not appear to be a scarce resource; although it should not be forgotten that labour still requires mechanisms for its mobilisation and organisation (see below).

It seems therefore that the principal reason for this general underexploitation of resources is that such societies are not structured in ways which seek to maximise their economic effectiveness, but rather the opposite: their social organisation seems actually to be determined by other criteria, which may at times even hinder their adaptive potential (Sahlins 1974:48-9, 53-5). Such societies appear to operate under the apprehension of resource abundance, with material wants, which are finite and few, and an available and undiminishing capacity to procure them (see Chapter 2 n.13). This type of production has been described by Sahlins as one directed purely towards the maintenance of the

livelihood of the producers (Sahlins 1974:68-9, 82-6). Such societies 'underproduce', through the under-exploitation of their resources and their labour potential, simply because this activity is sufficient to satisfy their material and spiritual needs - any additional increase in labour would be needlessly excessive. Sahlins explains the workings of 'production for livelihood' through a contrast drawn between 'production for use' and 'production for exchange' (Sahlins 1974:82-6). In the former, production is oriented towards the provision of livelihood and not towards the creation of surplus, wealth or profits. Importantly 'production for use' envisages a certain amount of exchange, since people in all societies "remain constant in their pursuit of use values, related always to exchange with an interest in consumption, so to production with an interest in provisioning" (Sahlins 1974:83). In contrast 'production for exchange', does not seek 'determinate and finite objectives', but rather 'as much as possible': as a result 'production for exchange' favours the development of economic intensification (e.g. the accumulation of 'wealth', the investment of capital, increases in economic efficiency), which is best achieved through social structures existing beyond the family (Sahlins 1974:102). 'Production for use' is characterised by underproduction and a satisfaction with sufficiency, 'production for exchange' by the intensification of production and the desire to acquire more.

A third characteristic of the DMP is the tendency amongst some households "persistently to fail to produce their own livelihood, although organised to do so" (Sahlins 1974:69). This failure in part results from varying subsistence yields resulting from a variety of factors from environmental failure, to the inevitable periodic variations in available labour force within the household. In any large community over time it is natural that households will vary in size and composition leaving some individual households particularly at risk of economic failure. Sahlins argues, however, that this tendency to failure is compounded by an 'antisurplus principle' (Sahlins 1974:86-92): since the DMP is oriented solely towards the production of livelihood, it has the tendency to produce only that which is needed and not that which is above the producers' immediate requirements: "nothing within the structure of production for use pushes it to transcend itself" (Sahlins 1974:86). However, this is something of an

overstatement since these immediate requirements will always include a 'normal surplus': producers' perceptions of sufficiency are always likely to exceed the basic level of subsistence, at least in part as a deliberate strategy to offset the risk of failure (Halstead 1989; cf. Sahlins 1974:86).

4.2.3 *Community, Kinship, Household* (Sahlins 1974:92-9, 123-30)

In this way, the DMP is constructed upon a theoretical contradiction (see Sahlins 1974:95-9). Although it describes a society composed of many separate individual producing units, which should in theory encourage a centrifugal tendency towards the fragmentation of communities and the dispersal of individual households, potential household independence is compromised by the long-term inviability of the truly isolated household. Thus, in order to ensure their survival, individual households must be able to mobilise external labour and cultivate external ties of obligation which can be relied upon at times in case of economic failure (cf. Childe 1981:87-8; Halstead 1989) as well as for other reasons. This means that the division of labour within such societies is never purely internal to each household; rather the production of different things may demand different degrees of cooperation, which can result in production being organised "in diverse social forms and sometimes at levels higher than the household" (Sahlins 1974:78). Of these social forms, the most important are kinship relations, since these both act to link individual households, thus countering the centrifugal tendency of the DMP, and serve to give wider expression to the domestic concern for livelihood, thus reducing the centripetal tendency within individual households (Sahlins 1974:123-30). Examples of the latter are the varied mechanisms employed by households designed to resist the obligation to share, even amongst close kin (see Sahlins 1974:125-7).

This long-term reliance upon the cultivation of external links, either within the community or beyond, effectively forces households to engage in a range of exchanges (cf. Halstead 1989:73), which to some extent places them in competition with each other. Sahlins has argued that the need to create and fulfil social obligations may act as a major incentive towards overproduction or production beyond livelihood, however, as emphasised by Halstead, the normal

surplus produced by households seeking only self-sufficiency could have been used competitively in this way without the need for further increases in production (Halstead 1989:73). And so, since in the DMP producers always retain some sort of control over their economic means, social competition tends to be played out in other arenas (Sahlins 1974:94): "The political game has to be played on levels above production, with tokens such as food and other finished goods; then, usually the best move, as well as the most coveted right of property, is to give the stuff away". Thus competition tends to be played out at the level of consumption and exchange. In general anthropologists have tended to focus upon household relations with respect to their place in production rather than consumption (Miller 1995b:274), however it is clear that households will strategically engage in acts of consumption (above all commensality) and a variety of forms of exchange, including sharing, gift-giving, exogamy and even trade, all of which serve to define reputation and status as well as encouraging reciprocity and obligation.

One conclusion to be drawn from this discussion is that within the DMP, acts of production, exchange and consumption all interrelate as part of an integrated social system, based not on economic necessity, but on a series of social values and social relationships (cf. also comments of Bourdieu 1977:175-6). Despite the tension between the duty to share (amongst kin) and the desire to hoard (within the household), instances of serious conflict tend to be rare (see Sahlins 1974:127-9). Indeed the general stability shown by 'primitive' societies must be one of their most remarkable features. Sahlins has described this in terms of a negative feedback relationship producing a persistent state of equilibrium, which could only change through "an historic conjuncture of additional and external contradictions" (Sahlins 1974:87). However as argued in Chapter 3, it is perhaps better to think of change in terms of a process and to view the main elements of the DMP (small labour force, simple technology, finite objectives, necessity of links beyond the household) not as simply balancing each other out but as elements within a dynamic process of social reproduction, which sought through its own social values and institutions to maintain cohesion.

It should be stressed that the DMP should not be seen as a *single* integrated social system (see Sahlins 1974:74-8). The DMP is not a strait-jacket, but rather

a generalised outline of the internal dynamics of such societies. Thus, within the basic model of the DMP there is considerable potential for variation in areas such as social organisation, the organisation of production, the division of labour. For example amongst the many examples given by Sahlins, some societies work considerably harder and are more productive than others (Sahlins p.38-9, 52); in some women are excluded from agriculture and thus have more leisure time, in others women play a more prominent role (cf. Sahlins 1974:54). Such examples emphasise that in the DMP much depends on the myriad different ways in which such societies constitute themselves socially. Thus consideration of the DMP awakens us to the possibilities of and the potential constraints on existence in such societies, it helps prevent us from importing too many modern economic notions and most importantly it provides us with propositions regarding the organisation of production, and the importance of exchange and consumption, which have the potential to form testable hypotheses (see below and Chapter 5).

4.3 The Application of the DMP to the Study of Production, Circulation and Consumption in Neolithic Greece

4.3.1 Identifying the Household in Neolithic Greece

The most important and influential application of the DMP in an Aegean Neolithic context is found in the work of Halstead (Halstead 1981, 1989, 1995, 1996, 1999). Halstead suggests several converging lines of evidence in favour of the archaeological identification of the household in Neolithic Greece (Halstead 1999:79-81).

- (1) Variety in size and construction techniques of structures in different settlements and the presence of house models suggest that house type is not simply a function of available raw materials, but reflects something more fundamental about the way Neolithic villages were structured;
- (2) Rare examples of relatively complete interiors preserve a broad tool-kit consistent with a social group of mixed age and sex performing a wide range of tasks;
- (3) Most free-standing structures range in size between 20-70m², suggesting an occupying group consistent in size with individual families.

Although not without its problems (Halstead 1999:81; see below), the likely identification of the household sanctions further study of the archaeological data within a framework based on the DMP.

4.3.2 Early Agriculture in Greece

Halstead has argued that the traditional 'Mediterranean' pattern of land use, involving the co-existence of extensive cereal cultivation, local specialisation in vines or olives and pastoralism, could only have emerged during social, environmental and economic conditions which were first prevalent in later prehistory (second millennium BC) (Halstead 1996:301-2). Extensive cereal cultivation involves the working of large landholdings using labour-saving crops, such as cereals, and labour-saving methods, such as animal traction and is marked by inequality of land ownership.

In contrast, early Greek agriculture seems to have involved the labour-intensive year-round⁴⁶ cultivation of small plots of land (see Halstead 1989:70-1; 1996:301-3): the archaeobotanical record suggests that labour-intensive pulses were grown as frequently as cereals; the range of crops grown is 'strikingly wide' in comparison with early agriculture sites in Central Europe (Halstead 1996:303); limited study of crop-weeds is consistent with intensive horticulture; there is no evidence for the use of animal traction; there is a lack of evidence in the palynological record for extensive agricultural land clearance until much later in prehistory. In addition, the predominance of sheep (in a relatively wooded environment) and the decrease in the size of domestic cattle and pig over time (suggesting a lack of accidental interbreeding with wild variants) when taken together suggest that stock husbandry was also small-scale with animals under close-supervision, probably confined to cleared areas. Mortality patterns suggest that these animals were managed on a 'meat' production strategy and, although this does not mean that other dairy products were not produced, this suggests that

⁴⁶ Whittle has argued that settlement in early farming villages in Greece may have been seasonal rather than year round (Whittle 1996:50-54, 69-71); however Halstead has effectively rebuffed this interpretation through his demonstration (using faunal and floral remains) of year-round occupation (see Halstead 1999:77-8).

stock husbandry was not geared towards maximising the energy yield (i.e. the 'milk' strategy of pastoralism) (Halstead 1989:70). The manure from these animals, especially if they were confined to cleared areas, would have been a valuable resource maintaining the fertility of small arable land-holdings (Halstead 1989:70).

In this way early Greek agriculture seems to have involved small-scale labour-intensive horticulture. Such a system does not seek to intensify yield, but rather resembles 'production for livelihood'. Although the 'meat' strategy could be described as underproductive, when taken in conjunction with the variety of crops grown, it becomes clear that as a system this form of agriculture provide a very stable diversified base which could effectively minimise the risk of environmental failure (see Halstead 1981:310-11; 1989:72-4; 1996:303). This feature of early Greek agriculture helps to account for the extraordinary longevity and stability exhibited by early farming communities, with some villages apparently in continued occupation for millennia (Halstead 1989:70).

A stable subsistence base on its own, however, does not ensure cohesion and stability. Using Sahlins' formulation of the basic inviability of the single household, Halstead has argued that individual households must have relied on periodic assistance from the wider community, both to offset fluctuating labour availability and as a further measure against environmental failure (Halstead 1989:73-5; 1996:304-5). Such assistance was ensured by the cultivation of social relationships beyond the household, which probably took the form of networks of alliances and obligations between different households and communities, such as marriage alliances, visiting relationships, exchange partnerships (Halstead 1999:89). The nature of these exchanges is likely to have changed with increasing social distance (Halstead 1989:74-5).

Such exchanges within and between communities must have included food, but also probably involved exotic materials, such as obsidian and artefacts such as stamp seals and ceramic vessels (Halstead 1989:73-4). In support of the importance of ceramic vessels Halstead notes the existence of large style zones for EN-MN fine pottery in Thessaly, but is forced to acknowledge that there is little evidence for the actual movement of vessels (1989:74, 1995:14). Halstead

suggests that the scale at which such finished goods circulated in the Neolithic, when compared to later prehistoric exchange, was small (Halstead 1981:307). The distances over which stylistic unity was maintained in Thessaly are considered to be less than the distances over which lithic raw materials moved but far greater than those necessary to secure marriage partners (Halstead 1995:14, 1999:78-9).

4.3.3 From Sharing to Hoarding: Changing Emphases on Community and Household During the Neolithic

Halstead has argued that the transition from a foraging economy to a labour-intensive agricultural economy required a move from an ideology of sharing to an ideology of hoarding (see Halstead 1995:16-19, 1999:80-1). Although the architecture of Greek EN-MN houses may have encouraged domestic isolation, this was countered by the crowding together of houses (Halstead 1996:305) and the location of many cooking facilities in the open spaces between houses, which together suggest the social sharing of food (Halstead 1995:16-17) and perhaps other commodities. Such a sharing of cooked food is in many modern ethnographic societies an index of kinship, which favours social cohesion and will have contributed to the stability of early farming communities (Halstead 1995:17). It should be noted however that the sharing of food should not be overestimated. As noted by Andreou et al. (1996:559) for northern Greek Neolithic sites, in addition to cooking installations located in open spaces between houses, there are also ash pits within houses. This pattern can also be seen at ENI Knossos, where the data (although limited) suggest that during ENIa-b there were numerous ash pits within structures as well as special built cooking facilities located outside (cf. inside and outside House C; see Chapter 13). These examples indicate that not all food was cooked communally and thus suggest that not every meal was shared. This does not so much detract from the hypothesis of sharing as add to it since it emphasises the special significance of those occasions when food was cooked and shared with other households.

This emphasis on sharing seems to have changed during the course of the Neolithic. The LN-EBA colonisation of agriculturally marginal areas and the concomitant increase in the risk of subsistence failure seems to have been

accompanied by changes in the internal organisation of settlements (Halstead 1995:17-18, 1999:80-1). Previously open villages are now organised into courtyard groups, which would have hindered sharing between households; furthermore in many FN-EBA settlements cooking facilities are now placed in internal extensions or in closed yards. It is perhaps significant that this final architectural isolation of the household is at times accompanied by the appearance of house models (Halstead 1996:305-6). In addition this phase sees an increase in deep pits, particularly suitable for the long-term storage of agricultural surplus, which may suggest an increase in hoarding. Finally, it has been argued that an increase in the relative importance of the hunting of wild animals during the EBA may also in part result from the progressive isolation of the household as an economic unit (Halstead 1999:83-6). As Halstead notes, such developments would have facilitated the unequal accumulation of wealth and status; it is perhaps thus unsurprising that this phase sees the first evidence for such inequalities (see Halstead 1995:18). This use of spatial organisation as an index of changing social organisation has also been variously applied to early farming villages in the Near East (cf. Byrd 1994; Kuijt 2000).

4.4 Problems Associated with the Application of the DMP to the Earlier Greek Neolithic (EN-MN)

Halstead's interpretation of the evidence for early agriculture within the framework of the DMP represents an important step forward in our understanding of how earlier Neolithic societies were constituted. Significantly, it suggests that within the context of the Aegean Neolithic, exchange was not the epiphenomenon predicted by the old Neolithic self-sufficiency model, but was likely to have been a key feature ensuring the continued existence of early agricultural societies. This helps to explain the heightened awareness of the importance of exchange already noted (see Chapter 2) in recent general syntheses of production, circulation and consumption in Neolithic Greece, Anatolia and the Aegean (cf. Andreou et al. 1996:558-60).

However, perhaps inevitably in work which seeks to understand the economic basis of such societies, Halstead at times overemphasises the economic explanation of behaviour. Thus the emphasis on risk-management as the principle

force promoting exchange and social contacts, although important, runs the risk of neglecting the important place, in competitive acts of consumption and exchange, of power, the construction of status and the negotiation of individual and group identity. Problematic also is the assumption that producers necessarily had a right to their own produce. It has been argued that the idea that people have a 'natural' right to the products of their own labour is a core assumption of Western philosophy: in contrast in Melanesia, where people are more interested in exchange than production, products are understood as having a natural relation to their intended destination rather than those who actually produced them (Strathern 1988; Thomas 1991:16).

4.4.1 Searching for Direct or Independent Household Storage in the Earlier Greek Neolithic (EN-MN)

A more serious problem is the contradiction between, on the one hand, the consistent archaeological evidence in earlier Neolithic (Greek EN-MN) communities for the importance of sharing and the slow architectural and ideological isolation of the household, and on the other the tacit assumption that the household was *always* the principal social and economic organisational unit of the Greek Neolithic (cf. Halstead 1999). This assumption can be seen in the consistent emphasis placed on 'direct storage' of normal agricultural surplus, perhaps in ceramic vessels, within even the earliest households (cf. Halstead 1989:71, 1996:304-5). Here Halstead seems to be influenced by Flannery's emphasis that communities architecturally divided into households, as even the earliest farming settlements in the Old and New Worlds appear to have been, reflect the disappearance of an ideology of sharing associated with hunter-gatherers and the manifestation of an ideology of hoarding from the very beginning of the Neolithic (Flannery 1972; cf. Halstead 1995:12-13; 1999).

Crucial to the argument is the supposed evidence for direct and independent household storage of surplus and thereby evidence for direct ownership by producers of their products. Unfortunately, however, and as Halstead admits, this data is 'sparse' (Halstead 1999:82) and Neolithic methods of storage are 'not certain' (Demoule & Perlès 1993:362). What evidence exists is also late in date; the earliest adduced examples date no earlier than MN: for example the carbonised grain within houses at Servia is MN (Halstead 1989:71-2). However, the key issue is not whether storage was taking place within the household at all - households could not have functioned otherwise - but rather whether households stored within their walls all that they required for the year, including their normal surplus. The likely use of non-ceramic containers, such as the clay or dung-lined baskets which may have been used at Tsangli (Halstead 1989:71), means that this question can never be satisfactorily answered. What does seem clear, however, is that storage at the scale required to provision a single household for a year could *not* have taken place using ceramic containers (see also Chapter 2): two independent studies of EN-MN ceramic vessels both conclude

that during this period vessels were neither large enough nor numerous enough to have been able to store all that a household would have required in a year (Vitelli 1989:26-7; Yiouni 1996b:191-2; see Chapter 2). Within this context it may also be significant that the first dedicated ceramic storage jars (pithoi) only gradually come into use during the course of the Greek LN (Cullen & Keller 1990; Perlès 1992:144), a period during which the socio-economic domination of the household is more assured. Further increases in the capacity for individual households to store agricultural produce also occur during LN with an increase in the incidence of deep pits suitable for the long-term storage of agricultural produce (Halstead 1995:17). That is not to say that EN-MN households did not store some produce in ceramic vessels, rather what appears to be absent or at least currently unsupported by the data is the 'direct storage' of all produce required by the household within a year. If such an absence is real, then there must have been some sort of communal storage of agricultural surplus. Admittedly, evidence for such a form of storage is equally sparse, although it is tempting to view as such a cache of carbonised grain at Knossos (stratum X) found in close association with a burnt post-hole structure, which was located *outside* the area of the Aceramic settlement, and thus outside the spatial realm of any individual household.

4.4.2 Community and Communal Action During the Earlier Greek Neolithic (EN-MN)

Further support for an early emphasis on the communal, particularly communal ownership, might be the evidence for an unusually large communal building ('clubhouse' or shrine) in a central location in EN Nea Nikomedeia (Demoule & Perlès 1993:386), which contained two very large caches of 'exotic' flint blades, five female figurines, two 'outsize' greenstone axes, two unusual 'gourd-shaped' pottery vessels and several hundred clay 'roundels' of unknown function (Rodden 1964:114; Demoule & Perlès 1993:386; Halstead 1995:n.19). Evidence for burial customs, although invariably late (LN), also suggests an emphasis on the communal. The rarity of individual inhumations in Neolithic Thessaly and the frequency with which human remains are found in a disarticulated state have recently been interpreted as emphasising 'the communal and the primacy of

group identity over the individual" (Triantaphyllou 1999:128, 131-2)⁴⁷. Consideration of the different areas in which communality can be expressed encourages the idea that an erosion of the 'liberal customs of sharing' characteristic of hunter-gatherer societies (Sahlins 1974:10-11), may have taken place more slowly in some areas (e.g. burial) than others (e.g. production), while in others (e.g. commensality) one could argue they have continued to the present day. In this way an emphasis on communality and an emphasis on individuality may simultaneously exist in different areas of practice within the same community.

It should be possible to investigate the slow erosion of customs of communality during the Neolithic and Bronze Age through the consideration of a range of potential archaeological indicators of sharing or hoarding. Thus one might expect within an ideology of hoarding to see a decrease in the popularity of large diameter serving bowls and in the incidence of decorated pottery. At the same time one might expect to find evidence for the appearance of very large storage jars within household contexts⁴⁸ and the decline or disappearance of communal burial and/or the appearance of individual interments. One might also expect to see much smaller communities perhaps based on one or two households, since larger-scale storage and an emphasis on hoarding should encourage a 'natural' fissioning process within the DMP (cf. Sahlins 1974). An emphasis on hoarding and accumulation might also be manifest by an increase in property and/or an extension to the potential range of available material goods, which may ultimately result in the development of forms of social inequality⁴⁹.

Evidence for an early organisation of production beyond the household is provided by Miller's study of shell bead manufacture at EN and LN Franchthi (Miller 1996). Detailed re-analysis demonstrated that while in EN it required an enormous labour investment to produce a single necklace, in LN changes in the

⁴⁷ In a separate study Jacobsen and Cullen (1981) concluded that burial customs during EN-MN, although very diverse, were lacking in elaborate ritual, placed no emphasis on the visibility of the dead and give no indication of social inequality (Demoule & Perlès 1993:385).

⁴⁸ It is interesting in this light to consider the Cretan evidence for large specialised storage containers (pithoi), which currently suggest their first appearance during EMI (David Wilson pers. comm.).

⁴⁹ It is interesting that the first potential signs of social inequality within a settlement, manifested at Sesklo in an apparent inequality in access to fine ceramics, occur only in the last sub-phase of MN (MNIIb) (see references in Demoule & Perlès 1993:384-5).

production process made it possible for one necklace to be made by relatively few individuals. This has been interpreted as indicating that EN production of bead necklaces was "a collective undertaking by some portion of the Franchthi community", while later LN production, because of greater efficiency, could have been an individual (or household) undertaking (Perlès & Vitelli 1999:104-5). Halstead has come to similar conclusions regarding the patterns of animal exploitation by individual households at LN Dhimini (1992).

Finally it is worth looking beyond the Aegean to recent work on early farming villages in the Near East. Detailed analysis of changing spatial organisation at the Neolithic site of Beidha, in the southern Levant, suggests that during the earlier Neolithic evidence for a more restricted social network for sharing production and consumption activities (increase in distinction between public and private space, greater architectural discreteness, relation between boundaries, access patterns and open spaces) is accompanied by the development of regulatory mechanisms for the *integration* of the community as whole (Byrd 1994:639-661). The continued role of 'community regulatory mechanisms' is manifested in the construction of non-domestic buildings situated near the centre of the village or bounded open spaces used for group gathering (Byrd 1994:644, 656-8). These non-domestic buildings were distinguished on the basis of their lack of evidence for domestic activities along with a series of attributes which set them apart from other dwellings, such as greater structural complexity, greater labour investment, raised stone-slab platforms. These buildings are interpreted as corporate/integrative buildings that perhaps acted as "a venue for conducting suprahousehold meeting and decision-making activities, and possibly related ceremonial or ritual activities" (Byrd 1994:657). It is tempting to interpret the public building at EN Nea Nikomedeia in a similar light.

When all this is taken in conjunction with evidence for the gradual architectural and ideological emergence of the household during the Neolithic, an alternative proposition emerges: that in Greek EN-MN settlements, the household may not have been the primary social and economic unit, but may have been subordinate to larger groupings, perhaps based on kinship relations or perhaps other ideals of communality, which might in effect constitute forms of production

organised beyond the household. If so then the later (approx. LN) architectural and ideological emergence of the household (e.g. Halstead 1995) would also be accompanied by the final emergence of the household as the primary social and economic unit⁵⁰. The same period may also have seen the first emergence of direct household (social) storage⁵¹ and thus possibly a new sense in which the household 'owned' the products of its labours. Regarding the possibility of an organisation of production *beyond the household* during the earlier Neolithic, it is worth repeating the comment of Sahlins that within the DMP, production can be organised "in diverse social forms and sometimes at levels higher than the household" (Sahlins 1974:78). Chapter 11 will investigate the ways in which Cretan ENI-II ceramic production might have been organised.

If the earliest farming communities in Greece organised production in a form which perhaps combined household labour with some sort of communal organisation and communal ideology, then this would suggest a slightly different interpretation of the evidence for an ideology of sharing. Bourdieu has noted that within small-scale pre-modern societies collective action of any sort (but especially feasts) contributes powerfully towards group cohesion and group stability:

"Moreover, when the conditions of existence of which the members of a group are the product are very little differentiated, the dispositions which each of them exercises in his practice are confirmed and hence reinforced both by the practice of the other members of the group (one function of symbolic exchanges such as feasts and ceremonies being to favour the circular reinforcement which is the foundation of *collective belief*) and also by institutions which constitute collective thought as much as they express it, such as language, myth, and art." (Bourdieu 1977:167).

In this way in communities of the earlier Neolithic, commensality, along with other forms of collective activity such as production, may have been more than mere economic necessity, but actually one of the fundamental ways in which such communities constituted themselves socially: that is *the* way in which they

⁵⁰ It is interesting that the first potential signs of social inequality within a settlement, manifested at Sesklo in an apparent inequality in access to fine ceramics, occur only in the last sub-phase of MN (MNIIb) (see references in Demoule & Perlès 1993:384-5).

⁵¹ cf. first appearance of dedicated storage jars during Greek LN (Cullen & Keller 1990; see above).

maintained certain social ideals and values. Thus such collective acts may have provided opportunities to reproduce an idealised economic situation where the community was always superior in standing to individual households. Here one might think of such values of sharing and communality during the earlier Neolithic as *doxa* (see Chapter 3), that is as values, reproduced through practice, which appeared somehow natural and beyond dispute. If this was so then it would help to explain the stability and longevity of earlier Neolithic communities.

4.4.3 Ideals of Communality and Social Competition

It should be stressed that within this sort of idealised economic scenario individual households would nevertheless have competed for status: a community must have leaders. Here it is perhaps useful to consider again the shell bead necklaces made at EN Franchthi, but this time from the perspective of consumption and exchange. Even if in some idealised sense a necklace 'made by all' was the 'property of all'⁵², only one person could have worn what was likely to have been an object of great value. Likewise, if such an item was exchanged with another community, someone must have represented the producing community in the transaction. Either scenario suggests the existence, within such communities, of individuals of higher social status. In this way, this example is instructive in the way it suggests incentives for individual status-competition even with an ideology of communality.

Halstead has suggested that during the Neolithic individual households could compete with each other in two ways (Halstead 1999:90):

- (1) Since neighbours would be likely to receive their biggest surpluses in the same years, they would inevitably compete for opportunities to 'bank' surplus with other households;
- (2) Households would probably compete to establish marriage alliances or exchange relationships with particularly successful households outside the immediate community.

⁵² As already noted, we should guard against the assumption that producers necessarily 'owned' the products of their labours. Products may have been understood as having a closer relationship with their intended destination.

The arena for both of these forms of competition is likely to have been occasions of commensality. However, if one questions the possibility of direct ownership and direct storage of all normal household surplus within the control of individual households during EN-MN and places it - notionally at least - in the hands of the community then opportunity for the first form of competition disappears. Rather than producing what was sufficient for the individual household, what becomes more significant is the need to produce enough for the community as a whole. This in turn would suggest that the second area of competition may have been more significant. If so, and if food was communally-shared, then the exchange value of food in contests between households may have been reduced. Instead, within such communities significant acts of exchange intended to cultivate important social relationships or to construct and maintain status may have been centred rather upon the possession of (or perhaps the ability to give away) other commodities, whether exotic raw materials, such as obsidian or colorants or finished goods, such as stone axes, ceramic vessels, stone mortars, woodwork and basketry (see Chapter 12). The exchange of food within various container types may therefore have been only of secondary importance to the container itself or else was valued more for its symbolism than as a contribution to subsistence livelihood. If so, then archaeologically we may expect to see during the earlier Neolithic a level of exchange of finished goods (e.g. ceramic vessels) and non-local materials, *in excess of that noted for later periods*, where the dominant presence of the household, as principal socio-economic unit might be more assured (see Chapter 12).

Finally it is perhaps worth briefly considering what factors in particular might contribute to the erosion of ideals of communality and which may have contributed to the late emergence of the household as primary economic and social unit in the Neolithic Aegean. It has been widely argued⁵³ that when societies grow beyond a certain limit (<500) face-to-face communication becomes impossible and coordination of the society as a single unit or community becomes difficult or impossible. As a result new social structures are likely to emerge. However, this

⁵³ See discussion and references in Halstead 1981:312-3; cf. 1995:13-14, n.21.

alone is insufficient since in general during the earlier Neolithic communities did not grow beyond around 300 people (Halstead 1995:13). This suggests that they employed methods to keep community size stable, one of which was the option of founding new settlements.

From recent anthropological research which focuses on households as units of consumption, it emerges that there is a relationship between the degree of communality and the degree to which a village is involved in the pursuit of commodities (see Wilks 1990:34-42). A study of house construction among the Kekchi Maya of southern Belize found that, where a village was not involved in the pursuit of commodities, house construction remained a communal task and was important in coordinating the relationship between the household and the community. In such villages the sense of corporate community remained very strong: houses were generally identical in form and did not reflect differences in household income and status. Strategic acts of consumption focused instead on the consumption of individual luxury items such as jewellery or cigarettes. In contrast in the village which had a greater involvement in commodities houses were embellished and those of the wealthy constructed in an entirely new style. In such villages the sense of communality was not so strong, the main priority being household welfare. In this way, one might argue that a more serious threat to ideals of communality and equality than simple population growth is the arrival of new economic opportunities and an extension to a previously stable range of material categories available for strategic acts of consumption. Such pressures can lead to changes in social values and social relations with previously indisputable *doxic* values, such as communality and sharing, becoming open to challenge and negotiation (heterodoxy and orthodoxy).

Summary

It has been argued that considerable caution should be exercised in the ways in which typological models, such as the DMP, or examples of 'Middle Range Theory', such as ceramic ecology, are employed as interpretative frameworks. That is not to say, however, that such models need have no meaningful input into the process of interpretation: indeed Sahlins' formulation of the DMP and Arnold's ceramic ecology model offer extremely rich and stimulating sources for the interpretation of archaeological data. However, what is important to recognise, is that, despite occasional claims to universality, such models reflect *generalised* or *idealised constructions* albeit based on numerous individual ethnographic cases. In this way they can at best only reflect general tendencies rather than universal truths. As a result, interpretation using such models should always caution itself against too reductive and too absolute a reading of the archaeological data: the distant past may have very different from the ethnographic present. Instead such models should serve only to suggest some of the *potential possibilities* and *constraints* influencing past material action.

For example Halstead's use of the DMP model, as a framework within which to situate and understand the evidence for early Greek agriculture, has added considerably to current understanding of production, consumption and exchange during the Greek Neolithic. Perhaps most significantly the DMP offers a means of understanding why exchange may have played such an important role in Neolithic social life. However, this application of the DMP model may have been too absolute and inflexible in its assumption of the primary socio-economic importance of the household during the earlier Greek Neolithic (EN-MN). Rather this period may have seen a greater emphasis on communal forms of organisation. In the very least the discussion in this chapter should have shown that there is a great need to think beyond the household and to understand communities in terms of a potential array of overlapping or even nested social groupings, such as kin or community, of which the household is but one.

This conclusion has a number of implications for the study of ceramic production, consumption and exchange. In Chapters 10-13 ceramic production, consumption and exchange at Knossos will be explored in terms of a range of

possibilities: organisation based on domestic household or on larger groupings; degree of specialisation involved; possible presence of individuals monopolising knowledge and practice; the role, status and value of ceramic vessels. Also important will be an examination of the degree to which patterns of production, consumption and exchange might change, especially between the earlier Neolithic (Cretan ENIa-b = Greek EN-MN) and the later Neolithic (Cretan ENIc/ENII = Greek LNI) (see Appendix I).

Finally, the possibility that the earlier Neolithic saw the maintenance of certain ideals of sharing and forms of communal organisation more characteristic of hunter-gatherer societies constitutes yet another argument against the idea that the onset of the Neolithic was in all ways a revolution. Rather, along with the possibility that methods of food preparation and values associated with food persisted long beyond the Mesolithic (cf. Vitelli 1989; see Chapter 13) and the possible slow emergence of the independent household it suggests a long process of evolution⁵⁴. As Sahlins has noted (1974:81-2) we tend to prioritise and fetishise the importance of technological developments in our view of human history as progressing through successive technological revolutions (e.g. agriculture; ceramic technology; secondary products revolution; metal technology; complex societies/states). Equally, if not more important is the history of changing social relationships and social values.

⁵⁴ Here it is perhaps worth noting the attitude of one hunter-gatherer - a Bushman - to the idea that he might turn to farming: "Why should we plant when there are so many mongomongo nuts in the world?" (Sahlins 1974:27).

CHAPTER FIVE

A METHODOLOGY FOR THE CLASSIFICATION AND CHARACTERISATION OF A NEOLITHIC CERAMIC ASSEMBLAGE

"This study [of EN pottery] has been a long time coming, and not solely because of the quantity of pottery recovered from the Franchthi excavations. Certainly there is an abundance of pottery... But what has really taken time is the slow process of reinventing a way to study pottery from an excavation. I did not realize when I began the study that I would need to do this" (Vitelli 1993a:xix).

Any study of an archaeological assemblage always begins with a mass of material, usually already separated by context. Further study of this material requires that it be broken down, or classified further, into more manageable units. There are many ways in which this might be achieved, producing different units, which are dependent on the nature of each different enquiry. Different archaeological questions may be answered by the explicit selection of different attributes as important and will thus produce different groupings. Methodology is therefore structured by the archaeological questions to be answered, which here relate to how Cretan ENI-II ceramic vessels were produced, consumed and exchanged. This methodology must allow for the classification, characterisation and integration of data in sufficient detail and with sufficient clarity to allow investigation of the theoretical possibilities, problems and contradictions outlined in Chapters 2-4.

5.1 Previous Classifications of Cretan Neolithic Ceramics and their Relevance to Questions of Production and Consumption

To illustrate the importance of selecting a suitable methodology to answer specific archaeological questions, one might consider the relevance of earlier studies of Cretan Neolithic ceramics to questions of production and consumption. In these studies the central guiding principle was the need to establish a secure relative ceramic chronology. The first study by Mackenzie (1903) established a basic tripartite framework, based on fairly impressionistic observations of stylistic change, the second by Furness (1953) attempted to produce a more detailed typology based primarily on form, but which also noted differences in finish. The type and frequency of variation was noted and an attempt was made to relate this

more closely to the stratigraphical information which was then available. In addition comparisons were made with other Neolithic and Bronze Age assemblages from surrounding Aegean regions, in order that Crete's Neolithic sequence might be linked to those of its neighbours, both for reasons of chronology and an interest in cultural origins (see Appendix I). In this way Furness was able not only to confirm Mackenzie's three Neolithic phases, termed Early, Middle and Late, but also to subdivide the Early Neolithic phase further through the identification of a short ENII phase. The third study by Evans (1964) clarified Furness' typology in the light of a new series of excavations within the Central Court at Knossos and fixed it more securely within the extensive and entirely new stratigraphy which had been produced. This new stratigraphy made it possible to observe variation and form and finish in much more detail. Nevertheless, ultimately Evans felt his study confirmed "to a remarkable degree" the original results of Furness (Evans 1964:194).

It is tempting to criticise these studies for the way that they prioritise detailed descriptions of the exterior appearance of the assemblage (form and finish) over any serious attempt to deal with technological aspects, such as fabric. However this would be to blame them for ignoring questions, which they had never intended to address in the first place. These studies prioritised variation in form and finish to produce a detailed relative chronology, a chronology which still provides the only low technology means of dating sites and assemblages. They did not, at least not in the first instance, seek to provide a new understanding of EN ceramic production or consumption.

However, in their summaries as well as in passing both Furness and Evans drew tentative conclusions about EN production and consumption, albeit based on data collected to answer very different questions. Production, according to Furness and Evans, was entirely local to Knossos: clay was selected from "the immediate vicinity", poorly processed and then tempered with powdered gypsum from the nearby Gypsades Hill to produce the single identifiable fabric (Furness 1953:95, 103, n.16; Evans 1964:194, 196). Clearly Furness believed that the observed homogeneity in form and finish translated simply into technological homogeneity: any variations within the assemblage presumably represented local variations

within this mode over space and time. In this way the assemblage seemed to consist of a wide variety of actual shapes, oscillating around a restricted range of 'ideal types'. Such a model conforms closely to prevailing notions of the time which emphasised Neolithic self-sufficiency (see Chapter 2), that is domestic production purely for domestic consumption. However in the light of new evidence for significant variation within this assemblage (see Chapters 6-7) it would seem that in their technological observations Furness and Evans were particularly influenced by the attributes (form, finish), with which they had chosen to sort the assemblage, by the groupings it had produced as well as by prevailing notions of Neolithic self-sufficiency.

This provides a useful illustration of the importance of examining one's own assumptions about the archaeological questions which one is seeking to answer, since these assumptions will also play a part, consciously or unconsciously, in guiding one's actions during the methodological process. In the previous chapter it was emphasised that there was a need to work in detail from the data upwards, seeking variety and difference wherever it might exist, rather than simply to identify general aspects of a prevailing model. Insights into production and consumption will be most successfully gained by new detailed studies, which place these questions at the heart of their methodology.

5.2 Defining Choices and Revealing Categories: Is There Life After Death for Pots?

In Chapter 3 it was argued that activities of production, consumption and exchange can be understood in terms of the exercise of choice. These choices, whether technological or related to consumption or exchange, are always socially informed and reproduce social values and a social order. The products of the sum total of these choices can be understood, as material categories, to reflect that order. As these material categories are consumed and exchanged they become subject to new classifications and new estimations of value, which in turn contribute to the social biography of the object from birth (production) through life (consumption, exchange) to death (deposition) and even, arguably, life-after-death (archaeological study and display). Although a large proportion of what happened to an object in its life is irretrievably lost, certain key stages in its life cycle can be studied via the

analysis of different attributes and a study of context (Tite 1999). And so, through the detailed classification and characterisation of the major forms of variation with a Neolithic ceramic assemblage it becomes possible to study activities of production, circulation and consumption.

It has long been recognised that the social values and social relations, which lie behind acts of production, may be profitably studied through the application of analytical techniques originally derived from materials science.

"There is no question... that we can excavate artifacts and reconstruct the technologies behind them. In doing so, we may discover specific technological styles which are renderings of appropriate technological behaviour communicated through performance. The culturally accepted rules of the performance are embodied in the events that led to the production of the artifact. We should be able to "read" those events, if not all of them at least those of a technical nature, through laboratory study of the materials that make up the artifacts in question. The history of the manipulation of those materials is locked into their physical and chemical structure: the methods of material science can interpret that technological history" (Lechtman 1977:14).

Technological style, as it was termed then, should have taken ceramic studies in a radical new direction. However, despite having a potential which is quite obvious now, technological style remained on the fringes of mainstream research, to the extent that a decade later (1987) Rice was still able to describe it as having "not yet been systematically investigated in pottery studies" (Rice 1987:245). Indeed a large majority of ceramic studies during this period continued to ignore the social side of technology, preferring to view ceramic production in terms reminiscent of ecological determinism or evolutionary adaptation or functional efficiency (see Section 3.2; Gosselain 1998). Moreover, even when the social dimension to acts of production is accepted, this recognition is often not allowed to fully inform the conclusions drawn. Adopting analytical techniques from materials science enriches archaeological enquiry, but such techniques comprise only one component of archaeological methodology and are not sufficient for understanding technologies of the past. As a result many studies have been compromised by their failure to employ interpretative frameworks explicitly derived from anthropology and not from materials science (see De Atley 1991:223). In the last two chapters just such an interpretative framework has been developed. In the present chapter specific

issues of methodology associated with the characterisation of acts of production, circulation and consumption will be addressed in detail.

5.3 Characterising Ceramic Production

The ceramic production process can be understood in terms of a sequence of necessary stages (see Figure 5.1).

Stages in Production
raw material selection
raw material processing
forming methods
finishing/decoration
firing
post-firing finishing

Figure 5.1 The Stages in the Ceramic Production Process

At each of these stages the potter exercises choices. From clay choice and processing to vessel forming, finishing and firing, these technological choices may be revealed through the macroscopic and microscopic examination of fabric, form (and forming methods), finish (and finishing methods) and firing. Consideration of these variables effectively encompasses all the various stages in the production process.

5.3.1 Identifying Production Groupings

Since acts of production do not occur randomly or in isolation but in accordance with social and material constraints and possibilities (Chapter 3), they manifest themselves as regularised sequences of techniques. By inter-relating data on fabric, form, finish and firing one can examine the possibility that groupings based on fabric will correlate in some way with groupings based on other technological data: for example, mineralogical consistencies and differences within and between fabrics may find their corollary in differences and consistencies in form, finish or even firing. Rye suggests that such "high correlations between process sequences" may be termed technological traditions (Rye 1981:5). In Chapter 3 it was shown that tradition, as a body of information and practice, plays an important role in all aspects of production, resulting in a final product with a

unique association of characteristics. In this way the recombination of technological data not only enhances group characterisation but also in many instances increases the likelihood that groupings might be identified, which reflect some reality associated with their production (production groupings). Furthermore, under certain favourable conditions, it may prove possible to locate certain production groupings or technological traditions with specific places or regions in the landscape (provenance). In this way the documentation of different production locations and the distribution of their products facilitates understanding of regional chronologies, as well as allowing the movement and exchange of ceramics to be studied in greater detail.

5.3.2 Raw Material Selection and Processing

5.3.2.1 Complimentary Techniques of Analysis Along a Visual Continuum

Raw material selection and paste preparation can be examined via the detailed study of fabric. Fabric study can be pursued at several levels from the examination of sherd breaks macroscopically in hand specimen, to study of thin sections of individual sherds under an optical microscope or at higher magnification under a Scanning Electron Microscope (SEM). The advantage of all three techniques is that they exist on a visual continuum from high to low to no magnification (Wilson & Day 1994:54). In this way structural and compositional details observed macroscopically can be compared and related to what is seen in thin-section under an optical microscope (petrology). Under the optical microscope there is much greater detail available, much of which is invisible macroscopically, and thus this technique, although still using subjective criteria, may offer greater objectivity, such as in the identification and characterisation of the mineralogy of non-plastic inclusions. When one moves to the higher magnifications possible with an SEM in secondary electron mode, one can study a range of features many of which are invisible not only to the naked eye, but also to the optical microscope (e.g. individual clay filaments). In general identification and interpretation of features, such as clay vitrification micro-structures, is more subjective than those studied petrographically (Kilikoglou pers. comm.).

And so when considered individually, each scale of analysis not only offers different types of information but also operates within different degrees of subjectivity. For example, a wider range of technological and mineralogical detail can be studied at a lower degree of subjectivity under an optical microscope, than is possible either macroscopically or under a SEM. Thus petrographic study of thin sections represents the single most useful technique in the study of fabric as well as being one of the more cost effective analytical methods (Peacock 1977; see Chapter 6; Appendix V). However, since these scales of analysis can provide different types of information, the characterisation of different forms of ceramic variation is best achieved through a combination of all three. For example, many more samples can be studied macroscopically than could ever be processed petrographically or under a SEM. However, study using a SEM in association with Energy-Dispersive X-ray Analysis (EDAX) has the advantage of allowing specific areas within the fabric, such as clay groundmass or non-plastics, to be selected and subjected to semi-quantitative elemental analysis; this can produce useful information about the types of clay, inclusion or slip being used (see Figures 8.2-9).

5.3.2.2 Provenance and Processing

Through mineralogical characterisation it may become possible to link raw materials, following the identification of their geological type, to specific sources in the landscape using geological maps and sampled clay deposits (Freestone 1991:399; Barnett 1991:19-22; Whitbread 1995:374). Clear correspondences, however, are rare: ancient deposits may be eroded, buried or even worked out and the degree to which raw materials have been modified during paste preparation and pottery manufacture is often high. In addition non-plastic inclusions may simply be insufficiently distinctive to ascribe a source, leaving several options open; in other words analysis may indicate the geological provenance and not the geographical. Nevertheless in favourable conditions it can prove possible to identify source and also to reveal something of the techniques through which the natural properties of the raw materials have been altered (Barnett 1991:19-22). A number of basic techniques of clay processing are possible such as crushing, grinding, sieving and levigation (cf. Sillar 1996:265-6). Ceramic pastes may be composed of clay from a single spatial location or source; alternatively they may comprise a mix of clays

from two or more sources. Frequently the properties of clays are manipulated by the addition of non-plastic material (temper)⁵⁵. All of these processes result in a variety of changes, which can often be visible petrographically, such as the incomplete mixing of clays or differences in the size, angularity and mineralogy of non-plastic inclusions. Further information can be gained by comparing archaeological ceramic samples with sampled clay deposits, which have been processed in different ways (Rye 1981:37; Day 1991; Barnett 1991:18, 27).

In practical terms, techniques of selection and modification can have a variety of effects (see Rye 1976, 1981:31), but in general potters use them to increase or decrease the workability of the clays to facilitate the formation of vessels and to restrict the likelihood of vessel failure during manufacture. In addition, since composition is one of the factors affecting the mechanical performance characteristics of a vessel (Braun 1983:109; Bronitsky 1986:211-8), selection and modification of raw materials may reflect the intended function of the vessel⁵⁶.

A number of researchers have gathered ethnographic support for the existence of cross-cultural regularities in raw material selection for certain functional vessels as well as for an awareness amongst ethnographic potters of the consequences of their actions upon mechanical performance (see Braun 1983:112). However, too often the significance of this has been overstated (see Woods 1986). As argued in Chapters 3-4, pre-modern societies are unlikely to have perceived acts of production in terms of economic efficiency or functional optimisation. The significant social dimension to the choices made by potters in such societies may even have encouraged them to use materials which were not ideally suited to the way vessels were subsequently used. It is one thing to demonstrate that

⁵⁵ See Rice 1987:409-11 on looseness in the use of the term temper. Here temper will only be used to denote deliberate addition of non-plastic material. In petrographic analysis added temper may be differentiated from naturally-occurring large non-plastics through analysis of grain size, modality and angularity (Freestone 1991:405).

⁵⁶ For example thermal shock resistance, important for cooking pots, increases if walls are thin, if the grain size of inclusions is small, if the thermal expansion coefficient of those inclusions is low and if the shape of the vessel is rounded (Braun 1983:118-9, 122-5; Woods 1986). However, it has been argued that a high thermal expansion coefficient may actually be advantageous owing to the formation of micro-cracks (Kilikoglou et al. 1998). In general a ceramic with a high quartz content displays increased toughness at a cost to overall strength and both may be optimised if the amount of quartz temper added is in the region of 20% (Kilikoglou et al. 1998:262-74). As a result cooking pots may often (but not always) be round-bottomed and tempered with crushed calcite, quartz or feldspar (but see archaeological epilogue in Kilikoglou et al. 1998:274-6).

ethnographic potters have an awareness of performance characteristics, it is quite another to see principles of materials science as the overriding criteria behind clay paste preparation (see Kilikoglou et al. 1998:274-6); rather the factors affecting raw material selection and combination may be variable, encompassing possibilities such as proximity to the place of manufacture (Woods 1986; cf. Arnold 1985:32-52) or habit (Livingstone Smith 2000:36-9). It is probably for these reasons that archaeological attempts to identify functional optimisation have at times struggled to produce convincing evidence from ceramics (De Atley & Bishop 1991:373-4; Woods 1986); often even if some sort of connection can be demonstrated, one cannot be certain whether potters were deliberately trying to achieve these properties or whether these properties were the natural outcome of choices made for other reasons; furthermore paste recipes, which were originally influenced by performance criteria, may over time come to be reproduced because they become part of a strong tradition (Kilikoglou, Vekinis, Maniatis & Day 1998:261, 275).

5.3.2.3 Systems of Fabric Description and Methods of Grouping

Since macroscopic and microscopic analysis rely on observation and description they are inevitably qualitative and subjective (Rice 1987:309-10; Freestone 1991:399). Systems of description have been devised for the characterisation of fabric in hand-specimen (e.g. Peacock 1977) and thin section (e.g. Whitbread 1995:365-396). Unfortunately, in hand-specimen it is often extremely difficult to identify, measure and quantify certain key features of fabric (e.g. clay micromass, voids, type of inclusions). Petrology, however, provides a greater array of information and detail, which allows the employment of more complex systems of description. This ultimately can allow more refinement in the formation of groupings based on fabric, reduce the level of subjectivity and enable different fabrics to be described under the same system. Indeed the large amount of information contained within a single section means that some information, however insignificant, will inevitably be neglected (Freestone 1991:400).

The system and terminology used in this study for the petrographic description of fabrics in thin section is modified version of that first proposed by Whitbread (1995:365-396, 1986:79-88). This system combines methodologies and

terminology drawn from both sedimentary petrology and soil micromorphology, allowing all features to be recorded without reference to their supposed origin. Whitbread defines fabric as referring to:

"the arrangement, size, shape, frequency and composition of components of the ceramic material. The term is therefore restricted to describing morphology and composition without genetic inferences" (Whitbread 1995:368).

Fabric, therefore, in this study is used in a relatively neutral descriptive sense. It has been used to describe groupings formed at a macroscopic and at a microscopic level. The most obvious drawback with fabric groupings identified macroscopically is that they are based on the observation of relatively few features (basic type, size and packing of largest non-plastic inclusions, orientation of largest voids, colour) and are thus based on fewer variables. However, if the range of observable variation within a macroscopic grouping is sampled and studied petrographically, then petrology can be used to explore the boundaries between these macroscopic groups and thus allow a more detailed characterisation of fabric. In this way macroscopic fabric groupings can be compared directly with petrographic fabric groupings and the degree to which petrographic groupings correlate with macroscopic groupings can be assessed. In the case of EN Knossos it proved possible to correlate almost all petrographic fabric groupings with a macroscopic equivalent (see Chapter 6; Figure 6.1). And so when macroscopic observations of fabric are combined with petrographic study of selected samples, they can be used together to produce a detailed characterisation of fabric at two scales. This in turn allows the incidence of other macroscopic features, such as form or finish, to be correlated with petrographic fabric groupings. In this way, although this use of the term fabric, whether at a macroscopic or microscopic scale, carries no implication as to how such groups might relate to other groups based on form or finish, this separation does not prevent the equation of some fabrics, at a later stage of study, to specific groupings based on other attributes such as form or finish.

Finally some comment is necessary on the techniques used to form petrographic groupings. The categories formed through petrology are based on the human observation, selection and comparison of specific attributes, whose variation

is considered significant. Despite the employment of detailed systems of descriptions, such groupings necessarily retain an element of subjectivity. To a large extent this is a virtue because the groupings formed are not significantly affected by minor chemical and mineralogical changes that can occur during the formation of raw material deposits, firing or burial.

In an attempt to minimise subjectivity still further, the sequence in which samples are grouped and described has come under scrutiny. It has been proposed that use of techniques of grouping, such as 'pairwise comparison' or 'attribute analysis', which describe each sample first and then subsequently group samples based on these descriptions (cf. Middleton et al. 1991:266-71), serve to reduce the ability of the grouper to consciously or unconsciously manipulate the groupings produced. Unfortunately the use of such techniques effectively robs petrological analysis of one of its most powerful features, namely the opportunity it provides of keeping archaeological questions in mind *during* grouping, with the result that the groups, which are produced, better reflect those questions. As a result the technique of grouping first and describing later is preferred here (e.g. Whitbread 1995).

Another technique used to try to minimise the subjective element is the use of standardised grain sampling procedures (see Middleton, Freestone & Leese 1985:64-74), such as point-counting, where fabric is quantitatively assessed through the determination of mineralogy at regularly spaced intervals across a sample area (Freestone 1991:403). However, it has been argued that this time-consuming and monotonous technique should be used very selectively, since under many circumstances grouping is more easily achieved using less absolute techniques (Freestone 1991:403-4). For example, largely because Crete is geologically heterogeneous, previous petrographic studies of Cretan ceramic have generally not used point-counting as a primary means of forming fabric groupings, but have instead used it to support specific technological interpretations⁵⁷. In addition, all EN fabrics represented at Knossos are sufficiently coarse as to allow a more straightforward characterisation in thin section.

⁵⁷ For example, Day has only used grain-size analysis occasionally to investigate specific instances of clay mixing and tempering (e.g. Day 1995b).

5.3.3 *Forming Methods*

In a similar way to fabric, the form of a vessel may be understood to result from a sequence of techniques and choices (see Figure 2.2). Unfortunately, simple observation of the sequence in which forming techniques were executed is complicated by the methods used to finish Neolithic ceramics which tend to remove direct evidence of the forming methods used: for example scraping, smoothing and burnishing can remove the sequence of ridges created during the initial construction of a coil-built vessel (Rye 1981:67)⁵⁸. However, even where such finishing methods have been used, forming methods may sometimes be observed either directly in the sherd break or indirectly through the characteristic ways in which vessels have fractured (Rye 1981:59-61; cf. also Yiouni 1995:614). Any hand-built pot, unless formed entirely as a pinch-pot, requires the formation of joins, which are structurally the weakest area of the vessel. Usually a vessel will fracture along them with the result that a coil-built or slab-built vessel will produce highly diagnostic fracture lines. Also the sherd edges of a coil-built vessel tend to fracture irregularly with a meandering contour or occasionally in a step-like manner (Rye 1981:67-8). Patterns of fracture within a sherd break can be studied at high magnification under a SEM (Roux & Courty 1995; Tite 1999:187).

Here a distinction must be drawn between primary fractures, namely fractures which occur during the initial breakage of an intact vessel when the area under stress comprises the whole vessel, and secondary fractures, that is fractures which occur after this initial breakage when the area under stress comprises only the sherd. Primary fractures are on the whole more predictable and are more easily related back to the forming methods used and to the structural integrity of the particular vessel form. Secondary fractures can also provide information about forming methods: for example, large diameter EN bowls and jars tend to fracture in two main areas simultaneously: vertically at roughly equally spaced intervals around the rim and body of the vessel and horizontally along weak coil joins. In addition, after initial breakage, bowl fragments often fracture further along these weaker coils, particularly at the rim if the rim is offset; thus demonstrating that the offset rim was added as a single final coil (see Plate 48).

⁵⁸ cf. similar remarks in the context of wheel throwing (Roux & Courty 1995:17-50).

Although forming methods are usually most easily observed macroscopically, the degree to which they can often be obliterated by finishing methods suggests that all possible sources of data be exploited (Shepard 1956:184; Roux & Courty 1995). Rye notes that in hand-specimen inclusions and voids in coil-built vessels show random orientation when cut at right-angles to the direction of coiling, but when cut parallel to the direction of coiling, especially along the centre of the coil, they may show parallel orientation (Rye 1981:68). For pinch-pots inclusions and voids may be vertical in a section cut vertically through a vessel, although orientation generally weak (Rye 1981:70). Unfortunately study of forming through the preferred orientation of inclusions and voids is difficult if elongate inclusions and voids are rare or where grains and voids are equidimensional (Whitbread 1996:413-5). More generally the size range of inclusions can provide hints since hand-building techniques tend to favour coarse fabrics, while wheel forming requires finer fabrics (Rye 1981:61).

The size and orientation of inclusions and voids can also be studied in more detail using thin-section petrology (Whitbread 1996:414). In most cases, forming methods which consist of a gradual accumulation of material to produce a vessel, such as coil-building, create 'structural discontinuities' in the orientation of inclusions, voids and micromass (Pierret 1994:75-91). Evidence for these 'structural discontinuities' may be observed petrographically by comparing the changing orientation of voids and inclusions across a single thin section. Sometimes at the actual point of contact between different elements, the pressure applied when joining coils "may force platy fragments into alignment with the plane of contact of [the] coils" (Shepard 1956:183) and this too may at times be identifiable petrographically. The added advantage of petrology is that if vessels are low-fired (cf. Neolithic vessels) then study of the preferred orientation of the clay micromass can provide further indications of forming, even in the absence of elongate voids and inclusions (see Whitbread 1996:415-25 for details). Whitbread recommends that differential birefringence across a section is best observed using a lambda compensator plate (1996:415). It should be stressed that identification of forming methods, in the absence of obvious indications should proceed with caution. Ideally identification should be based on a variety of converging criteria, combining

macroscopic observations with microscopic observations of variation in the orientation of voids, inclusions *and* areas of differential birefringence in the clay micromass.

5.3.4 *Finishing Methods*

The dividing line between a technique which forms a vessel and a technique which finishes a vessel is often difficult to discern or meaningless to pursue. As a result it has been suggested that finishing methods be viewed as secondary forming methods, some of which may partly or entirely have a decorative function (Rye 1981:89, 84-95). Within the category of secondary forming methods fall techniques such as beating, scraping, trimming and shaving. These techniques involve a variety of distinctive gestures and tools, traces of which may be preserved on the surface of the finished vessel and studied through macroscopic examination (see Rye 1981:84-88). The tools and gestures involved in more decorative techniques, whether involving simple finishing (smoothing, burnishing and polishing), cutting (carving, combing and incising), painting or the addition of further clay (appliqué, modelling), can also be studied in a similar way (see Rye 1981:89-95).

Macroscopic observations may be complemented and clarified by information gained from microscopic analysis. A variety of secondary forming techniques can be studied in thin-section: techniques which add or redistribute clay across the surface of a vessel, such as smoothing or plastic modelling may be visible petrographically as additional layers (see Chapters 6, 10). Information about techniques which remove clay, such as scraping or incising, can also be gained: for example a section through an incised line can provide hints as to the type of tool used (see Chapters 6, 10). Slip, paint and burnish layers can also be observed petrographically. However, these thin surface layers are better studied at higher magnification using a SEM (Tite 1999:187-8; see Chapter 8). Use of SEM in association with an energy-dispersive X-Ray detector is particularly useful because it allows detailed analysis of surface structure to be combined with semi-quantitative elemental analysis of different areas of the surface and body. Through comparison with elemental compositions of the sherd body it may be possible to establish whether or not the slip clay was a refined version of the body clay (Tite

1999:187). This sort of analysis also allows study of the composition of paint layers and other deliberate colour effects.

5.3.5 Firing Methods

5.3.5.1 Distinguishing Between the Effects of Firing and Techniques of Firing

In the absence of direct testimony, archaeological inferences about firing practices (i.e. choices, techniques, tools) have to be made either directly from evidence for firing environment (e.g. kilns, firing pits etc.) or indirectly from the finished ceramics themselves (vessels, sherds). In reality the luxury of direct evidence of the former is rarely enjoyed; indeed it is questionable whether more ephemeral practices, such as open bonfires, would ever leave an unequivocal mark in the archaeological record⁵⁹. Thus, inferences regarding firing generally must be made from the ceramics themselves. This is by no means straightforward: simple tests of sherd hardness, which test materials of known hardness against a sherd's surface, tell us very little without additional information on clay chemistry (e.g. refractory/non-refractory) (Shepard 1956:214). Likewise simple inferences regarding firing atmosphere based on colour ignore the degree to which clay composition can naturally promote (if oxidised in its raw state) or hinder (if mixed with carbonaceous material) oxidation.

It is therefore important to make a distinction between *description* of the effects of firing on pottery and *inferences* regarding firing method (Shepard 1956:214)⁶⁰.

"Paradoxical as it may seem on first thought, we can decide *how well* a vessel was fired much more easily than we can learn *how* it was fired" (Shepard 1956:214).

This tension, whether acknowledged or not, runs through all studies of ancient firing technology, recently resurfacing in a critique of the use of analytically determined maximum firing temperatures as the sole basis for inferences of firing

⁵⁹ The data for Neolithic Knossos are at best equivocal (see Chapter 10).

⁶⁰ For example, different clays will respond similar practices in different ways, with the same firing methods producing different effects; such as causing bloating and deformation in one clay, but leaving another unaffected (Shepard 1956:214).

method (see Gosselain 1992:243-59). Gosselain argues that too much attention has been devoted to the refinement of analytical techniques for determining firing temperatures and too little to evaluating the significance of firing temperature determinations for archaeological studies of firing practices. Using an array of ethnographic data correlating firing practices with firing temperatures, Gosselain demonstrates firstly that for different firing environments, such as bonfire, pit and kiln, there is a large overlap in temperature range and secondly that within each firing environment and even between the interior and exterior of a single vessel considerable variations in temperature can and do occur. Thus, different firing practices (bonfire, pit, kiln) are unlikely to produce maximum and minimum temperature ranges which cluster so discretely as to allow a simple identification of firing environment.

Firing Context	Av. Time to Reach Max. Temp.. ⁶¹ (mins.)	Av. Time at Max. Temp. (mins.)	Max. Temp. Range ⁶² (°C)	Max. Temp. Range for Bafia Firings ⁶³ (°C)	Av. Temp. Difference within firings ⁶⁴ (°C)
open bonfire	22	<1-10 ⁶⁵	270-920	400-950	240°C
pit	41		615-900	-	
updraft kiln	259	30-60 ⁶⁶	437-1075	-	180°C

**Figure 5.2. The Performance Characteristics of Different Firing Environments
(based on data from Gosselain 1992; Tite 1995)**

Gosselain concludes by advocating the greater relevance of heating rate and time of exposure for determining firing methods (see Figure 5.2). For example, in open bonfire firings it is over these parameters, rather than actual firing temperature, that Bafia potters exercise control, since they can select a fast burning fuel and choose to remove vessels as soon as they reach red heat (Gosselain 1992:257). As a result this control allows them to repeat firings with only minor variations.

Although his argument is strong, Gosselain fails fully to draw out its implications, preferring to express hopes for the future discovery of new archaeometric tests to allow heating rate and soaking time to be quantified. However, one need not invoke the future to study heating rate or soaking time and Gosselain is certainly wrong to caricature current archaeometric approaches to firing as the simple pursuit of maximum or equivalent firing temperatures. This sort of analysis is just one aspect of the broader SEM-based study of the effects of firing on clay micromorphology. The combination of this and other relevant data enhances the *characterisation* of a firing technology. Moreover inferences of firing method from firing effects can proceed from a detailed understanding of the main variables which govern the effects of firing on a clay vessel, namely

⁶¹ Gosselain 1992:246.

⁶² Based on ethnographic data presented by Gosselain 1992:245.

⁶³ Gosselain 1992: 251-3.

⁶⁴ Gosselain 1992: 244.

⁶⁵ Based on Gosselain's study of Bafia open firings (1992: 255-6).

⁶⁶ Tite 1995:39.

temperature, physical/chemical properties of the clay, firing atmosphere, time (see Maniatis & Tite 1981; Shepard 1956:215).

5.3.5.2 Towards the Identification of Heating Rate and Soaking Time

When a plastic clay is left to dry in air it begins to lose water. The application of heat during firing accelerates this loss of water, until ultimately the mineral structure of the clay is altered. Maniatis and Tite (1975b; 1981) have studied the effects of heat on a ceramic body and have identified a series of vitrification stages which occur during firing (Figure 5.3). The formation of each stage depends largely on the temperature to which the clay body is subjected (see Figure 5.4). However, as Maniatis and Tite have demonstrated, this supposedly simple relationship between temperature and changes in clay micro-morphology is complicated by the physical and chemical properties of the clay, the atmosphere during firing and, most importantly here, time (see Tite & Maniatis 1975a:122; Maniatis & Tite 1981:61, 65-6; Rice 1987:435).

Vitrification Stage [oxidising atmosphere]	Visible Characteristics at High Magnification (x1000-2000)
Non-Vitrification (NV)	Non-Calcareous and Calcareous: no vitrification
Initial Vitrification (IV)	Non-Calcareous and Calcareous: this phase is characterised by sintering beginning at the edges of clay flakes.
Calcareous Vitrification Minus (V_C^-)	Calcareous only: isolated smooth-surfaced areas or filaments of glass; vitrification not yet continuous.
Vitrification (V/V_C)	Non-Calcareous: with increased temperature clays the isolated areas steadily increase in size until they coalesce to form an "essentially continuous smooth vitrified layer, ...visible over the entire fractured surface" (Maniatis & Tite 1981:61). Calcareous: here the isolated areas of glass only increase and link up 'to an extent', with the resulting vitrification structure remaining essentially unchanged over a range of c.200°C (Maniatis & Tite 1981:65).
Calcareous Vitrification Plus (V_C^+)	Calcareous only: once the high melting temperatures of the crystalline phases are surpassed, glass increases rapidly (Maniatis & Tite:65).
Total Vitrification ⁶⁷ (TV)	Non-Calcareous and Calcareous: a glassy phase characterised by the formation of coarse unconnected spherical bloating pores (Maniatis & Tite 1981:61; 65)

Figure 5.3 Stages of Vitrification (based on Maniatis & Tite (1981) with modifications)

⁶⁷ Following Kilikoglou (1994:70) and Maniatis et al. (1984), the term Continuous Vitrification, favoured originally by Maniatis & Tite (1981), is replaced by the term 'Total Vitrification' (TV).

Stage of Vitrification	Non-Calcareous (<6% CaO)	Calcareous (>6% CaO)
NV (ox.)	<750°C	<750°C ⁶⁸
IV (ox.)	750-800°C	750-800°C
V _C - (ox.)		800-850°C
V/V _C (ox.)	800-900°C	850-1050°C
V _C + (ox.)		1050-1080°C
TV (ox.)	>900°C	>1080°C

Figure 5.4 The Relationship between Temperature, Atmosphere, Percentage CaO and Changes in Clay Morphology (after Maniatis & Tite 1981 and Aloupi 1993:16)

Although quantification of the actual rate at which a ceramic was heated and the exact period of exposure to the maximum temperature is currently impossible, the fast heating rates and short soaking times characteristic of open firings (see Figure 5.2), can, in favourable circumstances, leave a number of distinctive and potentially diagnostic effects, which, when combined, can cumulatively provide strong indications of original firing environment (*contra* Gosselain 1992). These effects are observable in hand specimen, thin-section and at high magnification under an SEM; therefore an approach is preferred which combines these three levels of analysis, since different techniques provide information about different effects. At a basic level the colour sequence in a sherd break can provide a crude indication of the oxidation/reduction sequence during firing. The presence of the so-called 'sandwich effect', where the core is darker than the edges, cannot, on its own, prove the occurrence of a fast firing, however it does indicate one of two things (Kilikoglou & Maniatis 1993:438):

- (1) *Fast Firing*: in the early stages of an open firing a reducing atmosphere/presence of unburnt organics turned the ceramic black, then later in a more oxidising atmosphere the ceramic began to oxidise from the edges towards the centre, however the firing was too short for this process to complete a full oxidation;

⁶⁸ Although Maniatis and Tite (1981:68) give 800°C as the lower limit of Initial Vitrification, subsequent study (Maniatis et al. 1982:193) favours a lower temperature range of 750-800°C for IV. The reason for this is that, while under laboratory conditions an oxidising atmosphere can be produced at will, under real conditions a purely oxidising atmosphere is only possible after c.800°C. Prior to this point the atmosphere is always either purely reducing or a mixture of oxidation and reduction due to incomplete combustion of the fuel: i.e. combustion produces both CO and CO₂ rather than just CO₂ and excess O₂. Since Maniatis et al. (1982) backed up their estimations with re-firing, I have accepted their modifications.

(2) *Slow Firing*: a reducing atmosphere was produced near maximum temperature, turning the ceramic black; this was followed by insufficient oxidation during cooling.

Subsequently it may be possible to differentiate between (1) or (2) through a consideration of other criteria. For example, when soaking time is as short as one minute (or even less) quantities of organic material within the clay, visible petrographically, may not be fully burnt out. The coarseness of a ceramic may also act as an indirect indicator of heating rate: coarse-textured pottery is much more suitable for fast heating rates because the large non-plastics facilitate the evacuation of steam formed from the vapourisation of either absorbed or chemically-combined water; fine fabrics are much more likely to crack and fail in an open firing environment (Tite 1995:39, 1999:188).

Maniatis and Tite have demonstrated that variation in the general duration of firing (heating rate + soaking time) has a significant effect on the temperatures at which changes in vitrification occur (Tite & Maniatis 1975a:122; Rice 1987:435): if firing is short (fast heating rate + short soaking time), the temperature may have to be c.50°C higher to produce the same level of vitrification. However, these results were gained in an artificially created oxidising atmosphere, whereas in real open firings fully oxidised vessels are rarely produced (Tite 1999:188)⁶⁹. This is not only because firing atmosphere can change rapidly from oxidising to reducing, but also because of the close proximity of incompletely-combusted fuel which produces carbon-monoxide (flux), the presence of unburnt organic material within the fabric, as well as the speed of the whole process (Tite 1995:39). A fast heating rate may not give enough time for the oxygen to reach the inner part of the ceramic, thus producing a localised reducing atmosphere, which facilitates vitrification. In this way, the presence of a reducing or mixed oxidising-reducing atmosphere in effect lowers the temperature at which vitrification can occur, thus at times partially off-setting the need for a higher temperature. Furthermore, ethnographic examples of non-industrial firings indicate that once peak temperature

⁶⁹ Here one might contrast this with a kiln firing: in a kiln, with the separation of vessels and fuel and the greater predictability provided by a built environment, the firing atmosphere can be more easily manipulated to allow the production of fully oxidised ceramics (see Tite 1999:189).

has been reached vessels may have been allowed to cool immediately; much of the sintering must therefore have taken place at temperatures below the maximum reached during firing (Rice 1987:435).

A fast heating rate and a short soaking time are much more likely to produce localised differences in vitrification. Consequently SEM study of differences in clay micro-morphology at the centre and the edges/surface of a ceramic may allow the identification of vitrification gradients. This phenomenon of localised differences in vitrification within a single ceramic, helps to explain how a ceramic may exhibit vitrification in its body yet still preserve a burnished outer surface⁷⁰ (see Chapter 8). A further indication of fast firing, visible under a SEM, is the increased presence of fine bloating pores in non-calcareous clays, which have been fired in a reducing atmosphere (Maniatis & Tite 1981:61): when a fast heating rate is employed (e.g. 800°C/hour + 1 minute soaking time at maximum temperature, compared to 200°C/hour + 1 hour soaking time) the production of fine bloating pores is increased; since open firings may in reality have heating rates well in excess of 800°C/hour, one might expect this effect to be even further enhanced in a real situation.

5.4 Characterising the Circulation of Ceramic Vessels

Characterising and recognising the products of non-local ceramic producers within single site assemblages has proved extraordinarily difficult for Neolithic ceramic studies (see Section 2.3.1). This difficulty was seen to arise largely out of conceptual and/or methodological failings. The methodology proposed here for the study of Neolithic ceramic exchange relies to a large extent on conclusions drawn from the study of ceramic production. Through the detailed classification of a ceramic assemblage in terms of fabric, form and finish, it should become possible to characterise the products of different producers: different fabrics may prove to correlate significantly with different forming and finishing methods and with

⁷⁰ Clay vitrification involves changes in both clay chemistry and clay structure both of which affect the decorative properties of burnished surfaces. Burnished surfaces reflect the light partly because the burnishing process causes clay particles to align in parallel; vitrification causes changes in clay structure which destroy that alignment. In addition, burnished surfaces tend to shine due to the presence of illite; since illite breaks down at the lowest temperature of all clay minerals (c.850+°C) it does not survive the vitrification process (V. Kilikoglou pers. comm.).

specific forms and finishes, so as to allow the identification of production groupings.

In favourable circumstances, it may prove possible to identify these production groupings with specific locations in the landscape, in others it may only be possible to demonstrate an incompatibility with a local provenance. Further indication of provenance is provided by a comparison of the form and finish of vessels from the site under study with published assemblages from neighbouring contemporary sites (see Chapter 7). Also useful in the determination of local or non-local provenance is information on the frequency with which certain fabric-form-finish combinations occur at the site in question (see Chapter 9): a low frequency may hint at a non-local provenance. It should be stressed, however, that in order to realise the full potential of these data the exchange of ceramic vessels needs to be considered more generally within the possibilities and constraints of its social and material context (Chapters 3-4). In addition the comparative study of how other goods circulated (see Chapter 12) also has the potential to inform on the circulation of ceramics.

5.5 Characterising Ceramic Consumption

Each pottery context is a mixture of broken vessels in a variety of different shapes, sizes, fabrics and finishes. Using the methods described above different broken vessels may be grouped together on the basis of similarities in fabric, form and finish. Within these larger groupings a range of recurring shape types can be defined and recorded in typological form (see Chapter 7) and through comparison with different contexts, whose stratigraphic relationship is known, changes in these types can be traced over time (see Appendix I). These types, or material categories created by producers, may during their consumption be subject to a variety of social classifications, which tend to be based, through the exercise of a form of 'fuzzy' logic, around certain key 'dimensions of variability' (Miller 1985; see Chapter 3). These dimensions of variability tend to relate to key aspects of form (e.g. neck-profile), finish (e.g. colour) as well as to the context in which they are used (e.g. cooking) (see Figure 5.5). As a result the types defined by archaeologists may prove to bear a close relationship to the categories in which ceramic vessels may have

been consumed in the past⁷¹: material categories frame acts of consumption, but it is also through those acts that these categories are reproduced (see Chapter 3).

Production	Consumption
clay selection	-
clay processing	-
forming	form
finishing	finish
firing	finish
post-firing finishing	finish
intended function/ use/valuation	actual functions/ uses/valuations

Figure 5.5 Stages in the Production Process and their Relationship to Consumption

Establishing a context for consumption is of paramount importance. This can be achieved in a variety of ways. Potentially the most important source of contextual information is the depositional context itself. However, this utility is always predicated both on the degree to which the context can be spatially and temporally defined and on how the context has been formed and transformed⁷². This in turn requires the employment of quantitative methods (see Chapter 9). Unfortunately, neither the choice of quantitative method nor the interpretation of its results are necessarily straightforward or uncontroversial: much depends on the degree to which real patterns of consumption have been distorted by differential breakage rates as well as subsequent processes of deposition, site formation and excavation (Orton et al. 1993:166-7). Ideally, only when ceramic material within contexts can be related back to equivalent vessels, can different contexts, if formed by different processes, be compared in a manner meaningful in terms of consumption (see Orton et al. 1993:166-72).

Approaches to quantification may also differ in regard to the questions they seek to answer. For example, the majority of previous attempts to quantify ceramic contexts at Knossos were firmly guided by the demands of seriation in the

⁷¹ This may be particularly true in small-scale societies, such as those of the EN Aegean, where producers were also very much consumers: thus the categories created in production are likely to reflect categories important to consumption (see Chapter 3).

⁷² The importance of selecting representative deposits is discussed in detail in Chapter 9.

construction of relative chronologies and *not* questions of consumption. Mackenzie counted the incidence of different types of decorated sherds as well as total sherds per metre of deposit and used the figures to compare strata dug below the Central Court and the West Court (Mackenzie 1903:159). Evans, by comparing the incidence per context of particular traits, such as shape, handle-type or decoration, sought "to facilitate the objective description of the material as a whole... with the hope that the results might eventually prove useful for purposes of comparison between sites" (Evans 1973:132; 134-5). Since the purpose of quantification, in both these cases, was seriation and since the typology in use has proved to be very coarse (see Chapter 7), one might question the utility of these data for the study of consumption (see discussion in Chapter 9)⁷³.

In addition to archaeological context, much information relevant to consumption can be gained from the vessels themselves. Thus, functional analysis, which considers such variables as shape, thickness, resistance to mechanical stress (hardness, strength), thermal behaviour, permeability/porosity/density (see Bronitsky 1986), can have an important role to play in outlining some of the potential uses to which material categories may have been put. However, the variation and flexibility in the ways communities from the ethnographic literature viewed their own pottery should caution against an overly functional interpretation of ancient ceramics (see above and Chapters 3-4). Further indications of context may be provided by study of use-wear, such as soot deposits, type and location of abrasion, evidence for mending as well as analysis of organic residues (Skibo 1992; Bronitsky 1986:220-33; Tite 1999:207-11, 218-22). Since consumption is integrally linked to exchange through the creation of value (see Chapter 3), evidence for the circulation of ceramic vessels may also provide useful information on consumption and on the differing roles ceramic vessels may have fulfilled during their life-cycle. Thus in the final analysis the study of consumption must be related to information gained from the study of production and exchange and set within a general consideration of the material and social possibilities and constraints potentially active in the society in question. It should be stressed, however, that acts

⁷³ cf. Broodbank's attempt to use Evans' data in his study of Neolithic ceramic consumption at Knossos and the subsequent critique by Whitelaw (Broodbank 1992; Whitelaw 1992).

of consumption also have a more active meaning, such as in the ways they serve to manifest social strategies or negotiate identity (see Chapter 3).

5.6 Creating an Integrated Methodology

"Ceramics is a complex industry and in order to understand its history correctly we need all possible lines of evidence and the closest possible cooperation between those engaged in the study" (Shepard 1966:86).

Classification and characterisation of a ceramic assemblage so as to facilitate the study of production, consumption and exchange requires the integration of a wide variety of data (e.g. fabric, form, finish, firing, frequency, use) collected using a variety of techniques (hand-specimen, petrology, SEM, chemical analysis). The necessity of integration is obvious: as has been consistently emphasised (see above and Chapters 3-4) acts of production, consumption and exchange may not only be studied individually by combining these forms of data in different ways, but may also be used to inform upon each other, since each is inextricably linked to the other as aspects of material and social reproduction.

5.6.1 Recording

The need to relate and integrate different types of data places particular demands on methods for collecting and recording data. Since at an early stage in fieldwork it was realised that fabric distinctions cross-cut established ware and shape categories (see Chapter 7), it was decided to sort first by fabric and then to use fabric as the basic unit within which to record variation in form, finish, firing, use-wear (e.g. abrasion, mending, sooting) as well as frequency (cf. Tite 1999:201). The explicit aim in this was to study the relationship between form, finish and fabric and to test whether variation in fabric correlated with variation in any other variables. This recording of inter-relationships between fabric, form and finish allowed variation to be studied at the level of the original vessel (see Chapter 9). This is particularly useful for the reconstruction of different vessel categories which may, as suggested in Chapter 3, have a particular relevance for consumption.

The need to examine these relationships also played a prominent part in the selection of samples for further analysis (petrographic, SEM). While the primary

aim was to sample all variation in fabric within the EN assemblage at Knossos, every attempt was made to choose samples which also contained information relevant to form, finish, firing and use. This allowed the examination of these inter-relationships to continue at a microscopic level. Over two field seasons (1997-1998) 240 samples were selected for petrographic examination and of these 56 were examined under a SEM.

5.6.2 *Integrating Different Techniques of Analysis: Problems and Solutions*

Successful integration also relies on the successful combination of archaeological field-work with archaeometric laboratory work. This task constitutes a long and ongoing struggle within ceramic studies (Widemann 1982:29-33; De Atley & Bishop 1991:359-60; Bishop & Lange 1991:2), the partial failure of which is underlined by the semantic separation of the task of archaeometry from the task of archaeology (van Zelst 1991:346). In their brief review, Bishop & Lange (1991:1-2; cf. Widemann 1982:29-30; De Atley & Bishop 1991) highlight several areas of difficulty, chief among them being the functional separation between scientists and archaeologists and the inevitable communication barriers that arise when research fields becomes multidisciplinary rather than interdisciplinary. The result of this has been an over-emphasis on analytical techniques, an under-emphasis on the development of compatible methodologies and interpretative frameworks⁷⁴ and a lack of awareness by archaeologists of analytical error and by scientists of the social/material basis of variation in analytical data. One consequence of this separation is 'appendix syndrome', where results of scientific analyses are relegated to appendices at the end of publications, creating an 'illusion of scientific rigour', but with rarely any attempt to integrate them within the main body of interpretation⁷⁵ (Beaudry 1991:250; De Atley & Bishop 1991:360).

⁷⁴ Adopting analytical techniques from materials science enriches archaeological enquiry, but as they comprise only one component of archaeological methodology they are not sufficient for understanding technology. As a result there is a clear need for interpretative frameworks within which different forms of analysis can be situated (De Atley & Bishop 1991; see Chapters 3-4).

⁷⁵ A good Neolithic example of 'appendix syndrome' is Coghlan's thin-section study of LN and LC pottery from Aphrodisias (Joukowsky 1986:297-302): the study is purely mineralogical and based solely on a small group of samples and unsurprisingly receives little mention in the final interpretation.

Clearly one important barrier to integration is the range and depth of knowledge required to combine archaeological and archaeometric data successfully (Widemann 1982:30). There is widespread pessimism that a single individual can combine all the skills necessary to conduct to perform pottery analysis (a thorough knowledge of geology, clay mineralogy, manufacturing techniques, training in taxonomy, field and lab processing procedures, research design, problem formulation). It is generally thought more reasonable to envisage groups of individuals from different disciplines collaborating closely (Widemann 1982:32-3; Beaudry 1991:253; Tite 1999:182-3). However, to be successful collaboration requires good *communication* and importantly *continuity*, that is continuity in problem formation, in sample selection and in data interpretation. This requires projects to be carefully structured: collaborative projects should not be planned in terms of equal but separate specialist partners, but must be led by individuals who are closely associated with all stages of the project and all forms of analysis. These individuals must combine knowledge in all of the above areas, although the presence of specialists frees them from the task of acquiring a deep understanding of all techniques. For example all analyses for this doctoral project were run by myself with advice and training supplied by various experts, who also provided advice on the final interpretation. In this way I could always keep in mind the archaeological questions as I compared and contrasted the results of various analyses.

The organisational structure should be a simple reflection of the structured use of different analytical techniques within a single initial research design, specifically aimed to address the archaeological concerns in question (see De Atley & Bishop 1991:370-1). Over three decades ago Shepard stressed that different analytical techniques provide different sorts of information and that archaeologists should therefore evaluate which technique might best answer their particular archaeological questions and preferably "combine different methods in a complementary or supplementary way" (Shepard 1965:viii-xi). However, since this important statement, there has been a consistent failure to correlate method with stated objective. Rather choice of technique seems to relate more closely to its ready availability, rather than a critical assessment of which method might be best suited

to which particular question (cf. Widemann 1982:29-30; Beaudry 1991:251). Within Bronze Age Cretan ceramic studies there are several examples of good practice: some of the best work has been conducted by Wilson, Day and Kilikoglou who have successfully integrated macroscopic study with petrographic and SEM analyses to produce important insights into EBA ceramic production, consumption and exchange (e.g. Wilson & Day 1994; Kilikoglou 1994).

5.6.3 Integrating Data and Techniques in Studies of Neolithic Aegean Ceramics

Some of the methodological problems associated with integrating techniques and data may be illustrated by a consideration of some recent studies of Neolithic Aegean ceramic assemblages. In the past two decades, there have been detailed macroscopic studies of fabric, form and finish (e.g. Vitelli 1993a); there have also been large-scale microscopic analyses of Neolithic assemblages, both petrographic (Courtois 1981) and combined petrographic and SEM (Schneider et al. 1991b). However no study of Neolithic ceramics has ever truly succeeded in combining these three scales of analysis within a single integrated research methodology.

Vitelli has argued that the size of sample chosen for chemical and petrographic characterisation may be insufficient to render the greater variability in composition exhibited by Neolithic fabrics (1993a:13-19). However, while Neolithic fabrics in hand specimen may well exhibit a greater variation than later fabrics, at a microscopic level a much broader range of grain sizes are visible and identifiable: indeed all variation should be easily comprehensible within a single thin-section and may be checked through comparison with other thin-sections from vessels in the same fabric⁷⁶ (Day 1995a:3). Regarding optical emission spectroscopy (OES), Vitelli is correct to emphasise the dangers of using percentage CaO to discriminate between calcite tempered and calcareous fabrics: here irregularity in the distribution of non-plastics will produce irregular groupings.

⁷⁶ Even the crudest Neolithic fabric has been subject to several mixing processes which will help to produce homogeneity: naturally occurring clays are all subject to natural sorting, added to this are the inevitable stages in human processing, such as crushing and mixing with water, which usually occur to make a clay workable.

However the final conclusion drawn is that OES is of no use at all, rather than that is just not best suited to the particular circumstances.

Implicit in this criticism is the assumption that all analytical techniques are essentially equivalent and interchangeable, equally appropriate to the study of technology and provenance. This assumption can be found in other analytical studies of Neolithic ceramics: only rarely are the results of one technique discussed within the context of the results of another (cf. Schneider et al 1991a) and even when this happens analytical data may be treated with suspicion and even rejected, particularly if they contradict initial conclusions drawn from macroscopic study (e.g. Vitelli 1993a:13-19)⁷⁷.

Such problems illustrate the importance of good communication between different fields of expertise. For Franchthi analytical results were given in the form of a final report presented as an end product (see Jones 1980 cited in Vitelli 1993a:266). As a result such data becomes a take-it-or-leave-it proposition, rather than something negotiable. Simple communication can, however, resolve many initial misunderstandings: for example, although petrological study of 'Serpentine Ware' did not show serpentine to be present in large quantities (Vitelli 1993a:19 n.4; Jones 1986:398-9, pl.4.7[a]), this is not so much an example of how "a thin section can miss mineral inclusions present in much of the rest of the sherd", but rather an indication that petrology provides a more accurate characterisation of mineralogy than simple macroscopic examination⁷⁸. Dialogue between the different parties would have enabled these supposedly contradicting results to be understood and would also have enhanced the characterisation of this fabric.

However, these interpretative problems also result from a failure to integrate different analyses at the *initial* stage of research design. In an analytical programme designed for Neolithic ceramics, different analytical techniques should *not* be used

⁷⁷ Vitelli appears to have become so suspicious of petrology that when two samples are judged to have "no carbonate inclusions", but are shown by OES to be c.15-17% CaO, then she resists the obvious conclusion that the clay itself is calcareous, preferring to believe that petrology mis-characterised the fabric (1993a:16-17). Ironically the *integration* of petrology with chemical compositional analysis can provide a powerful means of characterising ceramic pastes (Maniatis et al. 1984; Rands & Bargielski Weimer 1992; Stoltman, Burton & Haas 1992).

⁷⁸ In her description of the section in question Pomoni-Papaioannou mentions "fragments of sandstones... serpentinite and basic igneous rocks" (Jones 1986:396). Thus petrology does show the presence of serpentinite but undermines its presumed dominance.

interchangeably. Rather emphasis should be on the *structured* use of such techniques: that is the use of the technique which is most appropriate to answer a specific archaeological question and the use of techniques which complement each other. To return to the quote which introduces this chapter, it is not a surprise that Vitelli was forced to invent a new way of studying pottery when faced with Neolithic material. As noted in Chapters 2 and 7, conventional ware-based types of classification, successfully used on integrated analytical studies of Bronze Age material (e.g. Wilson & Day 1994), may not be able to characterise the full range of variation within a Neolithic assemblage, largely because the products of different dispersed production locations often appear to be visually indistinguishable (see Chapter 7), a situation quite unlike that encountered in the EBA (e.g. Wilson & Day 2000:57). Clearly the only way to study the full range of variation is to focus first on fabric. Thus, for Franchthi as for other Neolithic assemblages, petrology would represent a better 'front-line' technique than chemical composition analysis. Chemical analysis, although more accurate and 'objective' than petrology, may be particularly unsuitable as a front-line technique for the analysis of highly diverse assemblages, such as those of the earlier Neolithic, because it translates ceramic variability into a compositional continuum and therefore makes it more difficult to judge where the dividing lines are between ceramic groups without the use of complex statistics. Petrology can get round this problem precisely because it is more subjective, since it allows decisions of grouping to be taken by the analyst. Petrology is also highly suitable partly because it is relatively 'low-tech', partly because Neolithic fabrics lend themselves to it through their coarseness, but also because it serves to clarify and control macroscopic observations of fabric by providing more detailed technological and geological information (see above).

Conclusions

Through the combination of macroscopic and microscopic (petrology, SEM) forms of analysis, it becomes possible to characterise and describe some of the past material actions involved in the production, circulation and consumption

of ceramic vessels. A recurring theme in this discussion of methodology has been the importance of relating macroscopic observations of fabric, form, finish and firing to the results of microscopic and elemental analysis. This process of integration must be two-way or dialectic allowing conclusions drawn from study at each level to have their impact at other levels. This requires that different analyses are fully integrated into research design from the outset. The great benefit of this approach is that it characterises variation in detail and allows the study of how different forms of variation may articulate with each other at several levels.

In the next four chapters the results of the different analyses will be presented, beginning with petrographic study of fabric (Chapter 6) and followed by macroscopic study of form and finish (Chapter 7), SEM (Chapter 8) and finally the quantitative data (Chapter 9). The ceramic production process can be understood in terms of a sequence of necessary stages (see Figure 5.1), at each of which the potter exercises choices that are socially-informed and context specific. Therefore, when acts of production, circulation and consumption, as revealed by various analyses, are placed in their wider social, material, spatial and temporal context, they provide a window upon some of the choices, strategies and values that lie behind these activities. Thus the results presented in Chapters 6-9, will form the basis of separate discussions of EN ceramic technology (Chapter 10), production organisation (Chapter 11), exchange (Chapter 12) and consumption (Chapter 13). In Chapter 14 the conclusions drawn from each of these chapters will be compared and contrasted in order to explore how these different types of activity articulate and interrelate. In this way analytical data of a variety of types may ultimately be used to explore some of the many ways in which different people and different ceramic vessels were mutually entangled over the course of the earlier Neolithic at Knossos.

CHAPTER SIX

PETROGRAPHIC EXAMINATION

In Chapter 2 the issue of fabric diversity in studies of Neolithic ceramics from the Aegean was isolated as an area of considerable difficulty. What might be the limits of variation within a Neolithic ceramic assemblage? Moreover, if fabric diversity is a feature of all Neolithic assemblages, how should this variation be interpreted? Finding answers to these questions requires a commitment to the pursuit of variation of all forms. Thus in the subsequent three chapters the EN assemblage at Knossos will be characterised in terms of macroscopic variation in form and finish (Chapter 7), microscopic (SEM) study of finishing and firing (Chapter 8) and frequency (Chapter 9). In this chapter mineralogical and textural variation in fabric will be characterised and its significance discussed. This discussion is based on detailed petrographic analysis of 240 samples of ENI-II ceramic material. Full petrographic descriptions with extensive comment can be found in Appendix V. Further discussion of fabric variation and its significance can be found in Chapter 10.

6.1 The Relationship Between Macroscopic and Petrographic Fabric Groupings

Since macroscopic and microscopic observations of fabric operate at different resolutions on a visual continuum, groupings visible at higher resolution under the microscope may not be so easily identified macroscopically. This presents no problem for the study of petrographic groupings *per se*. However, since one of the aims of this thesis is the exploration of the inter-relationship between forms of ceramic variation of a variety of types and at a variety of levels of resolution, it is important to be clear regarding where petrographic groups can and cannot be identified macroscopically. Figure 6.1, which lists macroscopic fabric groups and their petrographic equivalents, reveals that in the majority of cases it is possible to isolate petrographic groupings macroscopically.

Petrog · Fabric s	Macrosc. Fabrics	Description
1a	1	calc., rare quartz, fine-grained sparite (97/4, 97/7, 97/22, 97/49, 97/51, 97/62, 97/107, 97/118, 98/1)
1b	2	calc., rare quartz, crushed fine-grained sparite (97/53, 97/55, 97/81, 97/83, 97/116, 97/117, 97/130, 97/135, 97/136, 98/71, 98/97)
1c	2	calc., rare quartz, coarsely/finely crushed fine-grained sparite (97/65, 97/103, 97/119, 97/120)
1d	3	calc., rare quartz, biomicrite/micrite, +/- grog (97/84, 97/105, 97/109, 97/111, 97/115, 98/51, 98/53, 98/54, 98/70, 98/85, 98/98)
1e	4	calc., rare quartz, crushed euhedral calcite, biomicrite (97/50, 97/121, 97/126, 97/127, 97/132, 98/79, 98/82, 98/86, 98/95)
1f	5	calc., rare quartz, crushed coarse-grained sparite (97/125, 97/131, 97/134, 98/76, 98/81)
1g	4	calc., rare quartz, euhedral calcite, coarse-grained sparite, biomicrite (97/133)
1h	3	calc., rare quartz, biomicrite/micrite + sandstone (97/122)
1i	3	calc., rare quartz, grog, sparite/micrite (97/40, 98/68, 98/69, 98/75)
2a	6	low/non calc., fine quartz-rich, chert, sparite (97/24, 97/37, 97/64, 97/85, 98/2, 98/5, 98/24, 98/34, 98/37, 98/42, 98/50)
2b	6	low/non calc., fine quartz-rich, chert, micrite/biomicrite (97/2, 97/3, 97/5, 97/44, 97/54, 97/63, 97/66, 97/82, 97/104, 97/106, 97/110, 98/3, 98/6, 98/36, 98/38, 98/49, 98/56, 98/77, 98/84)
2c	5	low/non calc., fine quartz, chert, crushed coarse-grained sparite (97/42, 97/58, 98/58, 98/72)
2d	6	low/non calc., fine quartz, biomicrite, calcareous sandstone (98/74)
2e	6	low/non calc., fine quartz-rich, biomicrite, grog (97/46)
3	-	Fabric 1b + Fabric 1d (97/140)
4	7	low/non calc., rounded quartz and chert, micrite (97/25, 98/25, 98/73)
5a	8	low calc., fine quartz, micrite/calcmudstone biotite/muscovite, (97/9, 97/15, 97/23, 97/29, 97/48, 97/52, 97/87, 97/93, 97/95, 97/98, 97/99, 97/112, 97/113, 97/114, 97/123, 97/128, 97/129, 98/39, 98/41, 98/52, 98/63)
5b	9	low/non calc., fine quartz, micrite/calcmudstone, foraminifera, (98/9)
5c	10	low/ non calc., calcareous sandstone/siltstone (98/57)

Figure 6.1 The Relationship Between Macroscopic and Petrographic Fabric Groups for Early Neolithic Knossos

Petrog · Fabric s	Macrosc. Fabrics	Description
6	11	non-calc., quartz-rich, altered volcanic, siltstone/sandstone, dolerite (97/8, 97/13, 97/21, 97/45, 97/67, 97/68, 97/74, 97/80, 97/96, 97/97, 98/12, 98/13, 98/14, 98/15, 98/16, 98/18, 98/23, 98/31, 98/61, 98/64, 98/100)
7	12	non calc., dolerite, fine-grained sparite (97/6, 97/14, 97/17, 97/26)
8	13	non-calc., quartz-rich, siltstone/pelite, micrite (97/1, 97/19, 97/20, 97/31, 97/35, 97/47, 97/69, 97/70, 97/75, 97/94, 98/8, 98/11, 98/19, 98/27, 98/28, 98/30, 98/45, 98/46, 98/55, 98/59, 98/60, 98/66, 98/93)
9	14	non-calc., quartz, pelite/phyllite (97/34)
10	15	non-calc., quartz-rich, serpentinite, silt/sandstone, mafic rocks (97/56, 97/71, 97/108, 98/40, 98/47, 98/48)
11	16	non-calc., quartz-rich, fine-grained phyllite (97/16, 97/18, 97/78, 97/102, 98/7, 98/17, 98/62, 98/67)
12	17	non-calc., feldspars, quartz, biotite, altered igneous rocks, phyllite (97/27, 97/41, 97/137, 97/138)
13	18	non-calc.(?), fine quartz, chlorite, calcite, phyllite (97/12, 98/4)
14	19	non-calc., quartz-rich, biotite, quartz-biotite phyllite/schist (97/10, 97/28, 97/32, 98/7, 98/65, 98/94)
15	20	low/non calc., fine quartz, organics, foraminifera (97/57, 97/88)
16	21	non calc., quartz-rich, crushed euhedral calcite (97/91, 97/100)
17	22	non calc.(?), quartz-rich, calcareous siltstone (98/77, 98/99)
18	23	low calc., fine quartz, micrite/biomicrite, shell, sand (97/11, 97/89, 97/90)
19	24	calc., quartz-rich, microfossils, pelite/phyllite (97/30, 97/72, 97/92)
20	10	calc., rare quartz, siltstone/pelite/phyllite (98/33)
21	25	non-calc., quartz-rich, bioclastic limestone/marl, chert, phyllite, biotite (97/33, 98/20, 98/35)
22	39	non-calcareous(?), fine quartz, marl, sandstone, phyllite, igneous rocks (97/124)
23	26	calc.(?), quartz, micrite, foraminifera (97/60, 97/61)

Figure 6.1 (Continued) The Relationship Between Macroscopic and Petrographic Fabric Groups for Early Neolithic Knossos

Petrog. Fabric s	Macrosc. Fabrics	Description
24	27	low calc.(?), micrite, phyllite, opaques (97/39, 98/29, 98/43, 98/44)
25	28	non calc., fine quartz, white mica, phyllite/coarse siltstone (98/92)
26	29	non-calc., fine quartz, siltstone/pelite, metamorphics, opaques (97/73, 97/76, 98/91)
27	30	calcareous, grog, organics, rounded phyllite (98/26, 98/83)
28	31	non calc., large quartz, grog, quartz-biotite phyllite/schist (97/36, 97/79, 98/21, 98/22, 98/87, 98/89, 98/96)
29	32	low/non calc., fine quartz, grog, limestone, phyllite (97/86)
30	33	low/non calc., fine quartz, biotite, siltstone/pelite (98/90)
31	34	non calc., siltstones, biotite (97/101)
32	35	non calc., quartz-epidote phyllite/schist (98/78)
33	36	non calc., quartz-rich, amphibolite, altered igneous, phyllite (97/59)
34	37	non calc., quartz-rich, dolerite, altered igneous, phyllite/schist (98/80, 98/88)
35	38	non calc., quartz and biotite-rich, blueschist (97/43, 98/10)
-	40	non-ceramic calcareous, quartz-rich, foraminifera, micrite (97/38)

Figure 6.1 (Continued) The Relationship Between Macroscopic and Petrographic Fabric Groups for Early Neolithic Knossos

Petrographic groups, which resist macroscopic identification tend to be those which comprise one or two samples which are very closely related whether mineralogically and/or technologically to one of the main petrographic groups: petrographic group 1c is closely linked petrographically to group 1b and together they comprise macroscopic group 2; petrographic groups 1g and 1h are closely linked petrographically to group 1d and together these comprise macroscopic group 3; petrographic groups 2a, 2b, 2d and 2e are closely linked and together comprise macroscopic group 6. Throughout the thesis wherever fabrics are referred to, these are the *petrographic* fabric groupings.

6.2 Inter-Group Relationships: Mineralogy, Technology, Provenance

The pursuit of variation in the petrographic study of ceramics in thin-section involves a delicate balancing-act between giving proper consideration to mineralogical and textural *differences* on the one hand and on the other seeking always to identify *similarities* wherever possible. In addition, this research is one of the first major, multi-sample petrographic studies of Neolithic ceramics to be conducted and as a result there were no prior indications as to what the best criteria for group formation might be. A conscious attempt was made throughout to maintain a strict consistency in the criteria employed in the forming of petrographic groups. Thus, prior to their description, samples were grouped into fabrics on the basis of similarities and differences observed *both* in non-plastics *and* in clay groundmass.

Although in most cases fabrics may be defined by the consistent association of a particular suite of large non-plastic inclusions with a particular clay groundmass, this does not prevent the existence of links between different fabric groups. Consideration of these links is important because their significance may vary. Some fabrics may be grouped together because of general mineralogical similarities in their non plastic inclusions, such as the presence in several fabrics of low grade metamorphic rocks (e.g. Fabrics 5a, 8, 14, 19, 21). Although demonstrating a common geological origin, this need not necessarily translate into a single source since most Cretan geological formations are repeated across the whole island (see Appendix III). Other fabrics, however, may have a closer relationship: some have similar groundmasses and/or large non-plastics and only differ in terms of their texture and packing (e.g. Fabrics 8 and 9); others differ only in the presence of additional large non-plastics. An example of the latter is Fabric 1h, which is otherwise identical to Fabric 1d, except that it also has large sandstone inclusions. Links of this sort between fabrics may well indicate a shared source or a related ceramic technology. In the following discussion the degree to which different fabrics relate to each other and the nature of any relationship will be assessed. More detailed discussion of these relationships can be found in the comment section at the end of each fabric description (see Appendix V).

(1) Limestone/Marl

By far the largest group of fabrics are rich in calcareous non-plastic inclusions of a variety of types (cf. Fabrics 1a-i, 2a-e, 3, 4, 5a-c, 7, 16, 17, 18, 21, 22, 23, 24). Of these fabrics, perhaps the most important are Fabrics 1a-i and 2a-e, since together they comprise at least half of any EN deposit (see Chapter 9). These fabrics share a number of close similarities (see Plates 1-10). Fabrics 1a-i share a very similar groundmass (calcareous, rare quartz, ostracods) and generally differ only in the form and packing of their limestone non-plastics (see Section 10.2.1). Likewise Fabrics 2a-e share a similar clay groundmass (non-calcareous, quartz-rich), which is different to the groundmass of Fabrics 1a-i; Fabrics 2a-e only differ from each other in the form and distribution of their limestone inclusions. The form and distribution of limestone non-plastics also links some fabrics in Fabrics 1a-i to those of Fabrics 2a-e: for example the limestone in Fabric 1f is similar to that of Fabric 2c (well-packed, crushed, coarse-grained sparite), the principle difference being that Fabric 2c is red-firing and richer in quartz; in a similar way (cf. Plates 5 and 9); Fabrics 1d and 2b sometimes share comparable types of bioclastic limestone (cf. Plates 3 and 8). In general these similarities support the existence of close technological links between Fabrics 1a-i and 2a-e, which may indicate a common origin. A single sample of an untempered piece of clay (see Appendix V, sample 97/38), indicating the mixing of a calcareous clay rich in micrite and foraminifera with a red, quartz-rich clay, might also support a connection between these fabrics. Although the mineralogy of Fabrics 1a-i and 2a-e is not indicative of provenance it would be compatible with a source within the immediate area of Knossos (<5km) (cf. calcareous clays, bioclastic limestone; see Appendix III).

Other fabrics dominated by limestone exhibit more marked differences from Fabrics 1a-i and 2a-e.

Fabric 4 has a different form of limestone (micrite with iron concentrations and quartz) and also contains larger rounded quartz grains and lacks foraminifera. The micrite in Fabric 4 shares some similarities with that in Fabric 24 although lacks

its silty component; moreover the groundmass of Fabric 24 is different (opaques, phyllite, fine quartz)

Fabric 5a may be distinguished on the basis of its distinctive form of limestone (calcimudstone) and groundmass (quartz-rich containing mica, chert and often quartz-mica schist) (see Plate 11). *Fabric 5b* only differs from 5a in having more foraminifera and is therefore considered closely related to Fabric 5a. *Fabric 5c* is dominated by calcareous siltstones of a type which do not find close parallels in other fabrics; however its groundmass is similar to that of Fabric 5a (fine quartz, mica, chert, quartz-biotite schist).

Fabric 7 contains fine-grained sparite which is very similar to that found in Fabrics 1a-c, however its groundmass is different (red firing, quartz-rich, doleritic rocks, sandstone) (see Plate 12). It remains unclear whether this similarity is coincidental or whether there is a link between Fabrics 7 and Fabrics 1a-c. The groundmass of Fabric 7 is very similar to one of the clay components of Fabric 6 (red-firing, quartz-rich, doleritic rocks, sandstone) and suggests that a technological link exists between these two fabrics. This may mean that they share a common provenance.

Fabric 16 contains crushed euhedral calcite not unlike that found in Fabric 1e; however Fabric 16 differs in both groundmass (red-firing, quartz rich, quartz-biotite schist) and in the presence also of quartz sand, which was possibly also added as temper.

Fabric 17 contains calcareous siltstones in a red-firing groundmass, which is rich in quartz and also contains chert, biotite, quartz-biotite phyllite. In general there is quite some variation in the form of the calcareous siltstones between the two samples of this group. Stronger similarities exist in the groundmasses of these two samples (very rich in quartz); however this remains a poorly defined group. Its separation from other groups may be justified on the basis of the combination of a quartz-rich groundmass with calcareous siltstone. Some of the calcareous siltstones resemble those found in Fabric 5a, although others do not; moreover the groundmass of Fabric 17 appears different (more quartz).

Fabric 18 contains a distinctive form of fossiliferous or 'shelly' limestone in a groundmass, which contains fine quartz and sand (quartz, chert, siltstone and phyllite). *Fabric 18* has no close parallels.

Fabric 21 has a calcareous component which varies from large shell fragments to foraminifera, micrite and sparite. Since the form of calcite may vary between samples, this is a somewhat varied group. The main feature which links all samples is the presence of a very quartz-rich groundmass, which also contains some low grade metamorphic rocks (siltstone/pelite). These low grade metamorphic rocks generally resemble those that occur in other fabrics (e.g. *Fabric 8*; see (2) below).

Fabric 22 is characterised by yellow/brown-firing clay groundmass, which contains rounded micrite together with fine quartz, biotite, siltstone/sandstone, rounded phyllite and igneous rock fragments. It is not clear whether the micrite was added as temper or forms part of the clay component.

Fabric 23 contains micrite and microfossils which are similar to those found in other fabrics (e.g. *Fabrics 2b*). This fabric differs from others in having large rounded quartz grains in the groundmass.

Fabric 24 contains micrite, with iron concentrations, which appears similar to some of the micrite found in other fabrics. However, this micrite differs in sometimes having a silty component. Moreover the groundmass of *Fabric 24*, which contains fine quartz, chert, feldspar, phyllite and opaques finds no close parallels.

In general, therefore, this group of fabrics exhibits sufficient differences from each other in the nature of their calcareous inclusions and/or the composition of their groundmass to allow their confident separation. Thus, unlike *Fabrics 1a-i* and *2a-e*, there appears to be no strong reason to associate them in terms of provenance. That is not to say, however, that they exhibit no relationship with each other. Indeed several recurring elements within these groups suggest that they might have a related geological origin: one might compare the frequent presence of large bioclastic limestone inclusions and/or foraminifera, ostracods, micrite with iron concentrations and epidote in the groundmass. None of these

features are diagnostic of a specific origin and therefore the provenance of these fabrics must remain open. However, all would in general be consistent with an origin in north-central Crete (bioclastic limestones, marls).

(2) Low Grade Metamorphic Rocks

A number of fabrics are characterised by the presence of low grade metamorphic rocks.

Fabric 8 is dominated by phyllite rock fragments (see Plate 13). Often these exhibit the relict texture of a siltstone (pelite). The groundmass of Fabric 8 is rich in quartz and also contains biotite mica, chert, quartz-biotite schist as well as a calcareous component (micrite, biomicrite, sparite). The siltstone/pelite in Fabric 8 resembles the siltstone/pelite in Fabrics 6 (see (3) below), 9, 19, 20 and 21 (see (1) above). The closest similarities are with Fabric 9, which appears to be a technological variant.

Fabric 9 is also dominated by phyllite rock fragments, which are indistinguishable from those in Fabric 8. In addition, there are also similarities in the groundmasses of these two fabrics (quartz, biotite, rare chert) and these two groups differ only slightly in terms of texture. It is therefore considered likely that Fabric 9 is a technological variant of Fabric 8 and that they both share a common provenance.

Fabric 11 contains phyllite rock fragments. In general these lack any trace of a relict siltstone texture and thus do not resemble the phyllite rocks in Fabrics 8, 9, 20 and 21. The groundmass of Fabric 11 also differs from that of other fabrics in Group 2: it is rich in quartz, biotite and contains also chlorite pseudomorphs as well as other metamorphic rocks. Fabric 13 (see (3) below) also contains chlorite and phyllite, however the chlorite is dominant and the phyllite rare; moreover the groundmass is poorer in quartz than examples of Fabric 11.

Fabric 14 is dominated by a type of quartz-biotite schist, which finds few parallels in other fabrics. The closest parallel is the quartz-biotite schist in one of the clay components of Fabric 5a (see Section 6.4). The groundmass of Fabric 14 contains quartz, biotite, opaques and rounded phyllite. Comparison of Fabric 14 with later

EBA material from Knossos indicates links with an EMII low grade metamorphic cooking pot fabric (i.e. Group 4, Wilson & Day 1999:38-9, 50-2).

Fabric 19 combines large phyllite non-plastics with a yellow-firing groundmass which is generally rich in foraminifera and ostracods. The phyllite may be compared to pelite/phyllites in Fabrics 8, 9, 20 and 21.

Fabric 20 contains phyllite in a yellow-firing groundmass, which also contains calcite, opaques and rare quartz. This combination of groundmass and non-plastics finds no close parallels in other fabrics. The phyllite would appear to link in general to similar low grade metamorphic rocks in Fabrics 8, 9, 19 and 21.

Fabric 25 contains large phyllite and siltstone non-plastics in a groundmass which also contains white mica. These inclusions are not particularly distinctive and the fabric is best defined by the association of phyllite and siltstone in a groundmass containing white mica. It remains unclear how Fabric 25 may or may not relate to other fabrics.

Fabric 26 also contains siltstone/pelite, however this differs from that found in other fabrics, such as Fabric 8, in frequently having opaque areas, which are oriented parallel to the bedding plane. In addition the groundmass of Fabric 26 differs from that of Fabric 8 in containing finer quartz grains, more metamorphic rock fragments, more opaques and no calcareous component.

Fabric 30 contains large siltstone/pelite non-plastics in a groundmass rich in biotite and quartz. The degree to which Fabric 30 resembles other fabrics is masked by the isotropic nature of the sample.

In general this group comprises a mixture of fabrics. Several (i.e. Fabrics 8, 9, 19, 20, 26, 30) contain phyllite, which in general preserves relict siltstone textures (pelite), while others contain phyllite, which is consistently more fully altered (i.e. Fabrics 11, 14). Several other fabrics also contain small quantities of pelitic rocks (i.e. Fabrics 6, 21). All of these rocks would seem to originate in low grade metamorphic deposits, such as those which characterise the Phyllite-Quartzite series of Crete. The nearest outcrops of this to Knossos are to the east or west of the Herakleion basin or possibly around Iouktas (see Appendix III).

Therefore none of these fabrics are likely to have a provenance within the immediate area (<5km) of Knossos.

(3) Igneous and Altered Igneous Rocks

A small group of fabrics are characterised by the dominant presence of igneous and/or altered igneous rocks.

Fabric 6 is characterised by the distinctive combination of doleritic and altered basaltic(?) rocks (see Plate 14). The doleritic rocks closely resemble those in *Fabric 7* and suggest a close relationship between these two Fabrics, which may indicate a common provenance. Comparison with later EBA material from Knossos suggests a close link between *Fabric 6* and an EMIIB cooking pot fabric (i.e. Group 3, Wilson & Day 1999:48-50).

Fabric 10 contains a distinctive combination of large serpentinite inclusions in a groundmass containing mafic rock fragments. This fabric has no close parallels with other fabrics.

Fabric 13 is dominated by chlorite rock fragments in a clay groundmass containing fine quartz. The chlorite is intercalated with calcite. This fabric has no close parallels with other fabrics. Chlorite is present in small quantities in Fabrics 10 and 11.

Fabric 34 contains large doleritic and altered igneous rocks in a groundmass that also contains quartz-biotite schist and siltstone/pelite. The presence of doleritic and altered igneous rocks suggests comparison with *Fabric 6*. Unlike *Fabric 6* *Fabric 34* also contains more metamorphic rocks of a different texture (quartz-biotite phyllite/schist).

The altered volcanic and doleritic inclusions in Fabrics 6 and 34, the serpentinite and mafic rocks in *Fabric 10* as well as the chlorite in *Fabric 13* may have an origin within the ophiolite series of Central Crete, the nearest outcrops of which are in the foothills of mount Ida or near Galeni and Roukani to the south of Iouktas (see Appendix III). Altered igneous rocks are common in both modern and ancient pottery from the site of Kanli Kastelli, which also lies to the south of Iouktas. The closest source for the serpentinite in *Fabric 10* would appear to lie

further afield in the region of Goniae on the eastern flanks of Mount Ida (Riley 1983:289-90; see Appendix III).

(4) Granodiorite Rocks

Fabric 12 is a distinctive fabric characterised by the presence of granodiorite rocks (large grains of feldspar, quartz and biotite mica) together with altered basic igneous rocks and phyllite (see Plate 15). These various components are inconsistent with an origin in the area of Knossos. The presence of granodiorite rock fragments, altered basic igneous rocks and phyllite in Fabric 12 compares closely to EM and later fabrics for which an origin has been established in the Isthmus of Ierapetra, East Crete (see Day 1991; Day et al. in press). Although granitic rocks occur elsewhere on Crete, such as in the Asteroussia, the combination of granodiorite, altered basic igneous rocks and phyllite only finds parallels in the Isthmus. In addition comparison of examples of Fabric 12 with Neolithic material from the site of the modern village of Kavousi (Locus 92/17, see Haggis 1995:173-4; see Appendix I), situated on the northern coast of the Isthmus (Bay of Mirabello), suggests that the two are so close as to be indistinguishable (cf. Kavousi 93/69). This would serve to support a provenance for Fabric 12 in the Mirabello Bay area of East Crete.

(5) Organic Material

Although most fabrics contain small quantities of burnt or partially burnt organic material, only two fabrics appear to have been deliberately tempered with organics. These appear as distinctive voids, which preserve the shape of the organic material after it has been burnt away during firing.

Fabric 15 is dominated by such voids (see Plate 16). The groundmass shares close similarities with the groundmass of Fabrics 2a-e (red-firing, quartz, biotite, chert, rare foraminifera, occasional altered igneous and sandstone rocks). It therefore remains possible that the provenance of Fabric 15 relates closely to that of Fabric 2a-e.

Fabric 27 is tempered with a mixture of grog and organics (see (6) below).

(6) Grog

A group of rare fabrics are grog tempered.

Fabric 27 contains grog and organic temper in a fine calcareous groundmass, which also contains rounded phyllites. Fabric 27 shares no close similarities with other fabrics. Although the clay is calcareous and in this sense resembles calcareous clays in Fabrics 1a-i, the presence of rounded phyllite rock fragments mark it out as different and moreover suggest that Fabric 27 is inconsistent with a provenance within the immediate area (<5km) of Knossos. Provenance remains open.

Fabric 28 contains grog in an orange to brown firing clay groundmass, which also contains large quartz grains, chert and some quartz-biotite schist. Like Fabric 27 this fabric shares no close similarities with other fabrics. The closest fabric is Fabric 29. Provenance remains open.

Fabric 29 contains grog in a groundmass, which is rich in fine quartz and which also contains biotite, chert and quartz-biotite phyllite. Fabric 29 differs from Fabric 28 in having finer quartz. Provenance remains open.

These fabrics all share the distinctive combination of grog temper in a groundmass that also contains metamorphic rocks. Their mineralogy contains nothing diagnostic of source and thus a specific provenance cannot be ascribed. Grog tempering is also a rare feature of Fabrics 1a-i and 2a-e (i.e. Fabrics 1d, 1i, 2b and 2e). It remains possible that some relationship exists between Fabrics 1d, 1i, 2b and 2e and the grog-tempered fabrics of Group 6, however the groundmasses of Fabrics 1a-i lack the type of metamorphic material that is found in Fabrics 27-9.

(7) Unique Fabrics

The final category considered here consists of a mixed group of fabrics, which bear little or no resemblance either to each other or to other fabrics at EN Knossos.

Fabric 31 contains large siltstone non-plastics in a groundmass which is rich in lath-like biotite mica (see Plate 17). Clays rich in biotite mica are rare on Crete (cf. area of the Isthmus of Ierapetra) and moreover none contain the type of lath-

like biotite which is such a feature of Fabric 31. The closest known parallels for this fabric occur in a fabric from Mochlos, for which an off-island provenance has been suggested (Day et al. in press). It is therefore considered likely that the source for Fabric 31 lies beyond Crete.

Fabric 32 contains quartz-epidote schist in groundmass, which is rich in quartz and white mica. Provenance remains open, but cannot be within the immediate area (<5km) of Knossos.

Fabric 33 contains amphibolite in a groundmass which contains quartz, biotite, amphibole, phyllite and altered igneous rocks. Provenance remains open.

Fabric 35 contains glaucophane-schist (blueschist) in a groundmass rich in quartz, biotite and quartz-biotite schist (see Plate 18). Although blueschists do occur on Crete (e.g. Preveli, West Crete), they are far more common in the Cyclades and also occur in coastal Anatolia (e.g. Knidian peninsula). The only blueschist fabrics found in a recent study of EM pottery on Crete come from the site of Poros to the north of Knossos and are considered to have an off-island provenance (P.M. Day pers. comm.).

6.3 Secondary Calcite Formation

In several of the petrographic groups listed in Figure 6.1, the primary form of large calcareous non-plastic inclusions was used as one of the main criteria by which samples were grouped or separated (see Fabrics 1a-i, 2a-e, 3, 4, 5a, 5b, 5c, 7, 16, 17, 18, 21, 22, 23, 24). The classification of limestone by form that was followed in this study is that first proposed by Folk (1974:156ff.) and is based on a primary distinction between sparry and micritic calcite (i.e. micrite = grain-size of <0.05mm). Since the primary or original form of calcite may become altered through a variety of processes active either during or after firing, it is important, when using the form of calcite present as one of the main criteria of grouping to distinguish between primary and secondary forms of calcite and also, in the case of the latter, to explain how such alteration might have occurred. Ultimately this information may prove useful in the study of firing behaviour and firing environment (see Chapter 8).

The different circumstances in which secondary calcite formation occurs may be grouped into two categories (see references in Cau Ontiveros et al., forthcoming):

- (1) *Allochthonous*: where secondary calcite enters the ceramic from an entirely allochthonous source, that is it does *not* derive from alteration of calcitic material originally present within the ceramic. Examples of this include the contamination of ceramics with calcareous material during use or by percolating groundwater following burial.
- (2) *Partially Allochthonous*: where the secondary calcite formation derives from the alteration of calcitic material originally present within the ceramic. Examples of this include alteration of calcite as a consequence of the firing process.

Many features of secondary calcite formation are visible under the polarising microscope, which may be grouped into a series of categories (Maggetti 1982; Cau Ontiveros et al., forthcoming):

- (1) *Infilling of Voids*: where calcite has become concentrated in open spaces (cracks, voids) within the ceramic. When the crystals show clear well-defined forms (geodetic) and when the border around the edge of the void shows no alteration in colour then it is likely that this results from an allochthonous contribution. However when the secondary calcite resembles a micrite and microsparite and when this is accompanied by a lighter-coloured border around the void, then this may result from a partially allochthonous contribution with percolating groundwater acting to alter calcitic material originally present in the ceramic. The frequency with which void infilling occurs increases in higher or over fired ceramics.
- (2) *Micritic Clots*: this term describes a crypto-microcrystalline mass of calcite (micrite), which to a variable extent may display the form of the original

carbonate grain, which has been transformed, or otherwise may present a porous structure with only some remains of decomposed primary carbonates. In this way this sort of secondary calcite alteration preserves the shape of the original inclusion, but changes its original internal structure. More rarely the microcrystalline calcite in micritic clots may be partially replaced by sparite. In their recent study Cau Ontiveros et al. (forthcoming) argue that micritic clots derive from the transformation of calcareous non-plastic material during firing and therefore are a strong indication of secondary calcite deriving from a partially allochthonous contribution.

It should be stressed that it is quite possible for allochthonous and partially allochthonous forms of secondary calcite formation to be present within a single ceramic. As a result identification and interpretation of secondary calcite formation must be based on consideration of all available information: for example identification of the alteration of calcite due to firing at higher temperatures (i.e. >c.800/850°C) should be supported by evidence for higher firing, such as low optical activity in the groundmass; likewise identification of an allochthonous contribution to secondary calcite formation should be supported by a more general understanding of how and from where such an allochthonous contribution might originate. For detailed discussion of the behaviour of calcite during firing see the discussion of Fabrics 1a-i, 2a-e and 7 in Chapter 8.

Petrographic study resulted in the identification of probable calcite alteration in several fabrics.

Fabrics 1a-c: in one or two samples of Fabrics 1a-c thin red striations were observed in an otherwise yellow (calcareous) groundmass. In one example (sample 97/65) these striations were observed in close association with a micritic clot (see Plate 19). Micrite with iron concentrations is a rare but consistent feature of Fabrics 1a-c. It would appear likely therefore that these striations result from the migration of iron from iron concentrations in the micrite probably during firing.

Fabrics 2a-c: a frequent feature of samples of these fabrics is the presence of sparitic limestone inclusions, which exhibit only a relict primary grain texture (see

Plate 20); in other words the interstices between the individual grains within a sparite cluster are blurred and the grains do not exhibit extinction, but rather have a texture similar to micrite. Some inclusions retain an angular outline, but have a fully micritic internal structure. The identification of micritic clots strongly suggests that this calcite alteration occurred as a consequence of firing. Further support for a partially allochthonous origin for the calcite alteration is provided by the general absence of the infilling of voids with calcite and the results of SEM analysis which suggest that most if not all samples of Fabrics 2a-c were fired beyond c.800°C (see Chapter 8). The identification and explanation of calcite alteration in Fabrics 2a and 2b is particularly important because it helps to explain how these two fabrics, which are separated petrographically by the presence or absence of coarse-grained sparite, may actually grade into each other (cf. Plates 7 and 8). Thus the many examples of Fabric 2b where micrite is dominant may originally have been tempered with sparite, which was then altered to micrite during firing.

Fabrics 7 and 21: in several examples of Fabrics 7 and 21 the limestone inclusions retain only a relict primary sparite structure. The identification of micritic clots suggests that some alteration has occurred to the calcite during firing. Further support for this is provided by the results of SEM analysis, which suggest that vessels in Fabrics 7 and 21 could be fired above c.900°C.

6.4 Paste Preparation and Clay Mixing

During grouping careful study was made of the groundmass of samples. As a result it was noticed that some fabrics exhibit quite a degree of variation in their groundmass. This variation is generally not observed within a single sample, but rather results from the comparison of different samples of the same fabric. It is perhaps for this reason that such inhomogeneities between samples within a fabric group were most frequently observed in groupings that were based on large numbers of samples (see Appendix V, Fabrics 1d, 2b, 5a, 6, 8). For example, in samples of Fabric 1d the groundmass may be very rich or very poor in ostracods or foraminifera; in Fabric 2a the groundmass may vary from being quartz rich to

relatively quartz poor; in Fabric 5a the groundmass may be rich or poor in quartz, biotite and schist; in Fabric 6 the groundmass may be rich or poor in igneous rocks, while some samples are richer in sandstone or siltstone/pelite; in Fabric 8 the groundmass may be rich in quartz and biotite or poor in quartz and biotite.

It should be stressed that this variation is never so much as to threaten the coherence of the grouping. Rather a continuum of variation is usually observable within different samples. In addition samples within each fabric are all closely linked by the shared presence of a distinctive form of temper: for example Fabric 1d (biomicrite), 2b (biomicrite/sparite), 5a (calcimudstone), 6 (altered igneous rocks), 8 (siltstone/pelite). In this way such variation would seem to exist *within* otherwise coherent fabric groupings.

Such variation, however, requires explanation. Possible reasons include inhomogeneity in the clay source used or clay mixing. Evidence of clay mixing may be identified in a variety of ways. The most obvious cases are those where two clays are incompletely mixed, which in thin-section appear as two discrete areas of different composition, such as clay swirls or streaks (e.g. Fabric 19, 97/92). In most cases, however, such obvious indicators are absent and the identification of clay mixing must proceed via the study and comparison of clay pellets and groundmass. For example, in Fabric 5a study of clay pellet composition suggested the use of two clays: a fine red clay containing only rare fine quartz and mica and a coarser red clay rich in quartz and mica and containing also chert and quartz-mica schist (see Plates 21-2; cf. Plate 11). This latter clay would therefore seem to be the most likely source for the large rounded quartz-mica schist inclusions found in some, but not all, samples. In a similar way clay pellets in samples of Fabric 8 suggest the mixing of a red-firing clay rich in angular quartz, which also contains biotite, chert, quartz-biotite schist, and a fine yellow/orange firing clay, which contains few inclusions usually fine discrete rounded clasts of quartz, some fine biotite, opaques and biomicrite. The latter clay would also seem to be the most likely source for the majority of the calcareous component of Fabric 8 (biomicrite, sparite, micrite with iron concentrations, foraminifera), although the angular coarse-grained sparite and the large individual calcite grains probably derive from the calcareous component of the

siltstone/pelite temper. In this way, the variation observed in the groundmass of individual samples of Fabric 5a (see above) may most plausibly be explained in terms of the mixing of two clays in varying proportions. In a similar way study of clay pellets in samples of Fabrics 1d, 2b and 6 also indicated the likely mixing of two different clays in varying proportions (see Appendix V).

6.5 Forming Methods

Although macroscopic study of sherds and vessels remains the richest source of information regarding forming methods, it is nevertheless possible in some cases to identify forming methods petrographically (see Sections 5.3.3, 10.3). Forming methods, such as coil or slab-building, inevitably require the joining of different elements, which results in the creation of 'structural discontinuities' in the orientation of inclusions, voids and b-fabric. These may be observed petrographically (Pierret 1994:75-91; see Chapter 5). Perhaps the clearest example of coil-joining is found in sample 97/140 (Fabric 3), where a coil of Fabric 1b can be seen to join a coil of Fabric 1d (see Plate 23). Coil-joining can also be clearly seen in samples 97/79 (Fabric 1e) and 97/12 (Fabric 13) (see Plates 24-5). In most samples, however, coil-joints were not so obvious. Thus, although inclusions, voids and b-fabric⁷⁹ frequently exhibit locally parallel orientation and although the angle of this orientation may vary from perpendicular to parallel to vessel margins, sometimes across a single sample, these features alone cannot demonstrate coil-forming, although they would be consistent with it. Thus, from a petrographic perspective, one can only demonstrate coil-forming for a small minority of cases, while for the majority one can at best point to a consistency with coil-forming.

6.6 Finishing Methods

⁷⁹ Observation of the differential orientation of b-fabric was aided by the use of a lambda compensator plate (Whitbread 1996:415).

The petrographic study of surface structure and composition can provide a wealth of information about the types of finishing methods used (see Section 5.3.4). When combined with the SEM study of surface microstructure and composition, these data can provide a very detailed characterisation of methods of surface treatment (see Chapter 8 and Section 10.4 for more detail). Petrographic study resulted in the isolation of the following key features.

6.6.1 Surface Compaction

The surfaces of many samples show little or no difference in composition, texture or structure from the body. In a number of such cases study of birefringence allowed the identification of an area parallel to the surface edge of the sample, which exhibited a different orientation to that of the body (see Plate 26). Often this area could be traced along the full length of the surface of the sample. This would be consistent with the compaction of the surface of the vessel as a consequence of burnishing or polishing. Burnished or polished examples of this are found in Fabrics 1a, 1b, 1d, 2a, 2b, 2c, 5a, 6, 8, 12 and 14 (see Appendix V).

6.6.2 Slips

On the surfaces of some samples thin layers were identified, which generally lacked non-plastic inclusions and which exhibited differential orientation from the rest of the sample. The birefringence of these layers was invariably parallel to the vessel margins and indicated a sharp boundary with the body. These layers would appear to be slips added to the surface of the vessel prior to burnishing or polishing, since in some cases compaction can also be identified (see Plate 27).

In most cases slip layers are red and lack any trace of calcite; these were interpreted as non calcareous slips. Examples of these were noted in Fabrics 1a, 1b, 1d, 1e, 2a, 2b, 8 and 21 (see Appendix V). By far the majority of these examples show a clear correlation between the use of slips and the production of polished vessels. Perhaps the most interesting cases where a non calcareous slip has been used are Fabrics 1a-e (see Plate 27). These fabrics are calcareous and thus the deliberate application of a non calcareous slip would appear to represent

a deliberate attempt to ensure a dark polished surface (see Sections 10.4.1, 13.2.1). More rarely slip layers exhibit a more yellow colour and/or contain traces of calcite. These might correspond to calcareous slip layers. Examples of these are found in Fabrics 1a, 1b and 25.

In some very rare cases these layers are too thin (c.0.01-0.02mm) to allow an identification of a deliberately added slip. Examples of this may be found in Fabrics 5a and 14. Since in both these Fabrics there is no clear evidence for the use of slips, it is possible that these thinner layers may represent the artificial creation of a finer clay fraction as a direct consequence of burnishing or polishing.

6.6.3 Clay Layers

A number of samples of Fabric 28 (i.e. 97/36, 98/87 and 98/89) have non-calcareous clay layers added to the surface (see Plate 28). These layers are often in association with features, which have been added to the original surface of the vessel, such as tubular lugs or plastic decoration. These layers contain fine quartz and biotite and may derive from a different clay from the body. They do not represent a fine fraction and do not, therefore, correspond to conventional slip layers.

6.6.4 Incision

Occasionally a thin-section cuts through surface incision and allows detailed observation of the shape of the tool used. For example in sample 97/99 (Fabric 5a) the incision appears to have been done with a tool with square-shaped tip, while in sample 97/98 (Fabric 5a) the scoring was done with a tool with a rounded tip.

6.7 Firing

In most fabrics the comparison of colour and optical activity between samples suggested that vessels were exposed to a variety of temperatures and that firing atmosphere could vary from mixed oxidising/reducing to reducing. Sometimes some fabrics appear to be more consistently fired: for example all

three samples of Fabric 21 are reduced. However, this seems more likely to result from small sample size than any real consistency in firing behaviour. Certainly, whenever a fabric is represented by a large group of samples (cf. Fabrics 1a-i, 2a-e, 5a, 6, 8), a much wider range of variation can usually be identified.

In some samples the identification of micritic clots has been used to infer the secondary alteration of calcite as a consequence of firing (see Section 6.3). In such cases it would seem that firing temperatures exceeded c.800/850°C. The frequent preservation of relict primary sparitic textures may indicate that the conditions under which calcite alteration took place did not persist long enough for complete alteration to micrite to take place. This would be consistent with fast firing (see Chapter 8). Similarly consistent with fast firing is the consistent presence in most samples of small quantities of burnt or partially burnt organic material. A particularly obvious example of this can be seen in sample 97/33 (Fabric 21). Although organic material may occasionally survive the longer firings (gradual heating rate, longer soaking time), which are characteristic of the use of kilns, the consistency with which organic material is preserved in EN fabrics would seem to suggest that the firing conditions were more frequently favourable to the preservation of this material. This too would be consistent with fast-firing. Further discussion of firing behaviour and inferences regarding firing environment can be found in Chapter 8.

Summary

Consideration of the relationship between macroscopic and petrographic groupings has suggested that in the majority of cases it is possible to correlate macroscopic fabric groups with fabric groupings observed in thin-section. Moreover, most of the instances where such a correlation could not be achieved correspond to fabrics which appear to be closely related in mineralogy and/or in texture (e.g. Fabrics 1d, 1g, 1h and 1i). This conclusion is extremely important because it means that variation in ceramic features best observed macroscopically, such as form, finish, forming methods or use-wear, *can* be correlated with variation observed at a microscopic level (petrology, SEM). The ability to

correlate these two levels of ceramic variation significantly enhances group characterisation as well as allowing study of the ways in which groupings based on form or finish articulate with groupings based on fabric (see Chapter 7).

Petrographic fabric groupings were formed on the basis of consistencies observed in *both* non-plastic inclusions *and* groundmass. A consistent attempt was made to apply the same criteria to all groups. Consideration of the nature of the relationship between different fabrics indicated a variety of possibilities. Some fabrics exhibit a close relationship with one another (e.g. Fabrics 1a-i, 2a-e) and usually this takes the form of strong similarities in the composition of the groundmass. In such cases the differences, which define the groups as separate, usually relate specifically to the nature and distribution of their large non-plastic inclusions. Although this means effectively that such groupings are based on only one of the two criteria outline above, the separation is justifiable, not only because it might tell us something interesting about technological variation (see Chapter 10), but also because it ensures that the groupings produced are more coherently and more tightly defined.

Other fabric groupings may exhibit more general mineralogical or technological connections: in some cases, such as Fabrics 8, 9, 11, 14, 19, 20 and 21, this reflects a compatibility with a single type of geological formation, here low grade metamorphic rocks of the Phyllite-Quartzite series; in others, such as Fabrics 27, 28 and 29, fabrics may share technological features, here grog tempering. This type of connection is suggestive of a general relatedness and need not necessarily reflect a common source.

Consideration of mineralogy, technology and provenance suggests that some fabrics are compatible with an origin within the immediate area of Knossos (<5km). These generally comprise fabrics dominated by limestone or marl (e.g. Fabrics 1a-i, 2a-e, 4), although other fabrics, which seem to share close links with one or more of these, such as Fabric 15 (organic tempered), may also derive from this area. However, many other fabrics, although compatible in general with a source in north-central Crete (e.g. Groups 2, 3 and 6), are nevertheless incompatible with a source within the immediate area of Knossos (<5km). In addition to these, there is a small group of Fabrics, which are incompatible with a

provenance in north-central Crete (e.g. Fabrics 12, 31, 35) and whose source must lie elsewhere. In the case of Fabric 12 the location of production is likely to correspond to the area between Kalo Chorio and Gournia in the Mirabello Bay, East Crete, while for Fabrics 31 and 35 an off-island provenance is considered likely.

In several fabrics evidence was identified for the secondary alteration of calcite during firing. This proved to be important in at least two ways. Firstly, the identification of secondary calcite alteration can help to explain variation in the form of calcite within and between different fabrics. This further enhances group characterisation as well as indicating how different petrographic groups may relate to each other (see above on Fabrics 2a and 2b). Secondly, this can provide important information about the temperature to which such fabrics had been fired. In general, very little can be inferred with certainty about the nature of the firing environment for different fabrics. However, observation of variability in optical activity (i.e. firing temperature) and colour (i.e. firing atmosphere) within fabric groups, the identification of relict primary textures in altered calcite as well as the regular presence of partially burnt organic material would all be consistent with fast-firing in an open environment (see Chapter 8 for further discussion of this).

In a similar way, consideration of forming methods could, in the majority of cases, only demonstrate at most a consistency with coil-forming. Clear evidence for coil-forming could only be identified for a minority of cases. These data, however, correspond well to the results of macroscopic study (see Section 10.3). Study of finishing methods demonstrated that a variety of methods were used. Some samples displayed evidence for surface compaction as a consequence of burnishing or polishing. Others provided evidence for the use of non calcareous or more rarely calcareous slips (see Section 10.4).

In short, this petrographic study has provided a wealth of new data, much of it of great importance for the way it challenges current assumptions regarding ceramic technology, production and exchange during the EN. The wider implications of this will be explored in Chapters 10-13. The range of variation in fabric that has been identified is surprising and directly contradicts previous studies of Neolithic ceramics, which have been based on the observation of form

and finish and have emphasised stylistic and technological homogeneity. In the next chapter the nature of the relationship between form, finish and fabric will be explored in depth.

CHAPTER SEVEN

FORM AND FINISH

7.1 Previous Analyses of the Form and Finish of Early Neolithic Ceramics from Knossos

Previous studies of EN ceramic material have focused exclusively on form and finish as the principal indices of variation within the assemblage at Knossos. Although a very general description of the Neolithic ceramic sequence was provided by Mackenzie as early as 1903, it was only after the careful study of Furness (1953) that the first detailed stylistic description of Neolithic ceramics appeared. Furness' stated intention was to work within the tripartite structure proposed by Mackenzie and defined by A. Evans in terms of Early, Middle, and Late Neolithic (A. Evans 1921). However, it would appear that in defining a new EN phase (designated ENII) Furness may have strayed into what Mackenzie originally defined as MN (see Winder 1991).

Furness originally divided ENI-II ceramics into seven wares or groups based on surface treatment, four common to both phases (coarse burnished, fine burnished, incised, plastic), one specific to ENI (pointillé) and two specific to ENII (coarse buff smoothed, rippled) (Furness 1953:96-99). In addition to these, Furness noted some instances of "scribblings", but chose not to separate these into an eighth category (1953:103). The excavations of Evans produced only minor additions and revisions to this list: pointillé was found to continue in some form throughout the Neolithic sequence and scribble burnished ware and 'black-topped' ware were also noted (Evans 1964:194, 196, 205). In his conclusions Evans, in common with all other scholars, chose to emphasise the 'extraordinary homogeneity' of the long ENI phase (Evans 1964:194; cf. Mackenzie 1903:158-9; Furness 1953; Manteli 1993a:42).

The boundaries between these ware groups were allowed to be quite fluid. Furness, and later Evans, acknowledged that no clear distinction was possible during EN between coarse burnished and fine burnished (the two most common ware types), but rather that there was a continuum of variability between the two (Furness 1953:109; Evans 1964:196). However this is by no means the limit to the overlap: it was clear that incised/pointillé decoration favoured fine burnished

vessels, while plastic decoration tended to occur on more coarsely burnished vessels (Furness 1953:114-5; Evans 1964:210). In this way plastic ware merges with coarse burnished, incised or pointillé with fine burnished.

The Furness shape typology divided EN ceramics into eight types based on form (see Appendix VI for details) (Furness 1953:103-120). This schema was adopted by Evans, although not without several modifications (Evans 1964:196-201, 212-4). In all Evans added seven new types, the majority of which correspond to unusual types first identified by Furness. Thus Evans introduced a Type 1A to distinguish open bowls (Type 1) from open bowls with a beaded or slightly offset rim and a Type 4A to distinguish bowls with an offset rim (Type 4) from carinated bowls with offset rim (Evans Type 4A = Furness Type 4). In addition Evans defined flat-based mugs (cf. Furness 1953:fig.7.17); oval dishes with pairs of ears at each end (cf. Furness 1953:pl.29a.18, fig.9.13); shallow rectangular vessels/'trays' with pointillé; pedestalled bowls; large rectangular troughs on four legs⁸⁰ (cf. Furness 1953:fig.13b.10 - 'legged receptacles'). Evans, however, chose not to extend Furness' numbering system to include these new types.

A glance through the profiles which Furness and Evans use to illustrate the various types confirms that there is considerable variation within each type (see Appendix VI). As noted above for ware groups, this fluidity was something Furness, and later also Evans acknowledged:

"Many intermediate shapes occur [within the typology], and the division into types is, of course, arbitrary" (Furness 1953:110);

"the main shapes [in the typology], ...are relatively few and tend to merge into each other, so that distinctions are inevitably arbitrary at times" (Evans 1964:196).

It is clear that Furness considered fluidity within and between ware and/or shape categories to be entirely appropriate to the material in question, describing it as being "usually the case with hand-made pottery" (Furness 1953:102). Although Furness never explicitly discusses her production model, when this statement is taken in conjunction with her stated belief that most if not all EN pottery from

⁸⁰ See Chapter 11 for a reinterpretation of these vessels as house models.

Knossos was produced at the site (Furness 1953:103), it becomes likely that Furness understood stylistic variation, whether subtle or striking, to be explicable purely in terms of intra-site variation, perhaps between different local producers. This might be termed a self-sufficiency model of household production for household consumption (see Chapter 2). Under such a model the degree of stylistic variation within each of Furness' types would be the natural result of different producers (households?) having slightly different interpretations of what might be called basic socially-accepted forms or mental templates. If so, then it is unsurprising that Furness chose to simplify this variation, by creating a rather coarse typology consisting of relatively few idealised vessel types.

7.2 The Furness-Evans Ware Groups Reconsidered

The Furness-Evans ware/shape typology remains the only available guide to EN ceramics. Thus it was with this typology that re-study of the assemblage began in the summer of 1997, with the principal aim of re-examining its relevance and usefulness for the intended technological study. The EN material under study came primarily from sounding AC from Evans' 1957-1960 series of excavations below the Central Court of the Palace at Knossos. Particular priority was given to the exploration of the ways groupings based on the existing typology mapped or failed to map onto groupings based on fabric.

It was immediately apparent that there was not one but many fabrics present (*contra* Furness 1953:103-117) and that these different fabrics entirely cross-cut the eight or nine EN ware groups. Closer inspection revealed that by far the majority of fabrics were finished in ways which were, in terms of ware, identical; that is the coarse burnished or fine polished versions of each of the most frequently represented fabric groups appeared to be finished in very similar ways; in other words, although a range of fabrics were employed in EN ceramic production, only a much more limited range of finishes are apparent.

Generally, within any single fabric group, vessels are *either* burnished *or* polished with little continuum of variation between the two (cf. Plates 29 and 30). Therefore, contrary to the statements of Furness and Evans (Furness 1953:109; Evans 1964:196) a coarse/fine distinction may be applied to the treatment of vessel

surfaces in ENI. In general polished vessels are distinguished from burnished vessels by the absence of marks left by the tool used to burnish. The quality of the finish seems to depend on the size of the vessel: coarser burnishing is usually reserved for larger thicker walled large diameter bowls or jars, polish is confined to smaller thinner walled vessels; however these are by no means absolute distinctions and some overlap is possible. Although within any single context colour might range from buff or orange to brown or black, in no case was a specific colour of finish found to be fabric specific; rather within each fabric group a range of colour was observable⁸¹. Those fabric groups with calcareous base clays exhibit more of a range, than those which are non-calcareous. The former may range from cream or buff to brown or black, while the latter are almost always red to dark brown burnished or polished in finish (see Chapter 10). In the case of calcareous Fabrics 1a-e, this dark polished finish was created by the application of a non-calcareous slip (see Chapters 6, 8, 10).

7.3 The Furness-Evans Shape Typology Reconsidered

The Furness-Evans shape typology similarly proved to be cross-cut by fabric. However, as will be demonstrated, no single fabric group encompassed the full range of shape types. Although some shape types, such as flat-based mugs or eared bowls, proved to correspond to certain fabrics, in the majority of cases the existing typology proved too coarse to allow closer correlations to be made between stylistic groupings and technological/mineralogical groupings. This conclusion compares well with the remarks of Phelps on previous shape typologies for Neolithic Southern Greece:

"minor variations of shape are important for distinguishing chronological and geographical relationships, and a system using only a few general categories is inadequate; the significant nuances are masked" (Phelps 1975:64).

⁸¹ This further underlines the unsuitability of using colour as a criterion for breaking down a Neolithic assemblage, a point elegantly made by Vitelli in her review of early typological study of EN mainland Greek assemblages (Vitelli 1993a:xix-xx, 3)

Several factors suggested that an improved EN typology might be possible (and preferable), which ultimately would allow closer correlations to be made between form, finish and fabric:

- (1) The variety of different forms within each of Furness' idealised types, strongly undermines the coherence of her typology. Particularly surprising is the occurrence of overlaps between her types, despite the coarseness of her typology (see Appendix VI). For example, coarse straight-sided vertically carinated bowls are placed in Type 2 and not Type 3; in addition there is a duplication of forms between Type 3 fine profiled carinated bowls and Type 4 fine carinated bowls with offset rim.
- (2) Existing Furness-Evans handle-types proved highly sensitive to fabric, with some rare types, such as tubular lugs, proving to be fabric-specific. This in turn suggests that if more profiles could be reconstructed, different fabric-specific forms might be similarly be identified.
- (3) Re-sorting by fabric enabled several shape types to be restored or identified, such as flared cups, which could not be easily fitted into the existing Furness-Evans typology.

On reflection, it is perhaps not surprising that Furness produced such a coarse typology, when one considers that the only other variable collected, against which morphological variation might be measured, was ware and, as argued above, ware provides a poor index of variation in comparison to fabric. By measuring form and finish against fabric a greater range of shapes and surface treatments can be identified, allowing the construction of a much more detailed shape typology (see Appendix VI).

7.4 Dimensions of Variability

The different form-types presented in Appendix VI can be studied in terms of the specific attributes (dimensions of variability) which define each type as different from another (see Chapter 3). Thus at a fundamental level one can see that

the presence or absence of an offset rim separates the basic typology of forms into two groups. Once separated, it becomes clear that these two groups comprise a more or less identical range of forms (shallow bowls, deep bowls, curved bowls, carinated bowls, hole-mouth jars etc.) and it is only the presence or absence of the offset rim that separates them. Within these groups different vessel types are distinguished according to their depth (shallow-medium-deep), the accessibility of their interiors (open-closed), the position of their carination (high-medium) and the shape of their body profiles (curved-flared-straight). A further dimension of variability is the overall size of the vessel, since the same basic form-type may be created in a variety of sizes from large to small. Good examples of this are the large and small deep bowls or the large collared jars with flared strap handles on the shoulder and the smaller curved jars with offset rims with false miniature flared strap handles on the shoulder.

Therefore, it becomes clear that the basic range of EN forms is created through deliberate selection from a limited set of dimensions of variability. In this way quite a wide range of shapes is created through the simple combination of a number of different forming sequences: e.g. a flared carinated bowl combines a straight-sided bowl lower half with a flared bowl upper half; a curved jar with offset rim combines a curved bowl lower half with an incurved bowl upper half and is finished with an offset rim.

7.5 Variation in Form, Finish and Frequency Per Fabric

In Appendix VII variation in form and finish is expressed in a series of tables, which document the presence and absence of features of form and finish per fabric per ceramic phase. As these tables demonstrate, the degree to which form and finish differs between fabrics varies considerably from those fabrics, which despite being very well represented exhibit relatively few differences in form and finish (e.g. Fabrics 2a/b and 5a)⁸², to those fabrics, which share no similarities in form and finish (e.g. Fabrics 1a and 25)⁸³. However, this broad continuum of

⁸² For example Fabrics 2a/b and 5a both have near identical types of flat-based mug with near identical incised/pointillé decoration.

⁸³ For example vessels in Fabric 1a are burnished, polished or incised, while the single vessel in Fabric 25 is dark-on-light painted with a cross-hatched pattern.

variation in form and finish between fabrics is not random, but has an internal logic, which seems to relate to the frequency with which different fabrics occur. When grouped in terms of frequency, variation in form and finish per fabric falls into three basic groups (see Figures 9.3-4):

- (1) *Fabrics which individually account for between c.5% and c.40% of any single context*: this comprises a small group of fabrics, namely Fabrics 1a-i, 2a-e, 5a, 6 and 8, which nevertheless together account for c.85-98% of any stratum. Although there are some differences in form and finish between these fabrics (see Appendix VII) these are generally subtle and are largely confined to finish⁸⁴. Moreover, what is most striking about these fabrics is that, despite the relatively large quantities in which they occur, the isolation of these subtle differences requires considerable effort (see Plates 32-3).
- (2) *Fabrics which individually only account for between c.0.01% and c.4.5% of any single context, but which nevertheless exhibit a close relationship in form and finish with those more frequent fabrics in Group (1)*: this comprises a much larger group of fabrics, namely Fabrics 4, 5b, 5c, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and 23, which together account for no more than c.3-11% of any stratum. All features of form and finish find good parallels amongst fabrics in Group (1) (see Appendix VII; cf. Plates 32-34). Although there are greater differences in form and finish between these fabrics, this is most likely to be a result of the small sample size.
- (3) *Rare or unique fabrics, which individually only account for between c.0.02% and c.1.5% of any single context and which exhibit no significant similarities in form or finish with fabrics in Groups (1) or (2)*: this comprises a group of fabrics, namely Fabrics 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34 and 35, which together account for no more than c.0.1-2.5% of any stratum. The correspondence between rare or unique types of form and finish and rare or unique fabrics is the most striking feature of this group.

⁸⁴ For example incised/pointillé decoration occurs on flat-based mugs in Fabrics 2a-e and 5a, but on other forms in Fabrics 6 and 8. Punched decoration is confined to Fabric 8, barbotine decoration to Fabrics 1d-e and 5a.

And so, when variation in form and finish per fabric is viewed in terms of frequency, an interesting picture emerges. It would seem that c.97.5-99.9% of the EN assemblage at Knossos is comprised of fabrics whose forms and finishes bear a close resemblance to one another, while the most significant variation in form and finish is actually confined to a group of very rare or unique fabrics, which together comprise only c.0.1-2.5% of any EN context. In no way could the fabrics in this latter group be said to be well-represented, it is therefore likely to be significant that they nevertheless exhibit greater variation in form and finish than those fabrics which are well-represented. The most likely explanation for the greater degree of variation of fabrics of Group (3), is that they represent imports. However, such a statement cannot be made with confidence until consultation has been made of all available data relevant to the discussion of provenance (see Section 7.6).

7.6 Provenance: Fabric, Form, Finish, Frequency

In this section all data on form, finish, fabric and frequency will be combined in order to attempt to assess the likely provenance of Fabrics 1-35. This discussion of provenance is divided into three groups, which reflect the three groups based on variation in form, finish and frequency, which were identified in Section 7.5. Those which recur most frequently (Group 1) and which therefore provide most information are described first (Section 7.6.1). Rarer fabrics (Group 2), which nevertheless exhibit a close relationship in form and finish to those in Group 1, are discussed in Section 7.6.2. In Section 7.6.3 variation in form and finish will be described for the remaining rare or unique fabrics of Group 3. Comparisons will be sought for unusual features of form or finish in sequences from sites around the southern Aegean. This will be combined with mineralogical and technological data to attempt to provenance these very rare vessels.

7.6.1 Group 1: Frequently-Attested Fabrics⁸⁵

In general a basic range of forms may be said to characterise the frequent fabrics of Group 1 (see Appendices VI-VIII, especially Figures VIII.2-19): curved bowls, deep curved bowls, shallow bowls, hole-mouth jars (both curved and

⁸⁵ Frequency data can be found in Figures 9.3-4.

straight-sided), 's' profile jars, flared bowls, curved bowls with offset rim, collared jars, incurved jars with offset rim, strap handles, flared strap handles, wishbone handles, flat bases and concave bases (ENIc-II). Types of finish common to all fabrics are burnish, polish, plastic cordon decoration, pellet/lump decoration and scribble burnishing. In addition to these common features, there are also features of form and finish that are found in only some of these Fabrics. These are discussed below.

pedestalled stands/bowls

A single example of this form occurs in ENIb in 2a-e. A similar form also occurs during ENIb in Fabric 11.

shallow curved offset bowls

During ENIa-b shallow curved offset bowls only occur in Fabrics 2a-e and 5a. In ENII they are also found in Fabric 1e.

carinated bowls

During ENIa-b carinated bowls are very rare occurring only in Fabrics 2a-e and 5a. Later (ENIc-II) carinated bowls of a variety of types become much more frequent.

flat-based mugs

During ENIa-b flat-based mugs occur only in Fabrics 2a-e, 5a and 6. A single example is also known in Fabric 23. Flat-based mugs frequently have a loop or a strap handle attached directly to the rim. During ENIb rim straps are found only in Fabrics 2a-e, 5a, 5c, 6. Later (ENII) they also occur in Fabrics 1b, 1d, 1e, 1f and 5a.

flared cups

These occur during ENIb-c and are confined to Fabrics 1b, 1d and 5a.

flared rim jars

These occur during ENIb-c and are confined to Fabrics 5a and 6.

carinated jars with offset rim

During ENIa-b these are found only in Fabrics 1a and 2a/b.

internally thickened rims

During ENIc-II curved bowls with internally thickened rims are found in Fabrics 1e, 1f and 2a/b.

miniature offset rims

These occur during ENIc-II and are confined to Fabric 1b.

house models

During ENII house models are found in Fabrics 1e and 1f.

'trays' and palettes

These rare forms only occur during in ENIa-b in Fabrics 2a/b and 6.

squared handles

Squared handles are a rare feature of ENI-II contexts and are found in Fabrics 1e, 1f, 2a/b, 6 and 8. They are also found in Fabrics 11 and 16.

tubular handles

Tubular handles are confined to ENIa-b and are found in Fabrics 2a/b, 5a, 6 and 8. They also occur in Fabrics 7 and 21.

pierced/unpierced ears

Pierced or unpierced ears on the rim of open bowls occur during ENIa-b in Fabrics 2a/b, 5a and 8.

incised line below rim

During ENIa-b rare examples of this occur in Fabrics 8 and 16. In ENIc a single example is known in Fabric 1e.

oblique/'v' punched decoration

Rare examples of this are found throughout in Fabric 8.

wiped decoration

This is found in Fabrics 1e and 2a/b.

incised/pointillé decoration

During ENIa-b incised/pointillé decoration is found on flat-based mugs and curved bowls with offset rim in Fabrics 2a/b, 5a and 6. It also occurs more rarely on flared bowls in Fabric 5a and on pedestal bowls/stands in Fabrics 2a/b and 11. During ENIc-II it occurs in Fabrics 1b, 1d, 1e, 1f, 2a/b, 5a, 6.

slashed cordon/rope decoration

Examples of this are found during ENIb-c in Fabrics 2a/b and 5a. This is also found in Fabric 10.

incised lattice/ladder decoration

During ENIb-c incised lattice or ladder decoration is mostly found on flat-based mugs in Fabrics 2a/b, 5a and 6. During ENIc it also occurs on curved bowls with offset rim in Fabric 1b.

barbotine decoration

During ENIb-c barbotine is found only in Fabrics 1d and 5a and during ENII in fabrics 1e and 5a.

ripple decoration

Ripple decoration first occurs during ENIb in Fabrics 8 and 11. During ENIc-II it is found in Fabrics 1d, 1e, 1f, 5a, 6 and 8. During ENII it is also found in Fabrics 10 and 12.

incised diagonal/chevron decoration

This form of incised decoration is largely confined to ENII, where it is found in Fabrics 1d, 1e, 1f, 2a/b, 5a and 8.

'barbed wire' decoration

This occurs during ENIc-II in Fabrics 1d, 1e, 1f, 2a/b and 8.

brushed decoration

During ENIc-II this is found in Fabrics 1d and 1e.

dribble painting

During ENIb-c dribble painting is confined to Fabrics 1d and 1e. A single example is known in Fabric 17.

7.6.2 Group 2: Rarer Fabrics Which Exhibit a Close Relationship in Form and Finish with Group 1

Fabrics in Group 2 occur infrequently and thus each fabric provides only a very incomplete picture of its potential variation in form and finish. As a result features of form and finish will be discussed separately for each fabric.

Fabric 4

Vessels in Fabric 4 generally have a white or grey burnished surface, created by the application of a calcareous slip (see Chapter 8). Owing to their very fragmentary state it is difficult to identify forms (but see Plate 54). During ENIa-b diagnostic sherds indicate the presence of straight-sided hole-mouth jars, strap handles and rounded bases. During ENIc-II curved bowls, deep curved bowls, straight-sided bowls, 's' profile jars, curved bowls with offset rim and carinated bowls with offset rim are also found together with strap handles, flat bases and curved bases. In ENII there is also an example of scribble burnishing.

All of these features of form and finish find good close parallels amongst fabrics in Group 1 (e.g. Fabrics 1a-i, 2a-e etc.). Fabric 4 is consistently present in ENI-II contexts, although in proportionately small quantities. The mineralogy of Fabric 4 suggests a link with Fabrics 1a-i and moreover, although not diagnostic of provenance, would be consistent within an origin within the immediate area of Knossos (<5km) as well as the general area of north-central Crete. Provenance remains open, although a north-central Cretan provenance seems quite possible.

Fabric 5b

Fabric 5b is represented only by body sherds (see Figure VIII.20). These are thick-walled with a burnished outer surface and a smoothed or unburnished interior. They would appear to come from a large type of closed vessel, possibly a straight-sided hole-mouth jar. Petrographic study suggested a close link with Fabric 5a and it seems likely that the two Fabrics share a common provenance, within the general area of Knossos (>5km).

Fabric 5c

Fabric 5c is a rare feature of ENIa and ENIb and comprises a straight-sided hole-mouth jar straight-sided, strap handles and a flared bowl with rim strap (see Figure VIII.20). Close parallels for these can be found in most fabrics in Group 1 (cf. Fabrics 5a, 8). Mineralogy is not distinctive of provenance, but not incompatible with an origin within north-central Crete. Provenance remains open.

Fabric 7

Fabric 7 comprises two incurved hole-mouth jars, one with a rim lump and one with a small tubular loop attached to the rim (ENIa) (see Figure VIII.20). Hole mouth jars, rim lumps and tubular loop handles are a feature of most fabrics of Group 1, particularly during ENIa. Petrographic study suggested that Fabric 7 might link to Fabric 6 (similar doleritic rocks in the groundmass) and to Fabric 1a (fine-grained sparite temper). It would seem likely that Fabric 7 shares a common origin with Fabric 6.

Provenance remains open, although it is likely to be within north-central Crete.

Fabric 9

Fabric 9 is largely confined to ENIa-b contexts and comprises the following features of form and finish: deep curved bowl (sometimes with rim lumps or U/V cordon decoration), straight-sided hole mouth jar, flared bowl (sometimes with U/V cordon decoration, strap handle, wishbone handle, flat base, punched oblique decorated rim. Close parallels for all of these features can be found in fabrics in Group 1. Fabric 9 is particularly close in terms of form and finish to Fabric 8 (punched oblique decoration, U/V cordon, straight-sided hole-mouth jar). Petrographic study also suggested that Fabrics 8 and 9 had a close relationship, the differences between the two being primarily textural than compositional. It therefore seems likely that Fabrics 8 and 9 share a common provenance. The low-grade metamorphic rocks in both fabrics would seem to link to the Phyllite-Quartzite series of north-central Crete, which crops out on the east and west sides of the Herakleion basin as well as around Iouktas (see Appendix III). Provenance remains open, although in view of the frequency with which Fabric 8 occurs at Knossos this is likely to be within the general area of (>5km) of the site.

Fabric 10

During ENIa-b Fabric 10 comprises the following features: deep bowl (sometimes with incised cordon/rope decoration), 's' profile bowl (sometimes with incised cordon/rope decoration), curved bowl with offset rim (sometimes with a false flared strap handle), flared strap handle (see Figure VIII.22; Plate 64). During ENII there is an incurved hole mouth jar and a vertical carinated bowl. Close parallels exist for all of these features in fabrics of Group 1. Indeed on most occasions vessels in Fabric 10 are indistinguishable from vessels in more frequent fabric (Group 1); for example flared strap handles in Fabric 10 are indistinguishable in size, shape and finish from similar handles in Fabric 8. Sometimes familiar features are combined in unfamiliar ways: for example a small curved bowl with offset rim has a very large false flared strap handle (see Plate 64 upper left). Fabric 10 is not compatible with a provenance within the immediate area of Knossos (<5km). The presence of serpentinite in a groundmass containing mafic rocks suggest a link with rocks of the Ophiolite series, the nearest sources of which lie to the south of Iouktas and in the area of Tylissos in the western half of the Herakleion basin (see Appendix III. Provenance remains open, although a north-central Cretan origin remains the most likely.

Fabric 11

Fabric 11 is a consistent if very rare feature of EN deposits at Knossos and comprises the following features: curved bowl, collared jar with flared strap handle, square sectioned strap handle, pedestal bowl/stand with incised and pointillé decoration, flared cup with plastic cordon decoration, ripple decoration, steep-sided flat base (see Figure VIII.24). All of these features find parallels in the more frequently occurring fabrics in Group 1. Sometimes, familiar features are combined in unfamiliar ways: for example a flared cup from ENIb with plastic cordon decoration. The square sectioned handle only finds parallels later in strata V and IV (Fabrics 1e, 1f, 6, 8, 16). The low-grade metamorphic rocks (phyllite) in Fabric 11 would seem to link to the rocks of the Phyllite-Quartzite series of Crete. Provenance remains open.

Fabric 12

Petrographic study of Fabric 12 suggests that this nearest compatible source for the raw materials of this fabric is the Bay of Mirabello. The likelihood that this area is the source of Fabric 12 is increased by the comparison of Fabric 12 in thin-section with thin-sections taken from Neolithic material from the site of Kavousi⁸⁶ in the Bay of Mirabello. Sample 97/27 (Fabric 12) proved to be almost indistinguishable in composition and texture from Sample 93/69 (Kavousi).

In the light of the likely source of Fabric 12 at some distance from Knossos (c.70km), it is interesting to note that Fabric 12 exhibits scarcely any variation in form and finish from fabrics whose source must be in the area of Knossos (cf. Fabrics 1a-i, 2a-e, 5a): e.g. curved bowls with offset rim, wishbone handle; vessels in Fabric are burnished (e.g. 97/41) or polished (e.g. 97/27) (see Plate 34).

Fabric 13

Only two examples of Fabric 13 were identified. Sample 97/12 comes from a dark burnished body sherd. Sample 98/4 is a dark polished wishbone handle (see Figure VIII.25). Parallels for wishbone handles are confined to fabrics of Groups 1 and 2 (e.g. Fabrics 1a-i, 2a-e, 5a, 6, 8, 9 etc.). The closest possible source to Knossos for the chlorite rock temper in Fabric 13 would be to the west of Herakleion in the eastern foothills of Mount Ida (Tylissos).

Fabric 14

Examples of Fabric 14 are very rare at EN Knossos: the only forms to be identified were curved bowl, flared bowl and strap handle (see Figure VIII.25). One example of Fabric 14 is dark polished with a unique type of grooved decoration. The design is typical for incised/pointillé decoration in fabrics of Group 1 (e.g. Fabrics 2a/b, 5a), however the tool used had a wider, more blunt tip. Since parallels exist for all features of form as well as the design of the decoration a link with the fabrics of Group 1 is considered probable. The mineralogy of Fabric 14 is inconsistent with a provenance local to Knossos. Comparison with later material suggested a close link

⁸⁶ See discussion of Kavousi in Appendix I.

between Fabric 14 and an EMIIb cooking pot fabric (quartz-biotite schist) from Knossos. Provenance of both of these fabrics remains open, although both would seem to link to rocks of the Phyllite-Quartzite series of Crete.

Fabric 15

Fabric 15 is consistent if very rare feature of ENIb-II deposits at Knossos. Normally examples are too fragmentary to preserve evidence for shape (but see Plate 45). Almost all surviving diagnostic examples come from the rims of large diameter deep bowls. There is also a shallow curved bowl and a vertical carinated bowl from an ENII context. The only example of decoration are a series of large pellets below the rim of a deep bowl (see Plate 45). Parallels for all of these features can be found in fabrics of Group 1. Particularly close parallels exist for the pellet decorated deep bowl (e.g. Fabric 2a/b). The mineralogy of Fabric 15 is not distinctive of a specific origin, but would be compatible with an origin within the immediate area of Knossos. In view of the links shared with Fabric 2a-e (see Appendix V), it seems possible that Fabric 15 and Fabrics 2a-e share a common origin. Provenance remains open.

Fabric 16

Only three examples of Fabric 16 were noted, all dating to ENIb (see Figure VIII.25): from stratum VI came an example of a dark polished curved bowl. Sample 97/100 (stratum VII) is an orange burnished deep bowl with offset rim, which has traces of a square-profiled handle. There are numerous parallels for form (deep bowl with offset rim) amongst fabrics of Group 1. A single example of a rectangular-profiled strap handle in Fabric 11 is known from stratum IX, however many more examples of rectangular profiled handles are known from strata V and IV (Fabrics 1e, 1f, 6, 8). Sample 97/91 is a dark polished curved bowl (stratum VI) with an incised line below rim. Numerous parallels for the form can be noted in other fabrics in Group 1. The use of incised lines to differentiate the rim finds good parallels in Fabrics 6 and 8. The mineralogy of fabric 16 is not distinctive of provenance, but would be compatible with a source in north-central Crete.

Provenance therefore remains open, but in view of the links in form and finish to fabrics in Group 1 is likely to be within Crete.

Fabric 17

Only two examples of Fabric 17 were identified. Sample 97/77 comes from a coarse burnished or wiped body sherd. Sample 98/99 is brown polished body sherd, which has a dribble of darker brown paint (see Plate 55). In appearance this painted decoration closely resembles the 'dribble-painted' sherds in Fabrics 1d and 1e, which date to late ENIb/ENIc. The date of sample 98/99 is broadly compatible with these (late ENIb, West Court Sounding AABB). The mineralogy of this fabric is not distinctive of a specific source, but is compatible with a provenance within north-central Crete.

Fabric 18

Fabric 18 comprises an incurved hole mouth jar, a straight-sided bowl, a vertical carinated bowl, a flat base, U/V cordon decoration. All of these features find parallels in fabrics of Group 1. The presence of cordon decoration seems to suggest a close link. The mineralogy of Fabric 18 is not distinctive of specific origin (quartz sand). Provenance remains open.

Fabric 19

Fabric 19 is a very rare feature of ENIa-b contexts. Sherds diagnostic of shape are rare and the only vessel shape identifiable with certainty is a buff burnished thick-walled deep bowl with lumps below the rim; strap handles and dark polished vessels are also found (e.g. 97/30). Parallels for the deep bowl with lumps below the rim are found in fabrics of Group 1. The mineralogy is not distinctive of a specific origin (fossiliferous calcareous clay, quartz-rich red clay, phyllite), but would be consistent with an origin within north-central Crete.

Fabric 20

The only example of Fabric 20 identified (sample 98/33) comes from an ENIa context and is from a flat-based vessel (see Plate 69). Parallels for flat bases exist

in fabrics of Group 1. The mineralogy of Fabric 20 is not distinctive of a specific origin. Provenance remains open.

Fabric 21

Fabric 21 is a rare feature of ENIa-b deposits. Features found in this fabric include straight-sided hole-mouth jar with a flat base, straight-sided hole-mouth jar with horizontal loop handle (sample 98/20), high carinated small diameter jar with offset rim, wishbone handle (see Plates 29, 65). Parallels for all of these forms can be found in fabrics of Group 1; closest is Fabric 8 which has parallels for all of these features (straight-sided hole mouth jars, flat bases, loop handles, jars with offset rim, wishbone handles). The mineralogy of fabric 21 is not distinctive of a specific origin. The presence of low grade metamorphic rocks, similar to those in Fabric 8, suggests a link with the Phyllite-Quartzite series of Crete. Provenance remains open.

Fabric 22

Fabric 22 only occurs in ENII contexts and comprises a flared bowl (97/24; see Figure VIII.26) and a strap handle. Parallels for these exist with fabrics of Group 1. Mineralogy is not diagnostic. Provenance remains open.

Fabric 23

Examples of Fabric 23 occur in ENIa-b contexts (see Plate 59). Sample 97/60 comes from a flat-based mug with an unusual type of incised/pointillé decoration (dots and wavy lines) and with the upper torso of a human figurine moulded into the rim. Sample 97/61 comes from a high carinated bowl with offset rim. Parallels for both forms and for the incised/pointillé technique can be found in fabrics of Group 1. The mineralogy of Fabric 23 is not distinctive of origin. Provenance therefore remains open.

7.6.3 Group 3: Rarer Fabrics with Rare or Unique Forms or Finishes

In this section only relative regional dates are given for the comparative ceramic material cited from sites around the southern Aegean. A detailed discussion

of how the Knossian EN sequence relates to those of surrounding regions can be found in Appendix I. On the basis of this discussion a comparative table was produced (see Figure I.6); a simplified version of this table is provided below (see Figure 7.1). A map of the distribution of the most important sites mentioned in the text is also provided (see Figure 7.2)

Approximate Dates	Knossos	Greece/ Cyclades	South-West Anatolia
>7000	Aceramic?	Mesolithic	EN
c.7000 - c.6500	Aceramic	Aceramic	EN
c.6500 - c.6400	Ac/ENIa	Ac/EN	EN
c.6400 - c.5800	ENIa	EN	LN
c.5800 - c.5300	ENIb	MN	EC
c.5300 - c.5100	ENIb	LNI	MC
c.5100 - c.4900	ENIc	LNI	MC/LC transition
c.4900 - c.4500	ENII/MN	LNI	LC
c.4500 - c.4000	LN	LNII/FN	LC
c.4000 - c.3300	FN	FN	LC

Figure 7.1 The Chronological Relationship Between the Cretan Neolithic, the Greek Neolithic and the South-West Anatolian Neolithic (See Appendix I)

Fabric 24

pierced oval lug

The single example of this (98/43) comes from an ENIa context (VIII) and is without parallel at Knossos (see Plate 68). In south-west Anatolia oval lugs are known from EN Kuruçay (Duru 1994:pl.38.12) pierced vertically and LN

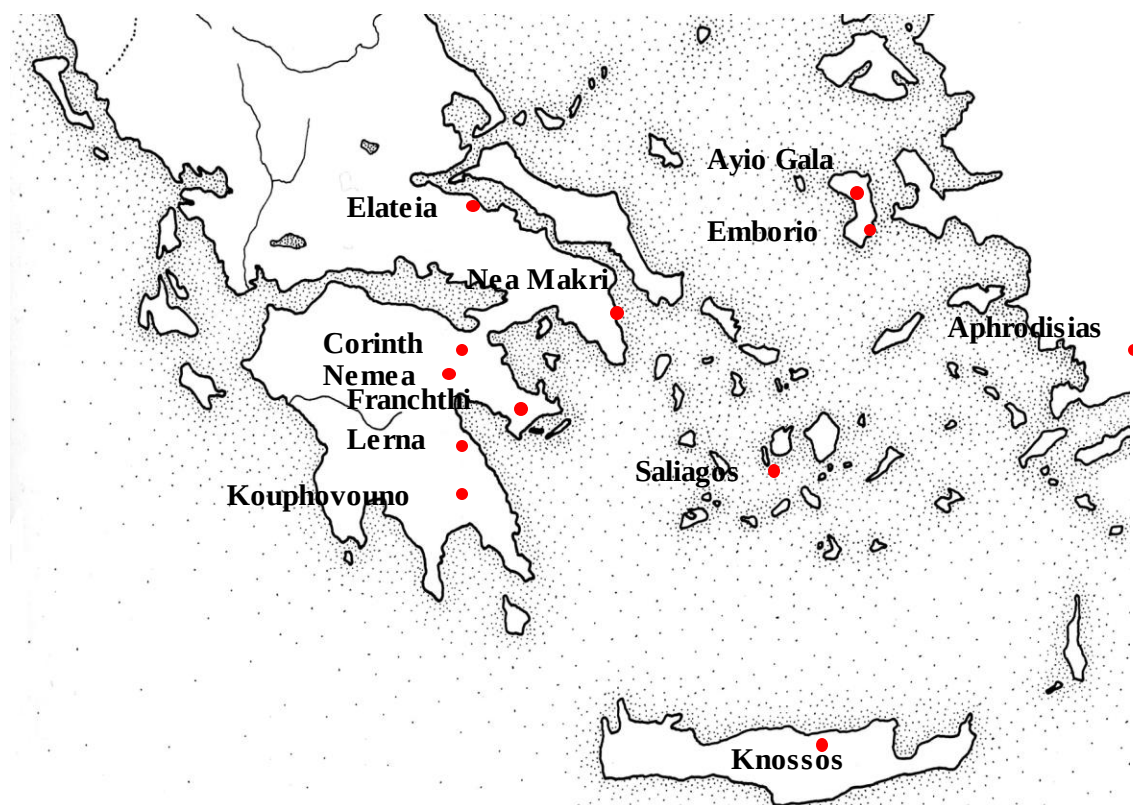


Figure 7.2 Map of the Main Aegean Sites Mentioned in the Text

Kuruçay pierced horizontally (Duru 1994:pl.44.10; 61.10; 77.16;84.12-13) and vertically (Duru 1994:pl.52.5-6;62.12). They are also a feature of LN sites in West-Central Anatolia (see Meriç 1993:fig.3.3) and of the lower cave (LN?) at Ayio Gala (Chios), where they are found on deep bowls with slightly everted rims and on shallow bowls; they are not as common as vertical tubular lugs (see below) and are all pierced vertically (Hood 1981:20, fig.5.6, 9). In the lower levels of the upper cave at Ayio Gala horizontally-perforated oval lugs outnumber tubular lugs (Hood 1981:34).

In the EN Peloponnese "both horizontally and vertically perforated lugs are the standard Period I [EN] form of handle" (see Phelps 1975:98, 98-9; cf. Caskey 1958:pl.37a, f [Lerna]; Holmberg 1944:39, fig.37.a-e [Asea])⁸⁷. They are most frequent on the coarser wares, but are also be found on fine vessels, and are usually placed close to or above the middle of the bowls, but never directly under the rim, either two or four to a vessel. Phelps notes that there is a development in lug types from earliest EN (rounded both in plan and section, which projects less from the body (e.g. Phelps 1975:fig. 9.30) to later EN lugs which become thinner (e.g. Phelps 1975:fig. 9.31) and often more profiled. Latest EN lugs tend to be triangular or rectangular as becomes common in MN. In the MN Peloponnese vertically/horizontally perforated lugs are less frequent than in EN: both types continue to occur on closed shapes, especially 'piriform' jars, low collar jars and closed bowls (Phelps 1975:157; cf. MN/LN Kouphovouno Renard 1989:xxiv.2; xxviii.1, 2, 6).

incurved bowl/pellet decoration

Although examples abound of pellet decoration on the rim and pellet decoration on the main body of a vessel, sample 98/44 (stratum VIII/VII) is the only example of single pellet decoration which occurs near but some distance below the rim (see Plate 68). Pellet decoration in this area of the vessel is however common for the EN Peloponnese (Phelps 1975:109-110), where the most typical form of decoration applied pellets (round or oval) usually placed close to the widest diameter or close

⁸⁷ Oval lugs are also known from EN Nea Makri (Pantelidou Gophas 1995:fig.2.1-26, 1-27; fig.5.2-35; fig.7.2-31, 2-36, 2-68, 2-69, 2-94).

to the rim although but *never immediately below* it⁸⁸. Like oval lugs (see above) pellets may be two or four to a pot. In MN there is "very little plastic decoration" (Phelps 1975:168).

Sample 98/43 (pierced oval lug) and 98/44 (incurved bowl/pellet decoration) are most likely from the same context and could well be from the same vessel. Oval lugs, identical to sample 98/43, are also found on incurved jars of this period (cf. EN Franchthi Vitelli 1993a:fig.1.j, fig.2.a, d, j, k; Phelps 1975:fig. 9.29-36, fig. 9.29). The closest parallels for the form and finish of samples 98/43 and 98/44 are therefore to be found at Greek EN sites in the Peloponnese.

ring bases

A single example of a ring base in Fabric 24 comes from stratum VII (Evans 1964:fig.24.16). Otherwise unknown at Knossos, ring bases are a feature of LN sites in south-western Anatolia (see Appendix IV) and EN-MN sites in Greece. Examples exist at EN/MN(early) Nemea (Blegen 1975:fig.3) and EN Elateia (Weinberg 1962:170;fig.7.1). In the Peloponnese the most common EN bases are concave feet and are occasionally perforated (Phelps 1975:95, fig. 9.20-22, 25). These are to be distinguished from true ring feet (e.g. Phelps 1975:fig.9.24, 26), since each is formed differently. True ring feet when found outside an FN context are diagnostic of MN where they are common (Phelps 1975:96, 120) and along with pedestals comprise the "majority of all vessel bases" (Phelps 1975:155; cf. also MN Nea Makri, Pantelidou Gophas 1995:fig 16).

flat bases

A single example of a flat base in Fabric 24 is known from ENIa (VIII). Flat bases are a feature of most fabrics represented at Knossos and are known from EN assemblages in the Peloponnese and LN assemblages from south-western Anatolia (see below).

strap handles

⁸⁸ Compare however examples from Elateia (Weinberg 1962:171) which do have pellets immediately below the rim.

There are no good parallels outside Crete for the early use of strap handles (see below).

Conclusion

On balance, the closest parallels for the form and finish of Fabric 24 come from the EN-MN Greek Peloponnese. Although the existence of a strap handle in Fabric 24 may hint at a Cretan provenance, all other features are without Cretan parallels (i.e. pierced oval lugs, incurved bowls/jars with pellets a little distance below the rim, ring bases). Although the mineralogy and technology of Fabric 24 would be compatible with a north-central Cretan provenance (limestone-tempered), they would also be compatible with other similar geological environments in the Peloponnese and elsewhere in the southern Aegean. It is therefore considered possible that Fabric 24 has its origins in the Peloponnese. Although not diagnostic, it is perhaps worth noting that technological parallels for the use of limestone-based paste recipes can be found at Neolithic sites such as Lerna and Franchthi (cf. Vitelli 1993a:208).

Fabric 25

The single example of Fabric 25, sample 98/92 (ENIb), comes from the body of a vessel which has been painted with a cross-hatched pattern. The surface of the sherd has fired to a grey colour and the paint has fired to a dark grey/black: it seems likely that this colour combination is the product of a heavily reducing atmosphere during firing and that the intended finish was dark-on-light painted.

Parallels for dark-on-light painted decoration can be found in Fabrics 1d and 1e, however these date to ENIc and moreover none are painted in the sort of linear design found on this single example. In Anatolia the earliest examples of painted pottery date to the LN: cf. Kuruçay (Duru 1994:pl. 81.13-15) and Hacilar (VI) (Mellaart 1970b:fig.59.1, 11). Cross-hatched designs are rare, first appearing during the LN/EC transition and disappearing before the end of EC (i.e. pre-Hacilar IIA): cf. EC Kuruçay (Duru 1994:pl.109.10, 12; 145.12) and EC Hacilar (V-III) (Mellaart 1970b:fig.62.7; fig.66.26; fig.74.20). The Anatolian parallels for cross-hatched painted vessels are therefore both very rare and at some considerable distance from

Knossos: no sites closer than the inland sites of Hacilar and Kuruçay have any parallels.

In the EN Peloponnese painted sherds are rare, first appearing late in EN (see Phelps 1975:100-2; Blegen 1975:267, pl.66.1-7, 9-10): paint and ground are usually burnished, with the ground varying from buff to red and paint from red to brown/black. Linear patterns dominate: simple multiple-line chevrons and zigzags and crosshatched triangles and wide bands. Blegen noted for EN/early MN Nemea that "in some instances zig-zag patterns overlap and thus produce an area of crosshatching; but crosshatching is frequently the main pattern itself, appearing in triangles, diamonds and other figures" (Blegen 1975:267, pl.65.3, 66.13-17, 19-23; cf. Vitelli 1993a:fig. 20.q). During MN patterns are rectilinear and geometric with cross-hatching dominant (Phelps 1975:160, 167; fig.12.2; fig.13.6; fig.15.10; fig.16.15; fig.17.5; fig.18.15; fig.19.12; fig.23.33, 35, 36, 37, 40, 43; cf. [MN Franchthi] Vitelli 1993a:fig. 30.e, g; 31.a; 32.l; 38.k; 41.c, h; 49.l, m; 51.i; 53.a, b; 62.a[3], e; 63.a, f; 64.a, c, f, g; 65.a, c, d; 68.d; 69.g; 70.d, e, g, h, i; 71.b, c, g, h; 72.e, f; 73.a; 74.b; 76.d, f; 83.b). Late in MN there is a sharp decline in the proportion of painted wares and an increase in 'stroke firmis' (Phelps 1975:121, 158).

The majority of the MN Peloponnesian examples of crosshatching closely parallel sample 98/92 (see especially Phelps 1975:fig.15.10, fig.18.15, fig.19.12, fig.23.33, 36). There is even a very close parallel for an (accidental?) reduction firing: at Nemea Blegen notes and illustrates a sherd with a "crosshatched pattern in jet black on a dark gray ground... Its appearance here, in remarkable contrast to the red-painted ware, is presumably due solely to a reducing treatment during or after firing" (1975:268, pl.65.3). The numerous contemporary (ENIb approx. = Greek MN; see Appendix I) close parallels from the Peloponnese make this area the most likely origin of Fabric 25. The mineralogy of Fabric 25 is not distinctive of origin, but would be compatible with a source in the Peloponnese as well as Crete.

Fabric 26

This group has produced two horizontal lugs (see Plate 66), one pierced (97/76) (stratum VII), the other unpierced (98/91) (ENIb), both of which have little low-

profile 'tails' extending below the lug. This fabric (and the first horizontal lugs) appears at Knossos in stratum VII (ENIb). The confinement of these pierced and unpierced horizontal tubular lugs to ENIb, means that their first appearance at Knossos approximately corresponds to the period in which horizontal tubular lugs first appear in the Peloponnese (MN) and at Ayio Gala in the Eastern Aegean and at Barakli near Izmir (EC) (Hood 1981:34; see Appendix I; see also Fabric 28 below). Elsewhere in south-west Anatolia tubular lugs are not found after the initial LN/EC transition. Thus for the period in which they occur at Knossos (ENIb) a provenance is possible in either the Peloponnese (cf. especially region of Kouphovouno) or the east Aegean (especially region of Chios). Further discrimination is difficult. All examples of Fabric 26 are red burnished, which compares well with eastern Aegean examples, but also does not exclude Peloponnesian examples: for example tubular lugs are frequent in ceramics of a lustrous 'Urfirnis' brown at Kouphovouno (Renard 1989:114).

Pierced and unpierced horizontal tubular lugs in Fabric 26 have 'tails' which continue below the actual lug, a practice which finds parallels on both sides of the Aegean where horizontal tubular lugs are known. Thus Hood notes the presence of 'lugs with tails' at Ayio Gala (lower cave) and at Emporio IX-VIII, while Phelps notes a similar practice for the MN Peloponnese. However, the lugs in Fabric 26, resemble neither earlier Ayio Gala lugs, which have a single thick tail projecting from one side of the lug, nor later Emporio lugs which have four thick tubular tails projecting from the lug in a star-like formation (Hood 1981:287). Rather the low-profile tails below the horizontally-pierced lugs in Fabric 26 appear to be closer to the MN Peloponnesian practice of moulding a horizontal lug into plastic cordon decoration, as noted on a MN sherd from Argos (Phelps 1975:158; 168).

Unfortunately the mineralogy of Fabric 26 is not distinctive of a specific source. The provenance of Fabric 26 therefore remains open, with perhaps southern Greece more likely than east Aegean.

Fabric 27

Fabric 27 is represented by two sherds, 98/26 and 98/83 (see Plate 66). Sample 98/83 (stratum VII) has an incised chevron design, which is unparalleled amongst

ENIb fabrics. Incised chevrons are only known from ENII in Fabrics 1e and 1f. The only general contemporary parallel within the Knossos sequence is to be found on a single example of Fabric 28 (98/90; see below). Approximate parallels can be found at EC Hacilar (Mellaart 1970b:fig 109.26) and LN/EC Ayio Gala (lower cave) (Hood 1981:pl.6.40, pl.7[c]) (see Section 7.8 on incised decoration for the occurrence of incised chevrons outside Crete).

Unfortunately the only other example of Fabric 27 (98/26, stratum VIII) is a coarse burnished body sherd and thus preserves no evidence for form. The presence of grog in its paste technology may indicate the possibility of a relationship with other grog-tempered fabrics, such as Fabric 28 (see below). However in no other fabric at Knossos are large quantities of organic material present as temper in conjunction with another deliberately-added non-plastic (i.e. grog). The only contemporary parallel for this practice comes from LN sites in West-Central Anatolia, where fabrics are generally 'grit' and/or organic tempered (e.g. Tepeköy, Meriç 1993:145). Later Anatolian parallels for this practice of grit and organic tempering are also available from MC-LC Emporio (X-VI) (Hood 1981:167) as well as MC pottery of the Kizilbel/Lower Bagbasi Group (see Eslick 1980:8-9). The provenance of Fabric 27 remains open, although in view of the eastern Aegean and south-west Anatolian parallels for the incised decoration and the combined vegetal and rock temper, an origin in this area is considered possible.

Fabric 28

pierced/unpierced tubular lugs (red/brown slipped and burnished)

Samples 97/36 and 98/87 are pierced tubular lugs, red slipped and burnished, mounted vertically or perhaps at a slight angle, on the upper half of closed vessels (jars?); sample 98/22 is a smaller unpierced lug (see Plate 67). Several more examples of tubular lugs were also identified in Fabric 28. The only other fabric at Knossos in which a form of tubular lug occurs is Fabric 26 (see above). There is an isolated and much later (ENII) example of a horizontal tubular lug in Fabric 5a. Examples in Fabric 28 are either red or brown slipped and burnished: this slip layer is visible in thin-section in the form of clay of different composition (see Chapter 6; Appendix V).

Pierced vertical tubular lugs (especially red slipped and burnished) have a wide distribution in early pottery from south-west Anatolia from Çatal Höyük to the Akhisar area (see French 1965:24 fig.5.1-3; Mellaart 1961:165.fig.3). They are known from late EN Kuruçay (Duru 1994:pl.34.1; 35.6,9,11-14; 38.9-10; 39.3; 48.6; 51.3) and are a characteristic feature of LN sites: cf. Gökpınar (Eslick 1992:pl.79.3-4), Hacilar (Mellaart 1970a:103-104; 1970b:fig.46.1-16), Kilzilkaya (Mellaart 1961:170, fig 6.35-9), Kuruçay (Duru 1994: pl.59.9; 62.9; 70.3; 74.4; 75.4) as well as sites in West-Central Anatolia (Meriç 1993:fig.3.3). The general absence of tubular lugs from EC or later assemblages makes them one of the main diagnostic features of LN sites. This absence is confirmed at Chalcolithic Kuruçay, Hacilar and sites in the Elmalı Plain, where they are rare to absent in Hacilar V and absent by Hacilar IV.

A distinctive form of vertical tubular lug from the Ayio Gala lower cave (Chios) has also been dated to LN (Hood 1981:19-20; fig.5.12-10). However in the lower levels of the upper cave *horizontal* tubular lugs seem to characterise EC deposits (Hood 1981:34). This as well as the discovery of similar red burnished horizontally-pierced lugs at Barakli, south of Izmir, which have been dated to EC, suggests that *horizontally-pierced* tubular lugs may characterise EC assemblages at Aegean coastal sites of Anatolia (see Appendix IV). This may be compared to the similar and contemporary MN practice in Greece (see below).

In the EN Peloponnese the first small tubular lugs, usually vertical, begin to appear in the EN/MN transition phase (Lerna, Franchthi, Nemea) (Phelps 1975:99, 120, 158; Blegen 1975:pl.65.7, 64.3; Caskey 1954, pl. 37d). In MN they become "relatively common" on closed shapes such as 'piriform jars' (cf. 's' profile jars) or small collar jars. These lugs may be tubular or square in section and can be short or very long (max. 9cm) (Phelps 1975:fig. 19.15). Although generally rare at other Peloponnesian sites, horizontally-pierced tubular lugs are frequent at MN Kouphovouno, where they are red/brown slipped and polished to a lustrous ('Urfinis') finish (Renard 1989:114; pl. xxiv.5; cf. also pl.xxviii.3).

The EN/MN transitional date (c.5800BC) for their first appearance in the Peloponnese rules out the possibility that these tubular lugs may be related to the tubular lugs in Fabric 28 (but see Fabric 26 above), since these first appear in

stratum IX (late seventh millennium) and disappear during stratum VII. Thus the last vertical tubular lugs in Fabric 28 disappear at Knossos at about the time that the first horizontal Peloponnesian tubular lugs appear. For the period at Knossos during which the lugs in Fabric 28 occur (c.6400-c.5800?BC), the closest, indeed the only comparanda come from the LN of the east Aegean/south-west Anatolia. Furthermore, the disappearance of vertical tubular lugs in south-west Anatolia, after around 5800BC, compares well with their disappearance at Knossos during the course of stratum VII, the majority of which must date before the middle of the sixth millennium BC (see Appendix I).

hole-mouth jar with adjoining pellet decoration

Hole-mouth jars are found in other EN fabrics at Knossos as well as at contemporary sites on both sides of the Aegean (see below on hole-mouth jars). However sample 98/89 (stratum VIII/VII) is unusual in having a row of adjoining pellets situated just below the rim (see Plate 68). No parallels for adjoining pellet decoration exist at Knossos. Rare examples of pellet decoration are known from LN Kuruçay and the Ayio Gala lower cave as well as from EC Kuruçay and LC sites in the Elmalı Plain (see below on pellet decoration). In late EN Peloponnese and EN Central Greece pellet decoration is uncommon but widespread (Phelps 1975:111). Sometimes it is found moulded into the rim of hole-mouth jars in a similar manner to sample 98/89 (Phelps 1975:fig.9.3-4 [Lerna]; Kunze 1931:fig.35 [Orchomenos]).

unusual incised zigzag pattern

Incised decoration is a feature found in many fabrics at Knossos, however the design and execution of the zigzag incised decoration on sample 98/96 (ENIb) is completely unparalleled at Knossos (see Plate 68). Incision on sample 98/96 is from a finer tool, is not as deep and is more compact; it has also been filled with a white paste. Incised decoration can be found in assemblages on both sides of the Aegean (see Section 7.8 on incision decoration for parallels outside Crete). It is rare at southern Greek EN sites, becoming rarer in MN. At sites in south-west Anatolia incision decoration is more common; indeed recent discoveries of LN material from

Aegean coastal sites hint at the possibility that incision may be particularly frequent here (cf. Miletus area, see below and Appendix IV). The closest published parallel for the design comes from a single example from LN Kuruçay (Duru 1994:pl.81.4).

Conclusion

The early presence at Knossos (late seventh millennium) of red slipped tubular lugs in Fabric 28 currently rules out the possibility that they originate in the Peloponnese and suggests an origin in south-west Anatolia. Other features in Fabric 28 are less unequivocal, such as pellet decoration on hole-mouth jars. Although close parallels for the form of incised decoration on sample 98/96 could not be found, the extreme rarity of incised decoration in the Peloponnese and the greater frequency with which it is found at coastal sites in south-west Anatolia, despite the general lack of research in this region, also point in an Anatolian direction. In this context it is worth considering a striking technological feature exhibited by sherds in Fabric 28: although represented by relatively few sherds in strata IX-VI the majority of sherds - a much higher proportion than in other fabrics (although cf. also Fabric 31) - have a black core in their break (cf. 'sandwich effect', Chapter 5). The frequency with which this occurs suggests the possibility that this is caused by the use of a particular firing practice. No mention is made of this distinctive feature in studies of EN-MN Peloponnesian fabrics, however studies of LN ceramics from south-west and west-central Anatolian sites consistently refer to black cores with orange or red outer layers. Thus, Eslick notes that among LN fabrics from the Elmalı Plain black cores are 'common' (Eslick 1992:81). Similarly around three-quarters of the pottery from sites along the Gediz and Büyük Menderes exhibit a black core 'sandwiched' between red (French 1965:18; Meriç 1993:146). This feature has also been noted as common in 'MC' fabrics from the Elmalı Plain (Eslick 1980:8-9). When taken together this suggests that the distinctive firing horizon noted in examples of Fabric 28 may also link this group to south-west Anatolia.

Fabric 29

There are no parallels, either within the Knossos assemblage or outside, for the combed decoration in sample 98/86 (stratum VI). Like Fabrics 27 and 28, Fabric

29 is grog tempered. This technological link between Fabric 29 and Fabrics 27 and 28 may hint that Fabric 29, which is represented only by two sherds in the EN Knossos assemblage, may also have an origin in the East Aegean or south-west Anatolia. This however remains speculative.

Fabric 30

Fabric 30 is represented by a single body sherd (98/90, EN1b), which preserves no distinctive information about the original form of the vessel (see Plate 69). The finish is buff burnished. The provenance of Fabric 30 remains open.

Fabric 31

Sample 97/101 (stratum VI) is from a small fine dark polished bowl (see Figure VIII.26). Parallels for this form are ubiquitous. However, the large quantities of biotite in Fabric 31 make it difficult to find a compatible source on Crete and would seem to suggest that its source probably lies somewhere beyond the island. Sample 97/101 has a distinct dark core, a technological feature which may or may not link it to the East Aegean (see above on Fabric 28), where parallels can also be found for the micaceous fabric: for example much of the pottery at Ayio Gala (lower cave) is in micaceous (both gold and silver) fabrics⁸⁹ (Hood 1981).

Fabric 32

Sample 98/78 (stratum VI) is from the body of a vessel painted with red and white lines on an orange burnished background (see Plate 70). The white paint is very thin and scarcely visible. Contemporary parallels for white painted decoration are hard to find. At LN/EC Ayio Gala (lower cave) some painted sherds have white painted striped decoration (Hood 1981:21, pl.7[b].30): like sample 98/78 the paint is a thin "dirty white" which has been applied after the surface of the vessel had been burnished and like sample 99/78 these occur in metamorphic fabrics. In the EN Peloponnese white-on-red painted decoration is rare (except Asea, Phelps 1975:105) and this white paint is crusty in contrast to that on 98/78. In MN white

⁸⁹ Compare also the predominantly micaceous (silver) fabrics at LN sites in the nearby Izmir region (R. Tuncel pers. comm.).

paint is very rare (Phelps 1975:160) and none of the examples cited resemble the linear design on 98/78. The provenance of Fabric 32 therefore remains open.

Fabric 33

Sample 97/59 is a body fragment from a small diameter (incurved?) bowl (see Figure VIII.26). Parallels for such a form are ubiquitous and thus provenance remains open.

Fabric 34

carinated bowl with flared offset rim with diagonal slashed rim decoration

The only close parallel for the form of sample 98/80 (stratum V; see Figure VIII.26) in any sequence of the southern Aegean, is a unique vessel also from Knossos in Fabric 35 (see on 97/43, 98/10 below), although the example in Fabric 35 dates considerably earlier (stratum VIII). Sample 98/80 is burnished using the same distinctive horizontal burnish as found on 98/10, although the leading edge of the rim differs from 98/10 in being decorated with diagonal slashes. The closest parallel for the diagonal design are with 98/88, also Fabric 34 (see below), although here the design is painted. Although slashed rims are a rare feature of MN Nea Makri and Elateia (Pantelidou Gophas 1995:pl.8.3-17, pl.24.5-16, pl.37.8-8; Weinberg 1962:175, pl.54(d).3-5, 7-9), these are all *vertically* slashed and found on different forms. In view of the close similarities in form and burnishing technique between 98/90 (Fabric 34) and 98/10 (Fabric 35) it is possible that these two fabrics originated in the same general area. The closest parallels for this form outside Knossos are almost entirely from south-west Anatolia.

curved bowl with flared offset rim with double cordon decoration

A similar vessel with flared offset rim and double horizontal cordon decoration is known from stratum VI (cf. Evans 1964:fig.22.10). See below on plastic decoration.

bowl with dark-on-brown/orange painted and burnished decoration

Sample 98/88 (stratum VIII/VII) is from a thin-walled bowl decorated below the rim with diagonally painted dark-on-brown/orange lines, which were then

burnished (see Figure VIII.26). Parallels for the form are ubiquitous. Closest parallels for the diagonal design are found in 98/80 above, but these are incised. Contemporary painted wares (Greek EN/MN or Anatolian LN/EC) can be found on both sides of the Aegean. However Greek EN/MN examples tend to be more often slipped and painted (see above on Fabric 25). Dark-on-orange/brown unslipped, painted and burnished sherds are a particular feature of LN/EC Anatolia: cf. LN Hacilar (Eslick 1992:p.68 n.18) and LN/EC sites in the Elmalı Plain, such as Akçay, where unslipped painted and burnished sherds with linear designs are noted and compared to LN Hacilar (Eslick 1992: 60, 68, pl. 31, pl. 77.32). It should be stressed that sample 98/88 cannot be compared to later Anatolian EC Hacilar-style slipped and painted vessels, rather the parallels are with LN and LN/EC wares. However, any such parallel with EC Hacilar (IV-II) painted wares would be unlikely in view of the very narrow distribution of this type of pottery within south-west Anatolia (see Appendix IV).

Conclusion

The provenance of Fabric 34 remains unclear, although the east Aegean or south-west Anatolia remain the most likely possibilities.

Fabric 35

large round-based carinated bowl with flared offset rim and strap(?) handles

This form is almost as unique in the EN assemblage at Knossos as the blueschist fabric in which it occurs. All sherds come from stratum VIII (97/43, 98/10) and are almost certainly from a single vessel with a dark exterior burnished or polished with horizontal strokes and an interior which has been scraped/smoothed (see Plate 71). The only parallels for the shape at Knossos are in Fabric 34 (see above) and these are almost as scarce.

The form may be compared to frequent examples from south-west Anatolia: cf. late EN Kuruçay (Duru 1994:pl.38.4-5; 48.10; 51.6), LN Kuruçay (Duru 1994:pl.90.5; pl.61.4-5; pl.64.1; 83.5; 69.11-12), LN Hacilar (IX, VI) (Mellaart 1970b:fig.45.2-3; fig.50.3, 26;60.3, 5, 14-17, 21) and LN Gokpinar and Akçay (Eslick 1992; cf. Mellaart 1961:fig.6.26-7). Many of these LN examples resemble

the vessel in Fabric 35 quite closely (cf. especially Duru 1994:pl.64.1; 83.5; Mellaart 1970b:fig.45.2-3), however none of these have strap handles, although an example from LN Kuruçay has handles which could approximate a strap (cf. Duru 1994:pl.73.9, 11). When painted wares first become common at LN Hacilar (VI) very good parallels for the Fabric 35 form remain very common in the monochrome wares; some of these have small horizontally-pierced lugs, which may be compared in form and position on the vessel to the vessel in Fabric 35 (Mellaart 1970b:fig.50.3, 26;60.3, 5, 14-17, 21). In absolute terms Hacilar VI is broadly contemporary with stratum VIII at Knossos (see Appendix I).

This form continues into the Anatolian Chalcolithic: cf. EC Kuruçay (Duru 1994:pl. 118.8;160.3; 177.2), LC Bagbasi (Eslick 1992:pl. 54.223) and LC4 Beycesultan (Lloyd & Mellaart 1962:fig. P.10.3-8; levels XXIII-XXIV). However these are much later than the example in Fabric 30 and are almost always vessels of a much smaller diameter (e.g. Eslick 1992:pl.54.223).

This form is less well paralleled in the EN Peloponnese. Examples are less close and these are considered rare transitional EN/MN forms by Phelps (1975:87; fig. 6.7.10). In MN 'flaring rim bowls' are very common (Phelps 1975:138, 141; fig. 14.7-10, 13, 16, 17), however the examples illustrated by Phelps are not close to the example in Fabric 35. Only in late MN/LN do carinated shapes become slightly more common and one can find closer parallels but these have ring bases, whereas the vessel in Fabric 35 is round-based (Phelps 1975:fig.16.5, 6; Vitelli 1993a:fig.59.e-h; fig. 85.k-l). The closest Greek parallel for the form is with a vessel from MN Corinth, which also is finished with a similar horizontal burnish (Weinberg 1937:501, fig. 8b; fig.11); unfortunately the shape is incomplete with no information as to whether it is ring or round-based.

Thus the closest contemporary parallels (i.e. late EN Greek/LN Anatolia) for the vessel in Fabric 35 come from south-west Anatolia. The fabric is dominated by blueschist, which is found throughout the Cyclades and parts of coastal Anatolia (e.g. Knidian peninsula).

7.6.4 *Unique Unsourced Sherds*

(i) Dark polished curved bowl with offset rim with incised triangle filled with a diagonally-incised lattice in a schist fabric (stratum VIII):

Although incised lattice decoration is known at Knossos in Fabrics 2a, 2b and 5a, the lattice is always horizontal, never acts as a filling for geometric shapes and occurs in later contexts (stratum VII-VI). Very good parallels for this type of decoration can be found at EN/early MN Nemea, where diagonally-incised lattice decoration acts as filling for diamonds and other shapes (see Blegen 1975:267, pl.65.13). Nemea is also one of the few sites in southern Greece to have good parallels for the form (Phelps 1975:fig. 3.2-3, 6, 8, 15; see below). These parallels from Nemea also have the virtue of being broadly contemporary with the example from Knossos (stratum VIII = late Greek EN).

(ii) Unburnished/smoothed with broken stump of a tubular handle from a thin-walled vessel (stratum VI); soft, very fine, pale white fabric, no large non-plastics: There are similarly preserved broken tubular handles on thin-walled vessels from southern Greece (Phelps 1975:447 fig. 1.11; 512:fig. 66.33, 38). The fabric is unique at Knossos. Possible parallels may exist with the "exceedingly fine" "gritless" fabric noted as a feature of Peloponnesian EN and early MN deposits (Phelps 1975:72): this fabric is always pale in colour, often with "cream, yellowish or slightly pink tones" and is sometimes unburnished and 'wet-smoothed', a feature which would compare well with the example from Knossos (Phelps 1975:73, 75). One might also make a comparison with the white wares which are a rare feature of some southern and central Greek sites. At Nea Makri, white ware is an early MN to early LN feature (i.e. contemporary with stratum VI) and very fine and thin-walled, in contrast to white ware in Thessaly and Peloponnese, but very much like the example from Knossos (Pantelidou Gophas 1995:305-6; 313 fig.1; Phelps 1998:433-4). X-Ray Diffraction analysis has shown the Nea Makri white ware to be almost pure clay (c.90% metakaolinite and illite) with quartz, mica and calcite; microscopic study concluded that the inclusions were volcanic and indicated an origin for the clay on Melos (Pantelidou Gophas 1995:322 Appendix 2). In his review Phelps concludes that the Nea Makri white ware was "imported from Melos, no doubt with the obsidian" (Phelps 1998:433-4).

(iii) Unburnished(?) bowl with rows of horizontally-spaced notches; schist fabric with silver mica (stratum V):

An identical example comes from Emporio VIII (Hood 1981:pl.42.418), the fabric of which is described as "sandy brownish grey-black clay with occasional large lumps of grit; silvery mica showing in surface" (Hood 1981:297). However, the origin of this parallel remains unclear since it is considered by Hood to be imported to Emporio.

(iv) Dark-on-light painted and burnished body sherd with linear pattern (parallel lines); fabric is pink with very fine calcite (stratum IV):

Closest parallels are with MN Peloponnese painted Urfinis, which usually has a similarly fine fabric (Phelps 1975:124): cf. MN Kouphovouno (Renard 1989:xxv.2, 4, 6, 7; xxvi.1, 3-8; xxx.1).

7.7 Defining Variation in Cretan Early Neolithic Forms and Finishes in the Wider Context of the Southern Aegean

In Section 7.6 provenance was assessed in terms of variation in form, finish and frequency per fabric. All fabrics belonging to Group 1 (frequently-attested fabrics) are considered to have a provenance close of Knossos (Herakleion area). Fabrics belonging to Group 2 (rare fabrics), were shown to have good parallels in form and finish with fabrics of Group 1 and as a result these are also considered to have a provenance within the general area Knossos. However, as the presence of Fabric 12 in this group shows, this area should probably include regions as distant as the Mirabello Bay in East Crete. As a result the extent of this zone of overall similarity in form and finish is considered to be large probably encompassing much if not all of Crete. When taken together Groups 1 and 2 account for c.97.5-99.9% of the EN assemblage at Knossos. This leaves a very small group of rare or unique fabrics which exhibit rare or unique forms and/or finishes. In two cases (i.e. Fabrics 31 and 35) petrographic study of these fabrics has indicated a provenance beyond Crete. In several others (i.e. Fabrics 24-8, 32, 34) comparison of these rare or unique forms with ceramic material from other regions of the southern Aegean has also indicated the possibility or even probability of a provenance beyond Crete.

And so if one excludes the fabrics of Group 3, one is left with a large group of fabrics, whose provenance is almost certainly within Crete and which share a range of types of form and finish. Taken together these forms and finishes may be understood at a general level to define the Knossian/Cretan EN in ceramic terms. In this section, in order to understand the degree to which this range of forms and finishes is distinct or similar to those found outside Crete, each form and finish type will be subject to a detailed comparative study based on published assemblages from south-western Anatolia, the eastern Aegean and southern and central Greece. In addition and wherever possible these EN forms and finishes, as defined at Knossos, will be compared to published material from other known, claimed or suspected EN sites around Crete⁹⁰. From this full and detailed discussion of the

⁹⁰ For a discussion of possible and certain EN sites on Crete see Appendix I.

available comparative material it will ultimately prove possible to isolate a smaller range of forms and finishes which are distinctively Cretan.

BOWLS AND JARS:

deep curved bowl/deep curved bowl with flattened rim

Simple curved bowls of various types are a feature of Neolithic assemblages all around the Aegean. Open flat-based types can be found at EN sites in northern and southern Greece, where they are generally outnumbered by types with raised or ring bases (see below). In south-western Anatolia they are common at late EN Kuruçay (Duru 1994:pl.36.1; 37.5; 46.3-5; 47.1-4; 51.1) and are known from LN Kuruçay (Duru 1994:pl.63.2-3) and LN Hacilar (VIII) (Mellaart 1970b:fig.48.29-30).

In south-western Anatolia deep curved bowls are found at EN? Beldibi (Bostanci 1959: pl. IV.3, 5) and late EN Kuruçay (Duru 1994:pl.37.3; 43.8). They are also a general feature of LN sites: cf. Akçay (Eslick 1992:pl.77.17-24), Hacilar (Mellaart 1970b:figs. 45.25, 47.6-7, 48.13) as well as sites in West-Central Anatolia (French 1965:fig.3.11-12, 15-16, 18-20). Flattened rimmed examples from EN Ia Knossos also have good parallels in contemporary LN levels at Hacilar (Eslick 1992:68; see Mellaart 1970b:fig.48.29-30), Akçay (Eslick 1992:pl.77.25) and at sites in West-Central Anatolia (French 1965:fig.11-13,15; Meriç 1993:fig.3.2).

Medium to deep bowls are the 'leitmotif' of the EN Peloponnese (Phelps 1975:82; cf. EN Elateia (Weinberg 1962:169-70); cf. EN/early MN Nemea (Blegen 1975:fig.3; 262). Like the Cretan examples these often have a slightly incurved rim; however while at Knossos more open versions are equally if not more common, in the Peloponnese they are rare outside Corinth and Nemea. In addition examples from the Peloponnese often have ring bases or concave footed bases and perforated lugs (cf. Phelps 1975:figs. 1.17, 18; 2.4, 10), which all examples from Knossos lack (except Fabric 24, see above). Simple medium to deep bowls are rare in the Peloponnese after EN having been replaced by straight, shouldered and carinated forms (Phelps 1975:135-6; fig.12.3, 4, 11).

shallow curved bowl

In south-western Anatolia these are known from EN Kuruçay (Duru 1994:pl.36.2; 43.1; 44.2; 47.5) as well as LN Kuruçay (Duru 1994:pl.55.5; 61.2; 68.3; 82.1-3), LN Hacilar (VIII) (Mellaart 1970b:fig.48.18) and LN Ayio Gala (lower) (Hood 1981:14, fig.5.2-3), where shallow bowls dominate the assemblage and are either curved or straight-sided. Shallow curved bowls are also known from EC Kuruçay (Duru 1994:pl. 122.1-3) and 'MC' Lower Bagbasi (Eslick 1992:pl.63.4-5).

In the Peloponnese examples are known from EN Akrata, Tarsina, Phlius, Nemea, Franchthi, Lerna, Ayioritika (Phelps 1975:80; fig.1.7; Blegen 1975:fig.3.a). In MN the 'dominant type' has a concave foot or ring base; pedestal-bases are rare (Phelps 1975:132-3; fig. 11.4, 7, 8, 10, 12, 14).

shallow straight-sided bowl

In Anatolia, flat-based examples are known from EN Kuruçay (Duru 1994:pl.37.6; 52.3-6), LN Kuruçay (Duru 1994:pl.68.5-9) and are especially common at LN Ayio Gala (lower) (Hood 1981:14, fig.5.4-5). Examples can also be noted at EC Kuruçay (Duru 1994:pl. 122.4-5;124.1). In contrast in the EN Peloponnese they are very rare (two from Nemea, one or two from Lerna, all with red or red-brown slip), although these rare examples are very similar to those from Crete (Phelps 1975:80, fig.1.2, 3; Blegen 1975:fig.5.a, b, c). They become more common in MN, however these are always with ring or pedestal bases (Phelps 1975:fig.11.1, 2, 13).

flared rim bowl

Flared rim bowls are known from EN? Beldibi (Bostanci 1959: plate IV.7) and cf. EN Kuruçay (Duru 1994:pl.50.8-9). They are common also at LN Anatolian sites: see LN Aphrodisias (Joukowsky 1986:fig 297.2,3), Akaçay (Eslick 1992:pl.76.9-12, 77.28), Hacilar (Mellaart 1970b: 47.37-8; 48:29, 50:12, 18, 51.1-5, 6, 53:2, 50:26), Kuruçay (Duru 1994:pl.58.5; 65.3, 10-12), LN Gökpınar (Eslick 1992:pl.79.6-7), Kizilkaya (Mellaart 1961:170 fig 6:26-7) as well as sites in West-Central Anatolia (French 1965:fig.3.2, 6, 7, 9; 5.6-8, 12, 14; Meriç 1993:fig.3.1).

They are also known from 'MC' Kizilbel (Eslick 1992:pl.74.10) and LC Bagbasi (Eslick 1992:pl.54.225).

Flared rim bowls are less common in EN Peloponnese than in Central Greece (Phelps 1975:94) and are known from Lerna, Franchthi and Nemea (Phelps 1975:fig. 2.8-11). In the MN Peloponnese they are equally rare and differ from the Cretan and Anatolian examples in being shallow with ring bases (Phelps 1975: 154, fig.11.3, 6, 14.5).

carinated bowls

Carinated bowls are generally not common in Neolithic south-western Anatolia: compare the single vertically carinated bowl from EN Kuruçay (Duru 1994:pl.37.8). However both flared carinated and vertically carinated bowls are very common amongst the monochrome wares from EC Hacilar (I) (see Mellaart 1970b:fig.111.1-2, 4-7 [flared], fig 111.3, 8-12 [vertical]) and are known also from EC Kuruçay (Duru 1994:pl. 159.10-12). Indeed several examples from Hacilar have pellet decoration on the carination, which recalls ENIc-II examples from Knossos (Mellaart 1970b:fig.111.1, 4-5). Also from EC Hacilar (IIB-III) are several examples of carinated bowls with rounded bases (Mellaart 1970b:fig.70.17-19), which resemble an ENII bowl in Fabric 1b at Knossos as well as examples from Elateia (see below). Carinated bowls are however uncommon in LC south-western Anatolia (Eslick 1992:85), although they are well represented at Emporio IX onwards as well as at Aphrodisias and in the Dinar and Burdur regions.

In the Peloponnese carinated bowls only become popular in MN, where they often have ring feet or pedestals (Phelps 1975:120). Vertically carinated bowls, similar to late ENI examples at Knossos, are actually quite rare in MN (only occurring in Corinth), only becoming more common in late MN/LN (Phelps 1975:142; fig. 16.7). Shallow flared carinated bowls are known from Corinth (Phelps 1975:142; fig. 12.10; 16.5, 8, 10). Carinated bowls with rounded bases are a late MN/LN feature of the Argolid (Phelps 1975:142; fig. 16.3, 9). Carinated bowls are also a feature of MN/LN Elateia (Weinberg 1962:10.4, 5, 7, 10, 11) where they are common, sometimes with rounded bases (e.g. in Fabric 1b [ENII]), one of which is rippled (Weinberg 1962:188; pl.60(d).8).

The synchronism between the popularity of carinated bowls at Knossos in late ENIb/ENII (especially flared carinated bowls) and their late MN/LN popularity on the Greek mainland has been noted by Evans (1971:109). However at Knossos, unlike Mainland Greece, these have a local ancestry going back to ENI (Broodbank 1992:48). This general synchronism is confirmed in Appendix I. However, what has not been noted previously is the synchronism with the appearance of these bowl types at late EC sites in south-western Anatolia. Anatolian late EC, Greek late MN and Cretan late ENIb/ENIc all occur in the latter half of the sixth millennium (c.5300BC; see Appendices I, IV). Under such circumstances it is impossible to speak of the influence of one area over another (although Knossos does have a longer history of carinated bowls), but the possibility is raised of contacts between these three areas.

curved/carinated bowl with offset rim

In Anatolia there occur occasional examples that are close to those from Knossos: for example at LN Kuruçay (Duru 1994:pl.55.8, 12; 68.10; 71.6, 8), LN Hacilar (IX, VI) (Mellaart 1970b:fig.45.29, 34; 47.17-18, 50.5) and LN Ayio Gala (lower cave) (Hood 1981:fig. 5.12, 6.13-18). However in general Anatolian bowls do not have sharply offset rims, but instead curve out gradually to form an 's' profile.

Curved or carinated bowls with offset rims are even more rare in the EN Peloponnese (Phelps 1975:93-4). The closest is a form of offset rim found chiefly on the glossy burnish rib and groove decorated black ware from Nemea (Phelps 1975:fig. 3.2-3, 6, 8, 15). Beaded or offset rims are more common at EN sites in Central Greece (e.g. Nea Makri, Elateia) as well as further north in Thessaly (Phelps 1975:94). Some examples from EN Elateia are quite close to examples from Knossos (see Weinberg 1962:fig.5.6-10; pl.52(a).2-6), although Weinberg suggests that overall the closest similarities are with the earliest pottery from Thessaly, where 'everted rims' are common (1962:171; cf. Theocharis 1973:figs.29-30; Milojcic & Milojcic 1971:pl.A.2, 3; pl. G.1-11; fig. I.3; fig. II.3-15; VII.1-24). During MN and LN, curved or carinated bowls with offset rims continue at Elateia and at Nea Makri (Weinberg 1962:fig.6.6-9; fig.8.2, 3, 6; fig.11.1-5, 7; pl.58(b); 62(c); Pantelidou Gophas 1995:fig.12.3-33, 3-34, 3-37, 3-42, pl.53.11-93, 11-94, 11-95). Some of the

later MN and LN examples from Elateia closely resemble examples from Knossos: cf. Weinberg 1962:fig.8.6, 11.1-5, 7, pl.54(a), which are flat-based high curved/carinated bowls with offset rim, one of which is even pellet decorated. Several of these are Black-on-red painted and others have the Urfirnis lustrous slipped surface. Therefore the closest parallels for the offset rims at Knossos come from Central Greece.

Variations of curved/carinated bowls with offset rim include:

(i) deep bowl with offset/beaded rim: examples of deep bowls are known from EN Kuruçay (Duru 1994:pl.44.6), LN Hacilar (VIII & VI) (Mellaart 1970b:fig.48.28), EC Kuruçay (Duru 1994:pl. 159.13-14) and LC Bagbasi (Eslick 1992:pl.47.140, 142).

(ii) shallow curved bowl with offset rim: examples are known from LN sites in Anatolia: for example Kuruçay (Duru 1994:pl.55.14) and Hacilar (VIII) (Mellaart 1970b:fig.48.15).

(iii) high carinated bowl with offset rim (ENIc/ENII): a particular variety of this bowl type, frequent at Knossos in ENIc/ENII has particularly close parallels with some LN bowls from Paradimi, Greece (French 1961:fig.6.17, 27): note in particular the presence of strap handles on carination and just below the rim and decoration in the form of "grooving or rippling" (French 1961:fig.6.12-15, 7.1-9).

curved jar with offset rim

As with curved/carinated bowls, close Anatolian parallels are rare; compare, however, EN Kuruçay (Duru 1994:pl.36.7; 51.8-9), LN Hacilar (VI) (Mellaart 1970b:fig.52.6-8), LN Kuruçay (Duru 1994:pl.57.6; 71.7) and LN sites in West-Central Anatolia (Meriç 1993:fig.3.1). Usually however rims are not sharply offset and resemble more an 's' profile (see below).

In the EN Peloponnese curved jars with offset rims are not common (Phelps 1975:86; Blegen 1975:fig.5.e, f, g, N19), but become more common in MN, where offset rims are more sharp and are thus closer to the Cretan examples (cf. Phelps 1975:fig.5.1-4, 6, 8-10 - from Nemea, Gonia, Franchthi). However the majority of

these rims are much more flared than Cretan types. Actual Cretan-style beaded rims are 'exceptional' in MN contexts (Phelps 1975:154;cf. fig.14.3).

incurved bowl/hole-mouth jar

Hole-mouth jars are found at EN Kuruçay (Duru 1994:pl.37.1-2; 43.2, 5-7; 44.11-12) as well as at a large number of LN sites in Anatolia: Akçay (Eslick 1992:68, pl.76.4-5) Hacilar (Mellaart 1970b:fig. 46.15, 48.14, 18), Gökpınar (Eslick 1992:pl.79.8), Kizilkaya (Mellaart 1961:170 fig.6.4, 9-10), Kuruçay (Duru 1994:pl.57.1-2; 64.2; 66.6-7; 71.2-3) as well as at other LN sites in West-Central Anatolia (French 1965:fig.3.21-3; 4.15). Usually these are curved in profile, however straight sided hole-mouth jars are known from sites on the Elmalı Plain (Eslick 1992; see Appendix IV). These may be compared to ENI examples at Knossos in Fabrics 6 and 8.

Incurved bowls/jars are equally common at sites in the EN Peloponnese, such as Asea, Nemea, Ayioryitika, Franchthi (Phelps 1975:fig. 4.5, 10, 16, 17, 20; Blegen 1975:fig. 3, 5.i, j, k, m;5.d). Many of these have oval lugs and ring bases. In MN this 'dominant' EN form plays only a minor role (Phelps 1975:137-8; fig.13.13, 14.1, 3, 4, 6; fig.14.2, 12).

's' profile jar/'necked' jar/collared jar

This form type differs from curved/carinated bowls with offset rims in the way that the rim is not sharply offset but gradually curves out to form an 's'. On some examples this curve is more sharp or 'necked', on others it is more elongated and resembles a collar.

In Anatolia 's' profile bowls are known from late EN Kuruçay (Duru 1994:pl.34.1-7,9-11; 36.5-9; 43.3-4; 45.1-8) and are a well-known feature of LN sites: e.g. Aphrodisias (Joukowsky 1986:fig 297.4), Akçay (Eslick 1992:pl.76.1-2), Kuruçay (Duru 1994:pl.57.3-4; 64.4-6; 84.6-7), Hacilar (IX, VII, VI) (Mellaart 1970b:fig.45.30-35; 47.19-25; fig.49.8-13, 17; fig.52.1-5) and LN sites in West-Central Anatolia (French 1965:fig.3.6, 8; fig.4.1-4; fig.5.5; Meriç 1993:fig.3.1). 'S' profile bowls are also known from 'MC' Lower Bagbasi, 'MC' Kizilbel and LC Bagbasi (Eslick 1992:pl.63.2-3; pl.74.9, 76.1-2; pl.70.10-14). 'S' profile bowls with

'necked' or 'collared' rims are known from EN and LN Kuruçay (Duru 1994:pl.34.8; 48.11; 50.5-7; 57.4; 58.1-2; 74.5-8) and at LN sites in West-Central Anatolia (French 1965:fig.4.16-17, 19-20; fig. 5.17); they are also known from EC Akçay, LC Bagbasi and LC Karaburun (Eslick 1992:pl.68.17-18, pl.71.a, pl.76.13-14). Examples of very high collared or 'funnel-necked' jars are known from LN Hacilar (VI) (Mellaart 1970b:fig.54.2, 4).

'S' profile bowls are also known from the EN Peloponnese (see Phelps 1975: fig. 4.21, 22; 5.5, 7, 11) and in MN they become a 'dominant form' (see Phelps 1975:135-6; fig. 13.2, 3, 8-11, 14): they are particularly common at Lerna. Medium sized vessels are usually painted, such as at Corinth, Gonia, Kefalari, Lerna, Ayioryitika and Kouphovouno. There are also a number of variants, such as a deeper type at Lerna, a narrower diameter 'tulip' vase (Phelps 1975:137; fig.13.12) and a variant which Phelps calls 'piriform jars' (1975:139; fig. 15.1-11; 17.3, 6, 8, 9). Sometimes these curve out into a carination (fig.15.9) others have an 's' profile; often they have round bases.

In the EN Peloponnese more collared versions of this type are rare and transitional to MN (Nemea, Lerna) (Phelps 1975:87): low-collars [$<2.5\text{cm}$] are known from Phlius, Prosymna and Franchthi, medium [$2.5\text{-}5.0\text{cm}$] from Nemea, Prosymna, Franchthi and Lerna and high collars [$>5.0\text{cm}$] from Akrata, Nemea, Lerna and Ayioryitika (Phelps 1975:fig.7.11; fig. 7.1-4; fig.7.5-10). Collared types are prominent at EN Elateia (Weinberg 1962:169-70; fig.5.17-20). In the MN Peloponnese collared jars become more common and necked-jars become rare (Phelps 1975:120; 144).

flat-based mug

There are few parallels for this form outside Crete. The only contemporary or earlier example come from LN Kuruçay in Anatolia: two low flat-based vessels, one with a slightly flared rim (Duru 1994:pl.68.2, 82.5). Other parallels are very late: cf. a LC flat-based vessel with rim attached loop/narrow strap from Bagbasi (Eslick 1992:120.38, 39, 41, 42, pl.99.f), a MN/LN incised vessel from Kouphovouno (Renard 1989:pl. xxxii.6) and a LN flat-based shallow steep-sided bowl from Paradimi in Greece (French 1961:fig.7.18). However, it is perhaps worth noting the

possibility of a connection at Knossos between incised flat-based mugs and incised 'trays', since these are the main ENIb decorated forms and both are shallow with steep sides (see below for LN Anatolian parallels).

rectangular 'trays'

Rectangular vessels with short feet, some of which have deeply incised decoration are known from LN sites in west-central Anatolia as well as along the coast to the north (Meriç 1993:145, fig. 3.5; see Appendix IV). Shallow rectangular vessels are also known from LC Bagbasi (Eslick 1992:pl.54.227, pl.56.242-9). However, it should be noted that several of these 'trays' are decorated on their bases (cf. Evans 1964:27.24, 26) and their interior are only very roughly finished. This may indicate that these 'trays' were actually used upside-down and could not have functioned as containers. One alternative would be that they were perhaps models of decorated tables. See also above for possible link in form, finish and potentially significance for 'trays' and flat-based mugs.

pedestalled bowl/pedestalled stand

In the EN and early MN Peloponnese pedestal bowls are rare, although such vessels are more common in the Magoulitsa culture of Thessaly (Phelps 1975:97, fig.9.27-8). However by mid-MN carinated bowls on pedestals are common and by late MN pedestals with fenestrated decoration are found (Phelps 1975:120-1, 155; cf. also MN Elateia Weinberg 1962:fig.9).

flared rim cups (and internal piercing)

Small diameter bowls/jars with internally-pierced rims are known from LN Kuruçay (Duru 1994:pl.56.2, 70.9-10; 72.7; 75.9). Examples of unpierced internal rim lugs are also known from LN (Duru 1994:pl.66.4-5) and EC Kuruçay (Duru 1994:pl.128-9). Sometimes these lugs are also pierced: e.g. EC Kuruçay (Duru 1994:pl.107.4; 140.15). However none of these are close parallels for the flared cups in strata VI-V at Knossos.

shallow bowls with internally thickened rim

This is a very late EN feature at Knossos (ENIc, ENII). Similar internally thickened rims are known from a large number of contemporary or near contemporary LC sites in south-west Anatolia: cf. LC Boztepe (Eslick 1992:pl.67.2-3, 5, 7-9), LC Arapkave Höyük, near Metropolis (Meriç 1975:fig. 106.6-9), LC Akhisar, Manisa, Balıkesir (French 1961:fig.5.35-8, 41-6), LC Aphrodisias (Joukowsky 1986:fig 35:13, fig. 33.3) and also LC Beycesultan (Lloyd & Mellaart 1962:fig. P2:15). However the parallels from Beycesultan are not as close as those from the other sites.

spoons

Spoons are a rare feature of the EN Peloponnese (Phelps 1975:91; fig. 8.7 [Lerna, Nemea]).

BASES:

round bases

Examples of round bases are known from EN Elateia (Weinberg 1962:170) and are common at sites in the EN and MN Peloponnese (Phelps 1975:94-5, 154-5).

flat bases (shallow, steep)

Shallow and steep sided flat bases are known from many Neolithic sites in south-west Anatolia: cf. EN Beldibi (Bostanci 1959: plate IV.1 [steep]), late EN? Kuruçay (Duru 1994:pl.34.12; 45.13; 49.12-13 [shallow]), LN Kuruçay (Duru 1994:pl.65.13-14; 76.6-7), LN Hacilar (IX) (Mellaart 1970b:fig.45.17; 47.34), LN Kizilkaya (Mellaart 1961:fig.6.43-9) and at LN sites in west-central Anatolia (French 1965:fig.4.21, 5.16). Flat bases are also common in the LN/EC Ayio Gala Lower Cave (Hood 1981:20; fig.5.10, 12; fig.6.13) and at LC Bagbasi (Eslick 1992:pl.51.e.g. 177-180, 183, 195, pl. 52-3)

Flat bases are also common in the earliest monochrome pottery at EN Elateia, but these often have a slight concavity (see concave bases) (Weinberg 1962:170;fig.7.1). In the EN Peloponnese flat bases are common on large heavy bowls, but are otherwise rare (Phelps 1975:95; Blegen 1975:fig.3 N12). In MN "apart from a few instances where the round base has been partly flattened, true flat

or concave bases are rare on fine wares" (Phelps 1975:154). In general flat bases are rare at sites in Greece, ring bases are much more common. At LN Saliagos most bases are flat (Evans & Renfrew 1968).

concave bases

Flat bases which are slightly concave are a consistent feature of LN Hacilar (IX-VI) (Mellaart 1970b:fig.47.33, fig.48.2-3, fig.49.4, fig.50.6, 10, 31, fig.52.3), LN Aphrodisias LN (Joukowsky 1986:348, fig.297.6,8) and LN Kuruçay (Duru 1994:pl.61.13; 62.15-16). They are also known from EC Hacilar (Mellaart 1970b:fig.109.13). Thus in south-west Anatolia parallels predate the examples from Knossos (ENIb-ENII).

Concave bases are a feature of EN Elateia (Weinberg 1962:fig.7.2) although here ring bases and concave footed bases also occur. Concave bases, comparable to those from Knossos, do not occur in the EN-MN Peloponnese; instead concave footed bases occur (cf. Phelps 1975:95, fig. 9.18). During MN the concave foot is replaced by the ring foot (Phelps 1975:120, 154). There is an example of a concave base comparable to Knossian types from LN Saliagos (Evans & Renfrew 1968:fig.53.12), which is unique and thus a possible import.

HANDLES:

wishbone handles

Wishbone handles are known from several sites on Crete. It was originally believed that this type of handle was restricted to EN at Knossos (Dawkins 1905:260-8; Evans 1964:204 fig.45; cf. Vagnetti, Christopoulou & Tzedakis 1989:88-89) and thus could be used to identify EN assemblages around the island (e.g. Treuil 1970:20 for Agios Ioannis Cave; see Appendix I). However, it is clear now that this handle form had a much longer life: later examples are known from LN Knossos (Manteli & Evely 1995:pl.1(b)), although these are not as common as in EN (Manteli 1993a:47). Since wishbone handles appear to be absent from pure FN assemblages, this would seem to indicate that they go out of use after LN. If this pattern proves to be island-wide, then the wishbone handles in supposedly pure FN assemblages at Phaistos (Vagnetti 1972-3:71 figs. 69, 76; Furness 1953: 105, n.20,

108, 112) and Nerokourou may indicate that some of this material should be dated to LN⁹¹. Outside Crete there are no good contemporary examples of wishbone handles (cf. Furness 1953:108, 112). The closest parallel is with the practice of attaching tubular handles to the rims of shallow curved bowls at LN Kuruçay (Duru 1994:pl.67.5-6, pl.247.4).

pierced/unpierced ears on the rim

These disappear at Knossos after stratum VI (i.e. after ENIb); however a similar form re-occurs at some Cretan FN sites: e.g. Lebena (Vagnetti & Belli 1978:pl.VII.2), Eileithya Cave (Amnisos) and Nerokourou, where they are common (Vagnetti, Christopoulou & Tzedakis 1989:fig.15.2; 16.13; 17.27, 31; 20.66). These FN examples also appear on open bowls, but, unlike the neat squat small triangles of ENIa-b, tend to project to a greater height above the rim. Outside Crete parallel examples of triangular ears on open curved bowls are later than ENI: e.g. LN Saliagos (Evans & Renfrew 1968:39, fig.58.3).

strap handles

In the southern Aegean outside Knossos there are a few early examples of strap handles. At LN Hacilar (VII) some large tubular lugs approximate strap handles (e.g. Mellaart 1970b:fig.49.16), however these are rare exceptions. For example from the LN/EC Ayio Gala Lower Cave there is not a single strap handle. Indeed the first possible Anatolian examples do not occur until the MC/LC period at sites on the Elmalı Plain, Chios and at Saliagos, where at the latter strap handles are the most common handle forms (Evans & Renfrew 1968:39).

For EN sites in Greece one must go as far north as the Cyclops Cave on Yioura to find early examples of strap handles (Sampson 1999:8) and elsewhere in the northern Aegean strap handles are rare or absent (e.g. EN Nea Nikomedeia, Pyke & Yiouni 1996:98). At EN sites in southern and central Greece strap handles are unknown (Phelps 1975:99; Weinberg 1962:170-1). Some large perforated lugs

⁹¹ NB The few incised sherds at Nerokourou have parallels in the LN strata at Knossos (Vagnetti et al. 1989:88). The parallels between pottery from LN Knossos and that found in the lowest level at Phaistos are well-known (Evans 1971:3-4; Vagnetti 1972-3:75) and suggest an LN date for the earliest occupation at Phaistos.

could be considered close to strap handles (Phelps 1975: e.g. fig 9.36). When strap handles first appear in the MN Peloponnese they are generally rectangular in section (see below) and are used first on collared jars.

rectangular-sectioned strap handles

These first appear in the Peloponnese in the latter half of MN and mark the first appearance of strap handles in this area; they are not common and are found on collar jars, pitchers and large storage jars (Phelps 1975:158; fig.22.15, 16).

flared strap handles

There are no close parallels for these outside Crete. However some early Anatolian jars have flared vertically-pierced tubular lugs: cf. late EN Kuruçay (Duru 1994:pl.45.10) and LN Kizilkaya (Mellaart 1961:fig.6.38). It thus remains a possibility that the flared straps on collared/necked jars at Knossos are a variation on this theme.

above rim strap

Above rim straps, approximately contemporary with ENIb examples are known from EC Kuruçay (Duru 1994:pl. 177.3-5) and MC/LC Emporio (Hood 1981:pl.35.262; pl.38.341).

tubular loop handles

Loop handles are known from LN south-western Anatolia: cf. Gökpınar (Eslick 1992:67, pl.79.1-2), Hacilar (Mellaart 1970b:fig. 46.6), Kuruçay (Duru 1994:pl.77.19). A form of horizontal loop handle is also known from EN Elateia (Weinberg 1962:170; pl.53b) and Chaironea (Weinberg 1962:pl.55.e-h). Horizontal loop handles are known from EN Nea Makri, where in MN they are the usual handle form (Pantelidou Gophas 1995:307; fig.2.1-29; fig.7.2-69; fig.11.3-79; fig.18.3-106-110). At EN/early MN Nemea, there is an example, which occurs on a jar at the point of largest diameter (Blegen 1975:266, fig.5.f, pl.64.22). Some examples at Nemea are monochrome, but the majority are painted, with examples found as

far south as Hageortika in Arcadia (Blegen 1975:266). Blegen also notes (1975:269) that this form of handle is common on coarsewares. Non-contemporary horizontal loop handles are known from MN/LN Kouphovouno where they are common in coarsewares (Renard 1989:pl.xli.1-6, 9-10).

pierced long handle ('spout')

A unique 'double-spouted' bowl from Saliagos (Evans & Renfrew 1968:fig.39) finds a close parallel with a unique vessel from stratum V at Knossos in Fabric 1d or 2a/b.

DECORATION:

Incised decoration

At Knossos, aside from occasional examples in rare or unique fabrics and one example of incised decoration on the base of an incised/pointillé flat-based mug (Fabric 5a), pure incised decoration is a feature of ENIc and above all ENII. Thus similarly decorated examples from Katsambas, near Knossos must date to the same period (Alexiou 1956:308, fig.7; 1957:373, fig.4; see Appendix III).

In south-west Anatolia incised decoration is consistently represented but rare: e.g. LN Hacilar (IX, I) (Mellaart 1970b:fig.47.28; fig.109.8,9,10, 22, 24, 25; fig.112.2-3), LN Akçay (Eslick 1992:fig 76.14-15), LN Kuruçay (Duru 1994:pl.81.1-6), at LN sites in west-central Anatolia and at MC Kizilbel (Eslick 1992:pl.75.18-20). These incised examples have mostly geometric designs (triangles, zigzags, chevrons), which mirror the motifs found on painted vessels: e.g. late EN Kuruçay (Duru 1994:pl.42.13-14), EC Hacilar (I) (Mellaart 1970b:fig.109.20, 22, 5-26). Rather more incised sherds are known from both lower (LN/EC) and upper (EC/MC/LC) caves at Ayio Gala (Chios), where the designs are largely diagonal lines and multiple chevrons (Hood 1981:23, 36, 60-1; cf. 232 for Emporio X-VIII). Incised sherds also appear to be more common at coastal sites further south, such as the Miletus area (cf. Niemeier et al. 1997).

Incision is very rare at Saliagos (one sherd) (Evans & Renfrew 1968:43-4), although a number of sherds have incised/pointillé decoration. Incision is also rare in the EN-MN Peloponnese, where it is considered "a rare eccentricity" (Phelps

1975:168; cf. Vitelli 1993a:fig.55.1-p). However at EN/MN Nemea several sherds are incised, usually with zigzags or triangles filled with diagonal cross-hatching (Blegen 1975:267, pl.65.5). Incision also more common at MN/LN Kouphovouno (Renard 1989). At EN sites in Central Greece incision is also rare or absent. At MN Elateia incision is restricted to short notches cut in outer edge of rim of bowls, sometimes at an angle (Weinberg 1962:175, pl.54(d).3-5, 7-9). At Nea Makri incision first appears early in MN (Pantelidou Gophas 1995:306). Although the incised designs link the examples from Nea Makri with light on dark painted designs on vessels from Saliagos as well as Naxos, Santorini and the East Aegean (Pantelidou Gophas 1995:306, n.22-3), these comparanda are all LN or later in date and have been taken to indicate that Nea Makri "had a decisive influence on Cycladic pottery" (Pantelidou Gophas 1995:306). None of the MN designs from the Greek Mainland find a close counterpart in contemporary Cretan ENIb/c incised pottery.

The first close comparanda occur in ENII deposits at Knossos, which are contemporary with Greek LNI (see Appendix I): for example compare multiple incised chevrons, characteristic of Nea Makri (Pantelidou Gophas 1995:pl.Γ.8-87, pl.45.9-32, 9-35), with much rarer examples at ENII Knossos (Evans 1964:pl.48(1).4). It should be stressed, however, that the majority of ENII incised designs do not find close parallels at Nea Makri or elsewhere. Much closer parallels for ENII designs can be found amongst incised wares from Emporio VIII (see Appendix I).

incised lattice decoration

The only parallels are from the nearby EN Cretan site of Katsambas (Alexiou 1956:308, fig.7; 1957:373, fig.4; see Appendix I).

incised slashed decoration (first appears ENIc)

One example illustrated from MN/LN Kouphovouno (Renard 1989:pl.xxxiv.4) is similar in design to examples from ENII Knossos.

incised/pointillé decoration

Pointillé or incised/pointillé decoration is rare in south-west Anatolia: cf. LN Kuruçay (Duru 1994:pl.81.10), EC Hacilar (I, III) (Mellaart 1970b:fig.109.24, 25), LC Bagbasi (Eslick 1992:pl.54.228). It is possibly even more scarce during EN-MN in southern and central Greece, absent even from EN/MN Nemea and MN/LN Kouphovouno, both sites where incised decoration is more common. None of the rare Aegean examples resemble Cretan incised/pointillé. However, very close contemporary parallels are possible with rare examples of incised/pointillé from EC/MC Ayio Gala and Emporio (X-IX). Indeed these are so close and rare for the east Aegean as to suggest the possibility of Cretan imports (see Appendix I). The only other contemporary parallels are from the site of Katsambas, near Knossos (Alexiou 1956:308, fig.7; 1957:373, fig.4; see Appendix I).

Intriguingly it is only when incised/pointillé becomes rare at Knossos (ENII), that Aegean parallels increase and similar forms of incised/pointillé decoration are found at many sites over a large area. At LN Saliagos several examples have incised bands containing pointillé and filled with white paste, one of which is from a fruitstand/chalice (Evans & Renfrew 1968:43-4, fig.56.9-13, pl.xxv.a-b). These compare well with the few examples of incised/pointillé at LN Nea Makri, at LN/FN Kitsos cave and at LN Tharrounia cave (Pantelidou Gophas 1995:144; 306, n.23). LN examples of incised/pointillé are also known from Crete. There are some unpublished "incised and punctuated sherds" from LN/FN Skaphidia (Lasithi) (Pendlebury et al. 1938:5), LN Magasa (Dawkins 1905; Manteli 1993b) as well as LN Knossos (Manteli 1993a:47; Manteli & Evely 1995:6; pl.2.a-c).

ripple decoration

There are no good contemporary parallels anywhere in the Aegean for the earliest few examples of ripple decoration at Knossos (ENIb). It is only when ripple decoration becomes more common at Knossos (ENII/MN), that contemporary parallels can be found outside Knossos. Phelps notes that rippling is found on a small number of black ware and grey ware sherds from Greek LN and FN deposits (Phelps 1975:233-4). Although the exact form of ripple design does not find parallels on Crete, the forms on which it occurs are reminiscent of Cretan ENIc and

ENII shapes, such as vertical carinated bowls and curved bowls with offset rims. Although small quantities are known from Delphi, Elateia, Attica and Euboia, the main centre of distribution appears to be Corinth (Phelps 1975:234; Weinberg 1962:188; pl.60(d).8). Although ripple decoration is absent from LN Saliagos, flattened rims on 's' profile jars, which at ENII Knossos would be decorated with ripple, are slashed, thus creating a similar effect (Evans & Renfrew 1968:43; fig.42.10, 11). Conventional dates for the Greek LN and FN indicate that this is a phenomenon of the fifth millennium BC, thus making ripple decoration in Mainland Greece broadly contemporary with Cretan ENII/MN ripple.

During LN at Knossos ripple becomes increasingly rare, disappearing in the very latest LN West Court phase prior to the beginning of FN (Manteli 1993a:47, 49, 54; cf. Evans 1973:146). Outside Knossos, MN/early LN style ripple is found at several caves in West Crete, i.e. the Lentaka Cave (Hood 1965:112), the Lera Cave (Guest-Papamanoli & Lambraki 1980), the Platyvola Cave (Vagnetti 1996:37) and at Ellenospilia (Marinatos 1928:100-1). It is also known from Mitropolis in the Mesara (Vagnetti 1996:37), the Eileithyia Cave at Amnisos (study collection in the Stratigraphical Museum at Knossos) and the Skaphidia Cave and Kastellos, both on the Lasithi plateau (Pendlebury et al. 1938:17; pl.V.18). Judging by the rest of the material in these deposits it seems likely that most of these examples of rippled ware date to LN, with the possible exception of Mitropolis which has other MN forms and finishes.

grooved decoration

Rare examples of grooved decoration can be found on both sides of the Aegean: cf. LN Kuruçay (Duru 1994:pl.81.8), EC Hacilar fig 109.20, 26), EC/MC/LC Ayio Gala (Hood 1981:60-1) as well as from the EN Peloponnese (Nemea, Tarsina, Lerna) and Nea Makri (Phelps 1975:113).

plastic decoration: pellets

Furness (1953:114) suggested that the 'closest parallels' for EN Cretan pellet decoration were to be found at LC Büyük Güllücek in Central Anatolia. However other spatially and temporally closer examples are now possible, although the

significance of parallels is often diminished by the frequency with which pellet decoration recurs across the Aegean (Eslick 1992:n.49).

single pellets

Rare examples of single applied pellets are known from LN Kuruçay (Duru 1994:pl.61.14), LN/EC Ayio Gala (Hood 1981:pl.6), EC Kuruçay (Duru 1994:pl.164.18) and MC/early LC Emporio (X-VIII) (Hood 1981:pl.42.430). In the EN Peloponnese applied pellets (round or oval) are the most typical form of decoration and are usually placed close to the widest diameter, sometimes close to the rim but never immediately below the lip (Phelps 1975:109-110; Blegen 1975:266-7). At EN/early MN Nemea most deep bowls have some oval or round knobs "either singly or in groups of two, three or more"; at EN Franchthi there is single similar example of three pellets arranged in a triangle on the body of a curved bowl (Blegen 1975:264; Vitelli 1993:fig.19.n). This arrangement parallels contemporary examples on carinated jars in Fabric 1a from stratum VIII at Knossos. Pellet decoration is also known from EN Elateia (Weinberg 1962:pl.53(c),(d).1-3). In the MN Peloponnese plastic decoration is rare: round pellets occur infrequently on the bellies of 'piriform' jars or bowls (Phelps 1975:168).

rows of pellets

Rows of pellets are known from EC Hacilar (Mellaart 1970b:fig 109.23), EC Kuruçay (Duru 1994:pl. 164.19 [vertical]) and LC Boztepe and Karaburun in the Elmalı Plain (Eslick 1992:71).

below rim pellets/lumps

In the EN Peloponnese pellets may be simply stuck on or moulded into the lip to produce a wavy effect (Phelps 1975:11, fig. 9.2-4). There are also examples of this from Nea Makri and Orchomenos (Kunze 1931:fig.35). There is a single example of a deep bowl from MN Kouphovouno with lumps below the rim, which closely parallels ENI examples from Knossos (Renard 1989:pl. xxviii.7). This type is frequent at Kouphovouno and occurs in a grey fabric with limestone temper (Renard 1989:115). There are examples of below rim pellets from Elateia

(Weinberg 1962:171). At LN Saliagos applied decoration is usually in the form of rows of pellets below the rim; sometimes these are finger impressed giving them a dimpled appearance (Evans & Renfrew 1968:43, fig.42.1).

above rim lumps

One example known from LN/EC Ayio Gala Lower Cave on a shallow bowl (Hood 1981:fig.5.3). Knobs or lumps projecting above the rim, similar to ENIa examples from Knossos, are known from EN Elateia (Weinberg 1962:pl.52(d)).

plastic decoration: cordons

Plastic cordon decoration is common on large 'storage jars' at LN/EC Ayio Gala (lower) and EC/MC/LC Ayio Gala (upper). These are applied to the surface of the vessel and not imbedded within it; diagonal, curving and straight cordons are found in both high and low relief (Hood 1981:24, 36, 61-2). In later (EC/MC) deposits (Ayio Gala upper cave lower deposit) curved cordon decoration is also found on fine burnished jars (Hood 1981:36). These examples closely parallel contemporary ENIb cordon decoration on polished vessels at Knossos. Plastic cordon decoration is also common at MC/early LC Emporio (X-VIII) and continues into levels VII-VI (Hood 1981:238).

In the Peloponnese plastic cordon decoration is a late EN feature which continues into MN (Phelps 1975:112). At EN/early MN Nemea plastic cordons are found and motifs include crescent, chevrons, zigzags, horizontal bands, slanting stripes (Blegen 1975:264, pl.64.11). In the MN Peloponnese, the use of cordons is rare (Phelps 1975:168). Plastic cordons are more common in Central Greece; they are known from EN Elateia, where single and double cordons are used to form simple lines and zigzags (Weinberg 1962:171). They also occur at MN Nea Makri (Pantelidou Gophas 1995:pl.21.4-147). Plastic cordon decoration at LN Saliagos is almost exclusively found on coarse wares and is normally concentrated near the rim (Evans & Renfrew 1968:42-3). More rarely (c.2%), cordons are found on fine wares (Evans & Renfrew 1968:fig.43.1-10). One of these (no.10), which consists of three near parallel cordons, is identical to an example in stratum IV (Fabric 1e) at Knossos.

plastic decoration: slashed cordons/'rope'

Slashed cordons or 'rope' decoration are very rare to absent at sites in the southern Aegean outside Crete:

- from EN/MN(early) Nemea comes a single example of slashed cordon decoration (Blegen 1975:264, pl.68.4), which is very close to ENIb examples from Knossos. Phelps considers this "unique" for the EN Peloponnese (1975:fig. 9.14).
- also from EN/early MN Nemea is a black burnished sherd with fingernail incised decoration which closely resembles ENIb examples in Fabric 10. Phelps considers this 'odd' (1975:114; fig. 9.13).
- from the LN/EC Ayio Gala lower cave comes a single example from a well-burnished deep jar (Hood 1981:pl.7(d).24, fig.7.24): the cordon has regular neat incision, which closely resembles examples of incised 'rope' decoration in Fabric 10 at Knossos, and is in association with incised/pointillé decoration. The co-occurrence of two features diagnostic of Cretan ENIb in a deposit broadly contemporary with ENIb makes this a very likely import from Crete (see Appendix I).
- from a mixed EC/MC/LC deposit in the Ayio Gala Upper Cave comes an example of slashed cordon decoration which Hood considers 'unique' and a probable import (Hood 1981:61, fig.42.308).

These examples are so rare or unique at the sites at which they are found and moreover are so similar to Cretan examples that it is likely that some or all of these are imports from Crete (see Appendix I).

plastic decoration: barbotine

A form of barbotine, known as 'crowded pellet decoration', occurs at sites in Central Greece (Phelps 1975:111): cf. EN Elateia (Weinberg 1962) and late EN Nea Makri (Pantelidou Gophas 1995:pl.1.1-24, pl.14.3-103, pl.22.4-32, pl.25.5-108, pl.41.9-19). 'Crowded pellet' at Nea Makri consists of small irregularly-formed pellets, which are close but always have spaces between them. These form a coherent local group, which lasts until early LN (Phelps 1975:111). It should be stressed that, although the earliest examples precede ENIb barbotine, none of these resemble

Cretan barbotine, which in contrast always consists of larger, more carefully modelled rounded lumps set so close as to be partially-overlapping.

- one example of barbotine at Nea Makri from an early LN context differs markedly from all other examples at the site (Pantelidou Gophas 1995:pl.41.9-23). It consists of larger, more carefully rounded pellets which partially overlap. In form and execution it is so close to contemporary ENIb and ENIc examples (Fabric 1d) at Knossos as to suggest the possibilities of an import from Crete (see Appendix I).

- a single example of barbotine is known from Emporio VIII, where it is noted as 'unique' and considered an import (Hood 1981:299, pl.41(d).421). Hood notes general parallels with barbotine from Nea Makri, but dismisses these since the Nea Makri pellets are not touching or overlapping. Hood notes examples of 'denser barbotine' at Saliagos (see below) as well as those from stratum IV (ENII) at Knossos (Evans 1964:214 pl.47(3):6; Furness 1953:115 pl.30, a:10, 11). The ENII parallels from Knossos are in Fabric 5a and are identical to the example from Emporio VIII.

- two examples of barbotine are known from LN Saliagos (Evans & Renfrew 1968:43, fig.43:15, 16): no.15 is very irregular but very dense and overlapping and finds close parallels in single example from Emporio VIII and in Fabric 5a in stratum IV; no.16 on a curved body sherd shows the interface between barbotine and an undecorated zone and finds an exact parallel with an example in Fabric 1e in stratum IV. These two examples are otherwise unique at Saliagos and the close contemporary parallels with ENII Knossos suggest the possibility of imports.

brushed ware

Brushed ware at Knossos first appears in stratum V in Fabric 1e and consists of streaky brown or orange brush strokes. Isolated streaky examples are also known in Fabric 1b from stratum VI. In south-west Anatolia at EC and EC/LC transition sites on the Elmalı Plain many of the brown or orange wares from sites are decorated with a 'brush-applied streaky slip, most often coloured scarlet ranging to

brown, and burnished" (Joukowsky 1996:134). For the Peloponnese, Phelps notes that a feature of late EN wares is the characteristic application of slip with a brush in such a way as to leave streaks or brush marks, a practice which becomes very common on MN Urfirnis (Phelps 1975:77-8). Phelps argues that this is not found elsewhere, however the examples from Knossos and sites in the Elmalı Plain suggest that this practice, although beginning at an earlier period in the Peloponnese, had a much wider Aegean distribution in the latter half of the sixth millennium BC.

scribble burnishing

At Knossos scribble burnishing is a general ENI feature found especially in Fabrics 2a/b, 6, 8. However scribble burnish ware (Fabrics 1d, 1e) first appears in stratum V and is common in stratum IV.

Scribble burnish ware begins in Emporio VIII (MC/LC) and is common in VII-VI (LC) (Hood 1981:305; see Appendix I). Hood describes it as a light brown burnished ware and compares MN Greek Urfirnis (1981:305-7), however Urfirnis parallels are too early. Moreover illustrated examples show a scribble burnish which is almost indistinguishable from red scribble burnished ware found in tiny quantities in Knossos V and in much larger quantities in IV (ENII). This parallel has the virtue of being both close and synchronous. In addition the range of forms is very similar to that found in red scribble burnished ware at Knossos: curved jars with 's' profile and 'necked' jars, long loop handles (Hood 1981:pl.43.a, b). Hood (1981:304) notes that it is used mostly for jugs, but there also a few bowls and jars. The fabric, as described by Hood, seems to be different from Fabric 1e.

pattern-burnishing

In the MN Peloponnese (Phelps 1975:167-8) 'stroke burnish' on late monochrome Urfirnis is of three kinds: scribble, regular and undulating. All three found on monochrome wares and where patterns are identifiable they are usually simple and often carelessly executed. Simplest are one or more vertical stripes, others are simple curvilinear patterns, "a product of the technique itself" (Phelps 1975:fig.16.9), others have exact counterparts in painted decoration (Phelps

1975:fig.16.3; 23.60-1, 63-4). It is found on shallow carinated bowls and 'piriform jars'. At LC sites in the Elmalı Plain in south-west Anatolia pattern burnishing is one of the main forms of decoration (Eslick 1992:84, 86)

7.7.1 Summary and Conclusions: Dimensions of Variation

Based on the above discussion of the Aegean parallels for Cretan forms and finishes a number of conclusions can be drawn:

(1) *Cretan forms in general find closer parallels with contemporary or earlier forms from LN south-west Anatolia.*

This area provides the best, earliest or only parallels for:

flat-based deep curved bowls, especially those with flattened rims, have many EN/LN Anatolian parallels. EN Peloponnesian examples are more often incurved with ring-bases.

flat-based shallow (curved) bowls have parallels on both sides of the Aegean, however EN Greek examples have ring bases.

flat-based shallow (straight-sided) bowls are common at EN/LN Anatolian sites (especially Ayio Gala) but rare in the EN Peloponnese.

flared rim bowls are common at EN/LN Anatolian sites, but rare in the EN Peloponnese.

incurved bowl/hole-mouth jars are common in EN/LN Anatolia and in EN Peloponnese.

's' profile jars are common in EN/LN Anatolia and in EN Peloponnese.

incised 'trays' are a rare feature of LN sites in west-central Anatolia.

flat-bases are found on both sides of the Aegean, but are more common in south-west Anatolia.

concave bases are common at LN-EC sites in Anatolia but are scarcely ever found at sites in the EN-MN Peloponnese.

incised geometric decoration - when pure incision decoration first appears in quantity at Knossos (ENII) it closely parallels incision at Emporio VIII in design and execution. Incised geometric patterns such as chevrons have a long history in south-west Anatolia beginning in LN.

(2) *Some Cretan forms and finishes have good contemporary parallels on both sides of the Aegean*

plastic cordon decoration - parallels can be found in LN Anatolia and EN Greece.

pellet decoration - parallels can be found in LN Anatolia and EN Greece.

carinated bowls are rare at Knossos until ENIb and common from ENIc-ENII; likewise they are rare at EN/LN Anatolian sites but are very common in late EC (Hacilar I) and at MC and LC sites (Emporio IX-VI, Aphrodisias). In the Peloponnese they are common from MN.

shallow bowls with thickened rims appear at Knossos during ENIc-ENII; they are likewise common in LC south-west Anatolia and can also be found at LN Greek sites.

(3) *Some Cretan forms or finishes lack any good contemporary parallels:*

sharply offset rims are scarcely ever found at sites on either side of the southern Aegean; earliest and closest are from Central Greece.

flat-based mugs have almost no contemporary parallels; there may be a link between this form which is frequently incised and the earlier incised 'trays' at Knossos and at LN sites in Anatolia.

flared cups with or without internal pierced rim lugs are unique, although parallels for internal pierced rim lugs can be found in LN Anatolia.

wishbone handles are not found outside Crete.

strap handles are not found at sites in the southern Aegean outside Crete until much later (Greek MN, Anatolian MC).

flared strap handles are not found outside Crete.

pierced/unpierced ears are not found at sites in the southern Aegean outside Crete until Greek LN (Saliagos).

incised/pointillé is not found in any quantity at sites in the southern Aegean outside Crete until Greek LN.

incised lattice is not found outside Crete.

dribble-painted decoration is not found outside Knossos.

ripple burnish first appears at Knossos in ENIb and does not appear at Greek sites until much later (LN).

barbotine - although 'crowded pellet decoration' in Central Greece precedes Cretan barbotine, its resemblance to 'Cretan' barbotine is not close.

slashed cordon decoration is scarcely ever found outside Crete. Indeed examples are so rare or unique at the sites where they occur, yet so close to Cretan types, as to suggest imports.

In general it would appear that Cretan forms find closer contemporary or earlier parallels with forms from south-west Anatolia than from southern Greece. However, the presence of numerous unparalleled features demonstrates that the Cretan sequence is also highly distinct. When analysed these features suggest that, rather than operating through a distinctive range of forms⁹², this distinctiveness breaks down into the selection of three specific 'dimensions of variability', namely rims, handles and forms of decoration. Thus EN Cretan vessels are most easily distinguished within the wider southern Aegean in terms of form by their use of sharply offset rims, wishbone handles, strap handles, flared strap handles and pierced triangular ears and in terms of finish by the use of incised/pointillé, incised lattice, dribble-painting, ripple burnish, barbotine and slashed cordon decoration. Thus, for example, while collared or necked jars can be found on both sides of the Aegean, what makes EN examples at Knossos distinct above all is the application of flared strap handles on the shoulder of the vessel. Likewise shallow bowls and curved bowls at Knossos find widespread parallels, but what makes them unique is the use of wishbone handles or pierced triangular ears.

The selection of similar dimensions of variability also serves to distinguish different sequences around the southern Aegean. Thus vertical tubular lugs are distinctive of EN and LN south-west Anatolia, while horizontal spouts and rib/groove decoration are specifically an EN Peloponnessian feature (cf. Nemea, Phlius, Akrata, Corinth, Lerna, Louka) (Phelps 1975:88-9, 116; fig. 8.3, 5, 8, 11-13, 16-18; Blegen 1975:pl.63, pl. 64.16, 17, 19, 20). In a similar way the features that distinguish Neolithic Attic vessels are based on variations in rim (bead rims,

⁹² Although there are a small number of unique forms, such as flat-based mugs or flared cups.

thickened rims), handle (large plain lugs, nail-impressed lugs) or finish (white-filled incised, 'overall pellet decoration') (see Phelps 1975:116). As at Knossos there are also a small number of unique forms: for example a unique feature of EN-MN sites in southern Greece are painted askoid jugs, 'husking bowls' and crucibloid vessels (Phelps 1975:116, fig. 8.19, 22-3, 26).

Summary

In this chapter variation in form and finish has been explored in some considerable detail. The existing Evans-Furness typology of shape and categories of ware were reconsidered using fabric as an index of variability. It was found that all types of shape and ware were cross-cut by fabric. In addition, the degree of variation apparent within existing form types suggested that a new, less coarse typology of form would be preferable (see Appendix VI). Consideration of this new typology of form suggested that variation in form was generated by the selection of a limited number of dimensions of variability: rim (type and size), profile (curved, carinated, straight, flared), handle (type, size and location), base (flat, curved, concave).

Variation in form and finish was explored for each fabric, the results of which are presented in a series of tables in Appendix VII. These tables demonstrate a considerable degree of variation within and between fabrics. However, this variation is not random, but instead seems to be structured by the frequency with which different fabrics occur. When grouped in terms of frequency, variation in form and finish per fabric was seen to fall into three basic groups:

- (1) Frequent fabrics that, despite being well represented, nevertheless comprise a very similar range of forms and finishes;
- (2) Rare fabrics that exhibit a close relationship in form and finish with those more frequent fabrics in Group (1)
- (3) Rare or unique fabrics, which exhibit no significant similarities in form or finish with fabrics in Groups (1) or (2).

In this way c.97.5-99.9% of the EN assemblage at Knossos may be understood to be comprised of fabrics whose forms and finishes bear a close resemblance to one another (Groups 1 & 2), while the most significant variation in form and finish is actually confined to a group of very rare or unique fabrics (Group 3), which together comprise only c.0.1-2.5% of any EN context. Detailed consideration of variation in form and finish among fabrics of Group 3 concluded that the closest comparanda for many of these vessels were to be found in sequences in south-west Anatolia (e.g. Fabric 28) or southern Greece (e.g. Fabric 25). In some cases the mineralogy of these fabrics also suggested an off-island provenance (e.g. Fabrics 31 and 35). It was therefore tentatively concluded that the likely provenance for at least some of the fabrics in Group 3 must lie beyond Crete. In contrast the strong similarities in form and finish between fabrics of Group 1 and 2 and their general compatibility with a Cretan provenance were taken to indicate that these fabrics share a Cretan provenance. However as a comparison between Fabric 12 (Mirabello Bay) and Fabrics 1a-i (local Knossos) shows, similarity in form and finish need not translate into spatial proximity.

In this way consideration of fabrics in Groups 1 and 2 allows the isolation of a range of features of form and finish, which can be said to define Cretan Neolithic ceramic production. In view of previous theories, which have suggested an exogenous origin (Anatolia) for Cretan ceramic forms (see Section 2.2.3), this range of Cretan features was compared to assemblages from the Peloponnese, the Cyclades, the east Aegean and south-west Anatolia. It emerged that although parallels for many of these forms could be found on both sides of the Aegean, the most one can say is that in general Cretan forms find closer contemporary or earlier parallels among assemblages from south-west Anatolia. However, what would appear to be more significant is that this wider comparison allowed a number of specific features to be isolated, which lacked contemporary parallels outside Crete. These distinctive features break down into three main dimensions of variability, namely rims, handles and decoration: offset rims, wishbone handles, strap handles, pierced triangular ears, incised/pointillé, incised lattice, dribble painting, ripple burnish, barbotine and incised cordon/rope decoration.

Many of these distinctive features of form and finish appear on ceramics belonging to the earliest phase of ceramic production (ENIa, stratum IX)⁹³. In this way, and contrary to what A. Evans and Childe claimed (see Appendix I), comparative stylistic study does not allow Knossos (and Crete) to be simply reduced to an 'offshoot' of the Anatolian Neolithic and Chalcolithic, but rather this exploration of variation in ceramic form and finish suggests that even the very first ceramic vessels mark this region out as distinct. Moreover, the continued absence of these feature from areas outside Crete would appear to undermine the current hypothesis that this range of Cretan forms had an exogenous origin (see Section 2.2.3). Simple diffusion alone would therefore appear to be an inadequate explanation for the origins of EN ceramic production (see Section 13.4 for further discussion of this).

⁹³ Compare the early presence of wishbone handles, strap handles, flared strap handles, triangular lugs.

CHAPTER EIGHT

SCANNING ELECTRON MICROSCOPY

The examination of a freshly fractured ceramic surface under a SEM⁹⁴, provides information on the degree of vitrification of a ceramic through the examination of the clay microstructure that develops during firing (e.g. Maniatis & Tite 1981; see Chapter 5). This information may be compared with known morphologies of similar clays/ceramics to produce an estimation of firing temperature. Study of the micromorphology of the body and surface of samples also provides information on surface treatment, including the identification and chemical characterisation of slip or paint layers. Certain studies of Bronze Age ceramics (e.g. Wilson & Day 1994; Kilikoglou 1994) have been successful in combining the results of SEM analysis with macroscopic and microscopic (thin-section petrography) studies of fabric, form and finish. These would seem to suggest that firing behaviour may correlate with groupings based on fabric, form and/or finish. This study, however, represents the first time that a combined analytical programme of this sort of size and complexity has ever been applied to a single Neolithic assemblage. In this way this study is to an extent experimental with the intention of exploring the potential and relevance of SEM-based analysis of finishing and firing in studies of Neolithic ceramics.

Finishing and Firing Per Fabric

In order to explore the degree to which finishing methods or firing behaviour might correlate with fabric, all samples studied using SEM have been grouped and discussed in their petrographic groups. Although this risks giving too much emphasis to the latter, it is necessary to allow evaluation of the degree to which finishing methods and firing behaviour might or might not correlate with other groupings. Information relevant to the discussion of each sample is presented

⁹⁴ The SEM used in this study was a Philips 515 with an EDAX 9900 energy-dispersive detector, housed at the National Scientific Research Centre 'Demokritos', Aghia Paraskevi, Athens.

in a series of tables (see Figures 8.2-9), which list the samples studied in their petrographic groups. Also included is an estimation of firing temperature of each sample. These temperatures generally correspond to a 'normal' kiln firing (oxidising atmosphere), where there is sufficient time for the relevant chemical reactions to take place. They are therefore *equivalent* firing temperatures. However, if the context of firing had been open (e.g. bonfire), where the atmosphere is rarely purely oxidising and often strongly reducing and the duration of firing shorter, then the actual temperature to which these samples had been fired could have been a little higher if only for a very short period of time. As a result estimates of firing temperature in Figures 8.2-9 have been given broader temperature ranges in order to accommodate this effect. These estimates of firing temperature are also displayed on a graph allowing the comparison of firing behaviour per sample and per fabric group (see Figure 8.1). In the discussion that follows, SEM data on finishing (surface compaction, slips) and firing will be discussed in combination with other relevant macroscopic and petrographic data. This discussion will form the basis for the discussion of EN firing practices in Chapter 10.

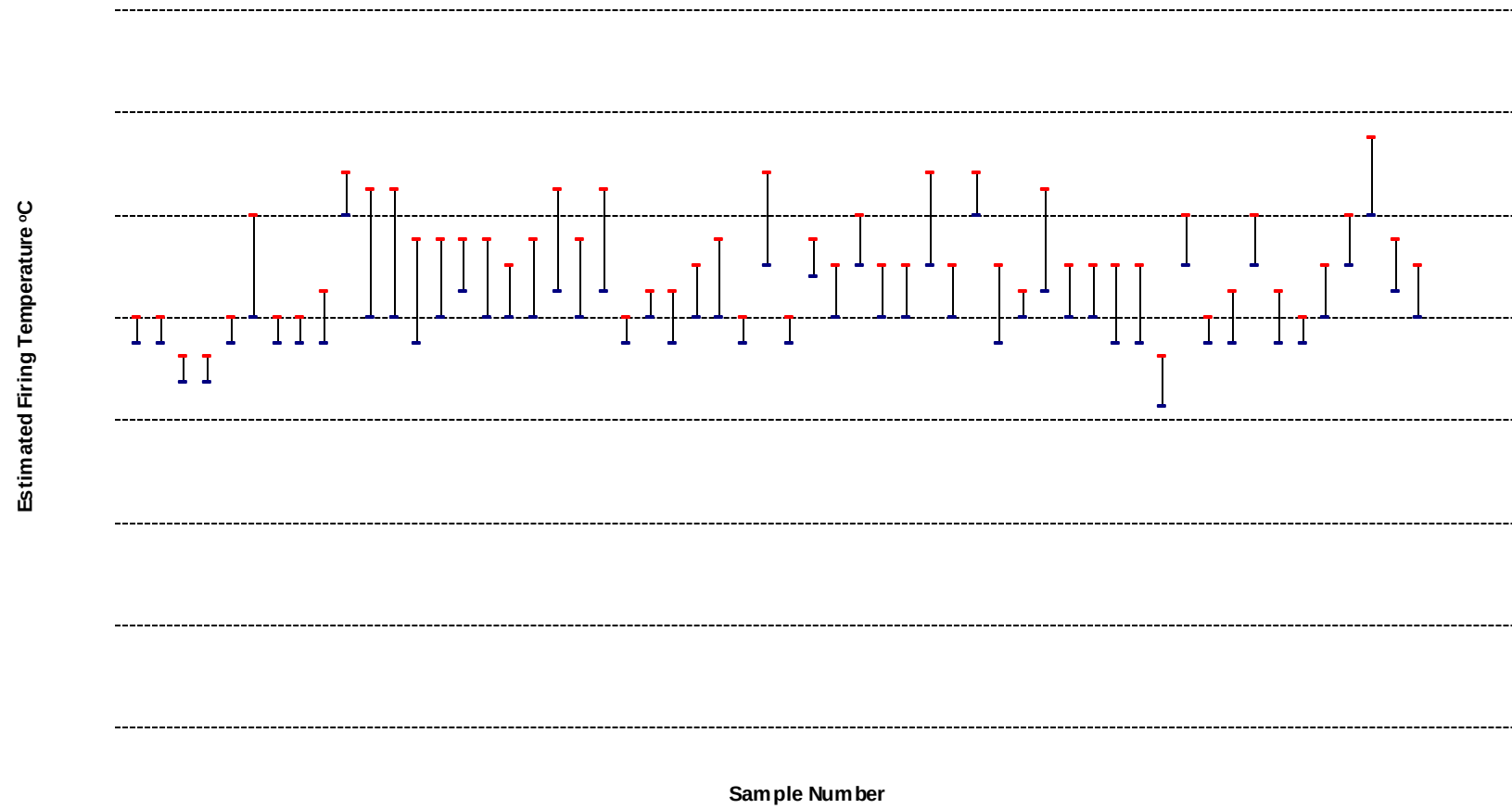


Figure 8.1 Estimated Equivalent Firing Temperature Per Sample

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo-sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
1	1a	97/4	IX	brown	brown burn. ext; black burn. int	F	O/R	med-high calc	IV/Vc-	low-non calc. (int. & ext.); no slip, compacted layer	P	750-800
2	1a	97/7	IX	grey	fine brown polish	F	R	v. high calc. (>20%)	IV	low calc; Al [↑] ; compacted slip layer ⁹⁵	P	750-800
3	1a	97/62	VII	orange /buff	black polish	F	O/R	extra high calc; (Mg in sparite inclusions)	NV/IV	medium calc; Al [↑] , K [↑] ; compacted layer	NV	~750
4	1a	97/107	V	grey	yellow/brown polish	F	O/R	v. high calc. (>20%)	NV/IV	same as body - no slip	?	~750
5	1a	97/118	V	brown	grey/brown burn.	C	O/R	v. high calc.; organics (smell)	IV	same as body - no slip; compacted layer	P	750-800
6	1b	97/55	VIII	grey /brown	dk. brown polish; fine wipe marks	F	O/R	med-low calc.	Vc- - Vc	Al [↑] ; K [↑] ; non calc.; visible compacted slip layer	V?	800-1000
7	1b	97/117	V	grey	yellow brown polish	F	R-O	med-low calc.	NV/IV?	calc. K [↑] ; compacted layer - finer fraction of body?	V?	750-800
8	1b	97/136	IV	red	fine red/orange polish	F	O/R	v. high calc. (>20%)	IV	non calc.; Al [↑] ⁹⁶	P	750-800
9	1c	97/119	V	red/brown	black wiped	C	O/R	low calc.; Al [↓] , K [↓] ⁹⁷	IV/Vc-	low calc.; no slip; compacted layer	P?	750-850

Figure 8.2 Fabrics 1a-c

⁹⁵ 97/7: slip (fine) for both exterior and interior surfaces is same clay, but different clay from body.

⁹⁶ 97/136: slip (fine) is different clay from body (cf. also 97/55; 97/117; 97/62).

⁹⁷ 97/119: body is hard cf. 'step-wise' fracture (V. Kilikoglou pers. comm.).

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo-sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
10	1d	97/84	VI	grey	grey burn.	C	R	high calc.	V _C +F _B	high calc.; Al↑; K↑; thin (5-8µm) compacted layer	V	1000-1080
11	1d	97/109	V	red/brown; thin dark core	red/brown burn.	F?	O/R	med-low calc.	V _C	low-non calc.; same as body - compacted burn. (10-15µm)	V	800-1050
12	1e	97/121	V	grey	red/brown on light painted	F	O/R	v. high calc. (>20%)	IV/V _C - (ext.); V _C + (int.) ⁹⁸	low calc.; Al↑, K↑; Fe↑; visible compacted slip layer (ext); visible slip (int.)	Incomplete (ext) V+ (int)	800-1050
13	1e	97/132	IV	grey	buff burnished & incised	F	O/R	v. high calc. (>20%)	IV/ V _C	same as body; thin (10-15µm) compacted burn.	P	750-950
14	1h	97/122	V	buff/brown	buff burnished	C	O/R	low calc.; K↓	V _C - or V _C -/V _C	K↑; same as body? thin (15µm) compacted burn.	V	800-950

Figure 8.3 Fabrics 1d-h

⁹⁸ 97/121: bowl may have been fired filled with fuel (V. Kilikoglou pers. comm.).

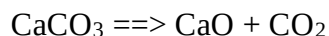
Fabrics 1a-i

Study of the structure and composition of the surfaces of samples of Fabrics 1a-i, revealed the existence of several finishing techniques.

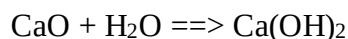
- (1) A large number of samples exhibited a compacted surface and lacked any evidence of slip layers (i.e. 97/4, 97/107, 97/118, 97/119, 97/84, 97/109, 97/122, 97/132). Almost all of these samples come from burnished vessels; only 97/107 is polished.
- (2) Other samples exhibit a compacted surface in combination with the application of a *non-calcareous slip* (i.e. 97/7, 97/55, 97/62, 97/136, 97/121). The use of this slip in each case corresponds to vessels with dark brown or red polished surfaces.
- (3) In one example (97/117) it is possible that a *calcareous slip* was applied to the vessel surface. This example was then polished.

The existence of these three basic finishing techniques was also suggested by petrographic study (see Chapter 6). The dark brown or red surfaces which result from (2) are created through the reduction or oxidation of iron.

As Figures 8.2-3 demonstrates there is considerable variation in firing within and between the subgroups of Fabric 1 with the maximum estimated temperature varying from around 750°C to over 1000°C. Variety was also suggested by petrographic observation of variation in optical activity of the groundmasses of different samples. Fabrics 1a-i are all tempered with some form of limestone. Under normal firing conditions (mixed O/R atmosphere, gradual heating rate, 1hr soaking time), limestone begins to decompose at temperatures exceeding c.800/850°C to form lime and carbon dioxide:



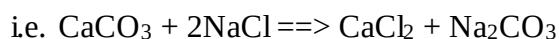
After firing the lime hydrates to form portlandite:



This reaction involves an increase in volume and leads to the phenomenon of lime blowing/spalling. Normally if the clay contains calcite grains which exceed 100 microns in size, this expansion in volume leads to the structural failure of the vessel. In time portlandite recarbonates to become fine-grained calcite (see Section 6.3 on secondary calcite formation).

This inevitably prompts the question of why those samples of Fabrics 1a-i, which have estimated firing temperatures of 800-1080°C (97/55, 97/84, 97/109, 97/121, 97/122), show no signs of vessel failure. If these samples had been fired under normal conditions (see above) they should have disintegrated. Petrographic study of Fabrics 1a-i in a number of cases identified micritic clots with relict primary textures, which would indeed suggest that some form alteration took place as a consequence of firing (e.g. 97/84, 97/109), which would also suggest firing beyond c.800/850°C.

Potters may minimise the problem of spalling by using lower firing temperatures, having shorter firing times, inducing a reducing atmosphere during firing or adding salt (Laird & Worcester 1956:545-55; Rye 1976; Woods 1986:165-8). The addition of salt to a clay paste may be identified in thin-section by the presence of yellow reaction rims surrounding calcareous inclusions (Middleton & Woods 1990:4-5). These rims are caused by salt reacting with calcite in the presence of heat and prevent its decomposition to lime:



None of the calcareous inclusions within samples of Fabrics 1a-i contained such rings, making it unlikely that salt was used in this case. Since in these examples lower firing temperatures are also not in evidence, this leaves the possibility that a reducing atmosphere and/or a shorter firing time acted to prevent limestone decomposition. Higher fired examples, such as 97/84, 97/109 and 97/121, exhibit clear evidence of reduction (grey colour; dark cores), making it likely that reduction was a factor in preventing limestone decomposition. However, a reducing atmosphere only delays

limestone decomposition for about 50°C. Thus in the case of 97/84, where the temperature must have been at least 1000°C, a reducing atmosphere alone would not have been sufficient to prevent decomposition. This example therefore suggests that another factor, namely fast firing, must have also been in operation.

In one or two cases comparison of clay microstructure in different areas of a sample indicated that the microstructure was not homogenous throughout the sample. This was most severe in sample 97/121, where a IV/VC⁻ (c.800°C) exterior grades into a VC⁺ (c.1050°C) interior (see Plates 35-7). A less severe example is 97/84, where a fully vitrified body (VC⁺) has a surface which retains its shiny burnished surface. Since under normal conditions vitrification should destroy a burnished surface by ensuring illite decomposition (>850°C) and by destroying the parallel alignment of clay particles (see Section 5.3.5.2, n.16), the survival of the burnished surface in sample 97/84 would suggest the existence of a vitrification gradient between body and surface. A gradient in vitrification effectively means an uneven distribution of heat within the ceramic body during firing. Such an uneven distribution is most likely to occur consistently when firing is fast and/or the firing environment unpredictable. Since 97/121 is an open vessel (deep bowl), the most likely explanation for the steep vitrification gradient between exterior and interior is that during firing the interior of the vessel was in contact with the fuel. These two examples would therefore suggest that firing most probably took place in an open environment, such as a bonfire.

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo-sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
15	2a	97/37	VIII	red/dark red	red/brown	F	O/R	non calc.; Al↓, K↓ (high refractory?)	V	non calc.; K↑; Al↑ a little; compacted layer	NV	850-950
16	2a	97/64	VII	red/grey	grey/brown wiped ext. dark burn. (int.)	C	O/R	non calc.	V	same comp as body; visible compacted layer	V	800-950
17	2a	97/85	VI	orange /grey sandwich	orange-brown polish	F	O/R	non calc.; K↓	IV/V	non calc.; Al↑ & K↑ a little; visible (8-18µm) compacted layer	V	800-900
18	2b	97/54	VIII	red/grey	brown polished & incised	F	O/R	non calc.; K↓, Fe↓ (high refractory?)	V	K↑; Al↑; compacted (10-15µm) slip layer	NV V?	800-950
19	2b	97/66 ⁹⁹	VII	grey/red brown	black burn.	C	O/R-R	low-non calc.	V	-	-	850-1050
20	4	97/25	VIII	red w. blackened interior	white/grey slip & burn.	C	O	non calc.	V	high calc.; K↓; Al↓; slip (10-15µm) different clay	V?	800-950

Figure 8.4 Fabrics 2a-b and 4

⁹⁹ Study of sample 97/66 could not be completed because of technical problems with the SEM (blown filament).

Fabrics 2a-e

All samples of Fabrics 2a-e exhibit visible compacted surface layers suggestive of heavy burnishing or polishing. In sample 97/64 this compacted layer is of the same composition as the body and thus suggests that following the construction of the vessel the surface was smoothed and burnished. However, the surface composition of other samples would seem to indicate the presence of a finer fraction (cf. higher Al and K), which would be consistent with an added non-calcareous slip layer, which could have been a finer fraction of the body (see 97/37, 97/54, 97/85). Some confirmation of this identification of a slip layer is provided by petrographic study, which noted the presence of non-calcareous slip layers in 97/54 and 97/85 as well as in other samples not examined by SEM. All samples with this added slip layer were then polished, which suggests that the use of a non-calcareous slip was confined to polished vessels.

Samples of Fabrics 2a-e exhibit a range of firing temperatures from 800°C to over 950°C. Since Fabrics 2a-e are dominated by large limestone inclusions, the lack of evidence for any failure of the ceramic body due to lime spalling, despite a firing range which consistently exceeds 800°C, necessitates comment. Petrographic study of samples of Fabrics 2a-e also consistently identified evidence for secondary calcite alteration in the form of limestone inclusions which exhibit a relict primary grain texture (see Chapter 6). The partial survival of the primary grain texture suggests that the firing conditions under which calcite alteration took place did not persist long enough for complete alteration to take place. This would hint at the possibility that firing was fast. An additional factor in the lack of total limestone decomposition is also the presence of a mixed oxidising/reducing atmosphere. As with Fabrics 1a-i, these features would be consistent with fast firing in an open environment.

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo-sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
21	5a	97/9	IX	red outer, grey core	burnished: red/grey patches	C	O/R	med-low calc.; Al↑, K↓	V _C +/TV _{FB} (centre), V _C -/V _C (edges)	low calc.; Al↑ (a little); K↑; Fe↑; compacted layer (5-15μm)	V ¹⁰⁰	850-1050
22	5a	97/23	IX	red /orange	orange polish	F	O	low calc.	IV	Al↑ & K↑ a little; visible compacted layer (5-10μm)	P	750-800
23	5a	98/63	VI	grey body	dark brown polish	F	R?	low-non calc.; K↓	V _C -	K↑; Al↑; Fe↑ (a little); well-compacted layer (15-30μm)	?	800-850
24	5a	97/114	V	red	red/brown polish	F	O/mild R	non calc.; K↓	IV/V	K↑; Al↓; Fe↑ (a little); well-compacted layer ¹⁰¹ (5-10μm)	?	750-850
25	5c	98/57	VI	grey/red	dark burn.	C/F	O/R	non calc.; (high refractory?)	V	compacted surface	NV	800-900

Figure 8.5 Fabrics 5a and 5c

¹⁰⁰ 97/9: sheen of burnish destroyed.

¹⁰¹ 97/114: compacted surface well bonded with body.

Fabric 4

The surface of sample 97/25 provides clear evidence for the presence of a calcareous slip layer. Since the body of this sample is non-calcareous, this slip must derive from another more calcareous clay. The use of a calcareous slip seems to be a general feature of vessels in Fabric 4: all have a burnished surface, which varies in colour from grey to white. Sample 97/25 was fired to c.850-950°C.

Fabric 5a

In contrast to Fabrics 1a-i, 2a-e and 4, study of surface structure and composition in samples of Fabric 5a failed to identify any evidence for the use of slips. The surfaces of all samples showed a clear compacted layer varying in thickness from 5-50µm (see Plate 38). Some samples showed a slight rise in K, Al and Fe in these layers, however this was not sufficient to suggest a slip, but instead may represent a slightly finer clay fraction produced as a direct consequence of burnishing or polishing. These conclusions compare well with the petrographic analysis of Fabric 5a, which concluded that there was no clear evidence for the use of slips and that areas of differential birefringence observed near the surfaces of some samples were consistent with compaction due to burnishing or polishing.

Comparison of the different firing ranges of samples of Fabric 5a (see Figure 8.1) suggests a wide range of firing temperatures (750-1050°C; IV-TV). Firing atmosphere seems to have varied from mixed oxidising/reducing to purely reducing (e.g. 98/63). In sample 97/9 there is a clear distinction in vitrification between the centre (VC⁺/TV) and the edges (VC⁻/VC), where all trace of burnish have been lost. This distinction corresponds to a reduced core (grey) and more oxidised (red) outer layer (cf. 'the sandwich effect'). Such a gradient in vitrification in conjunction with evidence for very local reduction within the ceramic indicates that firing was not homogenous throughout. This may be most easily explained if the firing was fast and if there was contact between the vessel and fuel, such as would be the case in an open firing (see above on 97/121).

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo-sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
26	6	98/15	IX	red	red/brown burn.	C/F	O - mild R	non. calc.; K↓	V	K↑ (a little) no slip; visible compaction (10-70µm) ¹⁰²	NV	800-950
27	6	98/16	IX	red	red polish	F	O	non calc.; Al↓, K↓ (high refractory?)	IV	slip K↑, Al↑, Fe↑ - same clay?; visible compacted layer (10-15µm)	?	750-800
28	6	97/21	IX	grey	orange polish	F	R-O	non calc.; Al↓; K↓ (high refractory)	V/TV _{FB}	Al↑ (a lot); K↑ visible slip layer (10-15µm)	V?	>900
29	6	98/23	VIII	red w. dark core	dark red scribble burn.	C	O/R	non calc.; K↓ (high refractory?)	IV	variable composition - visible (compacted) layer; but cannot confirm presence of slip chemically	?	750-800
30	6	97/96	VI	red/black	black rough burn.	C	O/R	non calc.; K↓	V	K↑ & Al↑ a little; visible thin (c.10µm) compacted layer ¹⁰³	? V	850-950
31	6	98/100	IV	dark red /brown	dark brown burn.	C	O/R	non calc.; K↓	V?	Al↓; K↑; Fe↑; compacted slip? layer (K not always so high)	V	800-900
32	7	97/14	IX	red/grey	dark brown burn.	F	O/R	non calc.; K↓, Fe↓ (high refractory?)	V	no slip; compacted surface layer	V	900-1000

Figure 8.6 Fabrics 6 and 7

¹⁰² 98/15: compaction through burnishing creates a smooth surface by filling in irregularities in sub-surface.

¹⁰³ 97/96: surface has visible tool marks criss-crossing at angles.

Fabric 5c

The surface of sample 97/57 shows no trace of slip and instead indicates the sort of compaction that would be a consequence of burnishing. Petrographic study also failed to identify any evidence for a slip. Sample 97/57 shows advanced vitrification with an estimated firing temperature of 800-900°C.

Fabric 6

All samples of Fabric 6 have evidence for surface compaction. In some cases (97/96, 98/15, 98/23) this is not accompanied by any trace of a slip layer, suggesting that these vessels were simply smoothed and burnished. Under a SEM, sample 97/96 showed visible tool marks indicating burnishing in a criss-cross motion. In other samples there is some evidence for the addition of a slip layer (97/21, 98/16, 98/100). Thin section petrography also indicated the existence of non-calcareous slip layers on some samples (including 98/16). The slip layer is clearest in 97/21 where there is a substantial difference in composition between surface and body. Such a slip would nevertheless be consistent with being a finer fraction of the body clay. It would appear that in general the application of a slip was confined to the finishing of polished vessels (cf. 97/21, 98/16). However sample 98/100, which dates to a later phase of EN (ENII), shows that a slip could also be used in combination with a rough burnished surface.

Samples of Fabric 6 vary from IV to TV with an estimated temperature range of 750->900°C. Estimated firing atmosphere ranges from oxidising (e.g. 98/16) to reducing (e.g. 97/21). Sample 97/21 exhibits a vitrification gradient between centre (V/TV) and surface (V?). The presence in the centre of fine bloating pores is suggestive of intense localised reduction. This is confirmed by a predominantly grey core. These features indicate that 97/21 is not homogeneously fired (cf. 97/9, 97/84, 97/121) and may be most easily explicable if the firing was fast in an open firing.

Fabric 7

The surface of sample 97/14 shows no trace of any slip layer, but instead appears to have been compacted due to burnishing. Fabric 7 contains large limestone non-

plastics (see Chapter 6), which in the case of 97/14 nevertheless appear to have survived intact despite exposure to temperatures in the region of 900-1000°C. Petrographic study of Fabric 7 identified evidence for secondary calcite alteration in the form of relict primary grain structures. Moreover, during lime blowing small spalls of clay are pushed out of the surface of fired vessels by hydration and concomitant expansion of the lime particles. Macroscopically this appears as pits in the vessel surface, each with a white or yellow lump at its base. This was observed to be a feature of some sherds in Fabric 7, suggesting that in some cases at least partial limestone decomposition has taken place. However, the absence of evidence for structural failure and the partial survival of the primary structure of the limestone non-plastics, when viewed in thin section, suggests that the firing conditions under which limestone decomposition took place did not persist for very long. This would seem to suggest that the duration of firing was short.

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo-sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
33	8	97/1	IX	red/grey sandwich	red/grey burn.	C/F	R - mild O	non calc.; Al↓, K↓ (high refractory)	V	non calc.; Al↑, K↑; fine slip diff. clay.	NV	800-900
34	8	98/27	VIII	orange /red	brown burn. (slip?)	C	O/R	non calc.; K↓ (high refractory?)	IV/V	non calc.; K↑	NV	800-900
35	8	97/69	VII	grey	red/grey burn.	C/F	R	non calc.; Al↓, K↓ (high refractory)	V/TV _{FB} ¹⁰⁴	non calc.; K↑	V	>900
36	8	97/70	VII	grey; thin orange layer	grey burn. blackened interior	C	R - mild O	non calc.	V	non calc.; Al↑ (a little) ; no visible slip layer ¹⁰⁵ ; irregular surface	NV	800-900
37	8	97/94	VI	red/black (burnt)	red/orange burn.	C	O	non calc.; K↓ (high refractory?)	TV	non calc.; K↑; Al↑; thick (15-50µm) compacted layer	V	>1000
38	10	97/71	VII	grey	brown polish	F	O/R	non calc.; K↓	IV/V	Al↑; K↑; visible thin (5-10µm) compacted slip? layer ¹⁰⁶	NV	750-900

Figure 8.7 Fabrics 8 and 10

¹⁰⁴ 97/69: fine bloating is due to intense reduction. Slip must be different from body clay.

¹⁰⁵ 97/70: very variable surface composition readings. High Cl & S suggest contamination (cf. black charring on the interior of the sherd).

¹⁰⁶ 97/71: compacted surface not well bonded with sub-surface.

Fabric 8

In samples 97/1 and 97/94 there is visual and compositional evidence for the application prior to burnishing of a fine slip of a different composition (illitic) to the body (see Plate 39). In both samples this slip layer is compacted due to burnishing. In samples 97/69, 97/70 and 98/27 there is no visual or compositional evidence for a slip layer, although all three samples do exhibit surface compaction due to burnishing. The slight increase in the proportion of K in the surface composition noted for 97/69 and 98/27, probably reflects the accidental creation of a slightly finer clay fraction as a direct consequence of the burnishing process. Petrographic study was only able to identify the presence of slip layers on the surfaces of some polished samples. However, as the SEM data suggest, some of the burnished vessels could also have been treated in this way (e.g. 97/1, 97/94).

The samples studied are consistently highly fired (800->1000°C) with a clay microstructure that varies from IV/V to TV, with the majority of samples being V or more. Firing conditions often appear to have been heterogeneous: in all samples a more highly vitrified body is found in conjunction with a less vitrified surface; this is particularly clear in 97/1 and 97/70. In general firing atmosphere shows considerable variation from mostly oxidising (e.g. 97/94) to reducing (97/69). The confinement of fine bloating pores to the body of 97/69 is suggestive of intense localised reduction and this is confirmed by the entirely grey colour of the sherd break. Sample 97/1 also shows signs of localised reduction (grey core). As was suggested for samples 97/9, 97/84, and 97/121, intense localised reduction and non homogeneous firing within a single ceramic body may be associated with fast firing within an open firing environment, where there is contact between vessel and fuel.

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo -sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
39	11	97/78	VII	red	brown burn.	F	O/R	non calc.; K↓ (refractory?)	IV	compacted burn - no slip	NV	800-850
40	11	97/102	VI	grey	brown/grey polish & ripple	F	R	non calc. ¹⁰⁷	V	low-non calc.; Al↑; K↑; Fe↑; compacted (5-15µm) slip? layer	?	850-1050
41	12	97/27	IX	grey/black	black polish	F	R	non calc.; K↓	V	same as body; compacted layer	NV	800-900
42	12	97/41	VIII	red/black (burnt)	grey/brown burn.	C	O/R	non calc.	V	same as body; compacted layer	V	800-900
43	14	97/10	IX	dark brown	black polish	F	O/R	non calc.	IV/V	same as body; compacted layer (10-20µm)	?	750-900
44	14	97/28	VIII	red body	brown burn.	C	O/R	non calc.; K↑	IV/V	same as body; compacted layer (20µm)	NV	750-900
45	15	97/88	VI	red	-	C	O	low calc.	NV/IV	-	-	c.750
46	16	97/91	VI	red	black burn.	F	O-R	non calc.; K↓, Fe↓ (high refractory?)	V	K↑; Fe↑; visible slip layer (12-30µm)	NV	900-1000

Figure 8.8 Fabrics 11, 12, 14, 15 and 16

¹⁰⁷ 97/102: compositional data indicates unusually high amount of magnesium and iron, which may suggest that the compositional scan is incorrect.

Fabric 10

Sample 97/71 has a visible compacted surface layer. A proportionate increase in Al and K with respect to the body may indicate the presence of a slip layer. Sample 97/71 is IV/V with an estimated firing temperature of c.750-900°C.

Fabric 11

Sample 97/78 has a compacted surface layer, which in composition was almost identical to the body. This would thus seem to be evidence for burnishing or polishing without the use of a slip. Sample 97/102 also has a compacted surface layer, however this showed increased Al, K and Fe in comparison to the body and may represent a slip layer. Samples 97/78 and 97/102 vary from IV to V with an estimated temperature range of 850-1050°C.

Fabric 12

Both samples of Fabric 12 (97/27, 97/41) show no sign of added slip layers, but do exhibit compaction due to burnishing or polishing. The absence of slip layers is also suggested by petrographic study. Thus the fine black polished surface, which is such a feature of polished vessels in Fabric 12 (e.g. 97/27), would seem to have been created by smoothing and polishing the vessel surface. When a sample of 97/27 was refired in an oxidising atmosphere it turned red, confirming that the dark finish was created through iron reduction. All ENI polished examples of Fabric 12 have a black finish suggesting the possibility that this black finish was deliberately produced by inducing a reducing atmosphere during firing. Both samples are vitrified with an estimated firing range of 800-900°C. A sample of 97/27 was refired to 950°C (oxidising). When compared with the original sample the refired sample appeared more highly fired. This would be compatible with an estimated range of 800-900°C.

Fabric 14

Samples 97/10 and 97/28 both exhibit compacted surfaces and have no visible or compositional evidence for the use of slip. Petrographic study of 97/10, as well as of other polished examples (e.g. 97/32, 98/65), identified the presence of very thin, fine, non-calcareous clay layers at the vessel surface: both slip layers and accidental self-slip as a consequence of the burnishing process were considered possible explanations. Since no slip could be identified under SEM, it would appear that such layers result from the polishing process. Both samples are IV/V with an estimated range of 750-900°C.

Fabric 15

The surface of sample 97/88 appears to be very irregular with no clear evidence for surface treatment. The most notable feature of this sample when examined at high magnification (x2000) were the clear imprints and voids left by the organic temper which characterises this group¹⁰⁸. Sample 97/88 is relatively low-fired (NV/IV) with an estimated temperature around 750°C.

Fabric 16

Sample 97/91 has a visible layer, which in its composition resembles a non-calcareous slip (higher K and Fe) and shows compaction due to polishing. The presence of such a slip layer in this sample was also suggested by petrographic study. Sample 97/91 is relatively highly fired (V) with an estimated temperature range of c.900-1000°C.

¹⁰⁸ Although beyond the scope of the present project, it would be interesting in future to see if these distinctive impressions could be used to identify some of the types of organic temper used.

	Fab. Grp.	Sample	Date	Colour of Break	Surface Finish	Surface Quality	Atmo-sphere	Clay Composition (point scan)	Vitrif. Body	Surface Composition	Vitrif. Surface	Temp. (°C)
47	18	97/11	IX	red/grey split	red/grey burn.	C	O/R	non calc.; K↓	IV	Al↑; K↑; visible compacted slip layer	?	750-800
48	20	98/33	VIII	grey	dark brown (ext.) buff (int.)	F	O/R	low-med calc.; K↓	IV/VC-	K↑; Al↑; Fe↑; visible compacted layer (15-35µm)	NV?	750-850
49	21	97/33	VIII	grey /black	grey burn.	F	R	non calc.; K↓ (high refractory?)	V?	low calc.; K↑; Fe↑; different clay?	P	900-1000
50	22	97/124	IV	red/grey	red/brown burn. (ext.), slipped? (int)	C	O/R	low-non calc; Al↓, K↓	IV/VC-	Al↑; K↑; compacted (10-15µm) slip? layer	?	750-850
51	23	97/61	VIII	grey /brown	dark brown burn.	F	R	med. calc.	IV	low calc.; K↓; Al↑; visible compacted thin (c.10µm) layer	?	750-800
52	28	97/36	IX	red	red burn.	C	O	low calc.; Fe↑	V	K↑; Fe↑; visible compacted layer	?	800-900
53	29	97/86	VI	dark grey	dark wiped	C	R	non calc.; K↓ (high refractory?)	V	med. calc.; K↑; Fe↑; diff. clay? visible slip layer (15-20µm)	?	900-1000
54	30	98/90	ENIb	grey	buff	F	R?	med-high calc.; K↓	TV _{FB}	low calc; K↑; visible slip layer (15-20µm)	V	1000-1150
55	31	97/101	VI	orange; grey core	brown polish (gold mica)	F	O/R	low-non calc.; K↓	V	compacted surface (10-20µm)	?	850-950
56	35	97/43	VIII	red w. darker core	dark brown burn.	C	O/R	non calc.; K↓	V	Al↑ & K↑ & Fe↑; compacted layer	V?	800-900

Figure 8.9 Fabrics 18, 20-23, 28-31, 35 and 36

Fabric 18

Sample 97/11 would appear to have a slip layer (higher Al and K), which has been compacted due to burnishing. This sample exhibits IV and has an estimated firing range of 750-800°C.

Fabric 20

Sample 98/33 has a surface compacted by polishing. Comparison of surface composition with that of the body suggests the possibility of a slip (less calcareous, higher Al, K, Fe). The application of a low calcareous iron-rich slip to a more calcareous body may explain the production of the dark polished outer surface of this sample. Comparison between external (dark polished) and internal (buff polished) surfaces would thus suggest that the internal surface was not treated in this way. Sample 98/33 is IV/VC⁻ with an estimated range of 750-850°C.

Fabric 21

Sample 97/33 has a clear slip whose composition is quite different from the body (low calcareous, high K and Fe). Petrographic study of Fabric 21 identified traces of a non-calcareous slip layer on the surface of sample 98/20. Sample 97/33 is high refractory and vitrified, suggesting a relatively high firing temperature of c.900-1000°C. Petrographic study also indicated that all samples show low optical activity (high fired) and appear to have been fired in a predominantly reducing atmosphere. Frequently, large calcareous non-plastics show evidence of secondary alteration (micritic clots, relict primary textures), however there is no evidence for complete decomposition or failure of the ceramic. This would be consistent with fast firing.

Fabric 22

Sample 97/124 has a possible slip layer (slightly higher Al, K and Fe) that has been compacted due to burnishing. This observation accords with macroscopic study of this sample. Sample 97/124 has a vitrification microstructure of IV/VC⁻ with an estimated firing range of 750-850°C.

Fabric 23

Sample 97/61 has a visible low calcareous slip layer, which has been compacted through burnishing. This slip layer has reduced to create a dark burnished surface. Since the body of 97/61 is more highly calcareous, this use of a low calcareous slip may have been a deliberate attempt to ensure a dark finished surface. Sample 97/61 is IV with an estimated temperature of c.750-800°C.

Fabric 28

Sample 97/36 has a compacted surface, which in composition does not suggest the presence of a slip. This is consistent with petrographic study, which identified the existence of a coarse red-firing non-calcareous clay layer on sample 97/36. The coarseness of this layer helps to explain why in composition it did not appear to be a fine fraction. The surface is iron-rich, which explains the red colour of the sample. Sample 97/36 has a vitrification microstructure of V with an estimated firing temperature of 800-900°C.

Fabric 29

Sample 97/86 has a visible slip layer, which is very distinct in composition (calcareous, high K, Fe) and may derive from a different clay from the body. This sample has a vitrification microstructure of V with an estimated firing temperature of 900-1000°C.

Fabric 30

Sample 98/90 has a visible slip layer, which unlike the body is low calcareous. This sample seems to have been very highly fired (TV; 1000-1150°C) in conditions which created heterogeneity in the body: the centre is TV, while the surface is only V. The presence of fine bloating pores in the body is suggestive of intense reduction. This is also indicated by the grey colour of the sherd break.

Fabric 31

Sample 97/101 has compacted surface with no evidence (visual, compositional) for the use of a slip. This contradicts petrographic observation of

a non-calcareous slip layer. This sample has a vitrification microstructure of V with an estimated firing temperature of c.850-950°C.

Fabric 35

Sample 97/43 has a compacted surface, which is only a slightly finer fraction than the body. Petrographic observation of 98/10 also suggested the possibility of a non-calcareous slip layer. This sample has a vitrification microstructure of V with an estimated firing temperature of 800-900°C.

Summary

Study of the surfaces of samples using SEM resulted in the identification of a range of different finishing techniques. To a large extent these results confirm and enhance the results provided by petrographic and macroscopic study. A frequent feature of the surfaces of the samples studied was the presence of a compacted area, which varied in thickness from 10-50µm (see Plate 38). In most cases this does not result from vitrification, as one might suppose from its microstructure, but results from the compaction, which the surface clay has undergone as a consequence of intense burnishing or polishing. In some cases, there was also evidence (visual and/or compositional) for the application of a slip layer (see Plate 39). In the majority of cases the slips used were non calcareous, however calcareous slips were also identified. The use of slips appears to be largely confined to the production of polished vessel, although examples of burnished vessels were noted in some fabrics (e.g. Fabrics 4, 8). However, not all polished vessels testified to the use of slips: in some fabrics there was no evidence for the use of slip (e.g. Fabrics 5a, 6 and 12). The absence of slip layers from these fabrics was also supported by petrographic study. This would seem to suggest that subtly different finishing techniques were employed in different fabrics to create essentially the same finish (see Section 10.4).

Study of how the range of estimated firing temperatures (see Figure 8.1) suggests that there exists a considerable variation both within and between fabric groups (see Plates 40-3). This would therefore indicate that the use of SEM-based

estimations of firing temperature do not constitute a productive means of exploring potential differences in firing behaviour between Neolithic fabrics. This difference between Neolithic and Bronze Age pottery may be explained at least in part by the more regular use during the Bronze Age of kilns, which in general allow more control over firing (heating rate, soaking time, atmosphere) and thus are more likely to produce more discrete patterning.

Although the greater variability in behaviour observed within Neolithic fabric groups would be most consistent with firing in an open environment, in most cases one further more reasoned insight is not possible. However, as argued in Section 5.3.5, inferences of firing method and firing environment *can* in certain favourable circumstances proceed from a detailed understanding of the main variables which govern the effects of firing on a clay vessel, namely temperature, physical/chemical properties of the clay, firing atmosphere and time. For example, several samples, which had been shown through petrographic study to exhibit calcite alteration as a direct consequence of firing, proved to have been fired to temperatures exceeding 900°C. Under such circumstances, the only explanation for the absence of total limestone decomposition (spalling) is that the firing was fast. It has been suggested that there exists an inverse relationship between speed of heating and the separation of vessel and fuel (Gosselain 1992:246). If so, this identification of a fast heating-rate would also be a strong indication that firing took place in an open environment, such as a bonfire (see Section 10.5.4.1).

Inferences regarding firing environment are also possible through a consideration of non homogenous firing. In one example (97/121) comparison of clay microstructure in different areas of the ceramic body indicated that the microstructure was not homogenous throughout with a gradient in vitrification between a less vitrified exterior and more vitrified interior (e.g. 97/121). In effect such a gradient in vitrification means that there was an uneven distribution of heat within the ceramic body during firing. Such an uneven distribution is most likely to occur consistently when firing is fast and/or the firing environment unpredictable (atmosphere, temperature range): for example the most likely explanation for the gradient in sample 97/121 is that the interior of the vessel was

in contact with the fuel, as would be the case in an open firing (cf. Kilikoglou & Maniatis 1993).

In this way, inferences regarding firing environment are possible in a small number of cases. These consistently suggest that firing took place in an open environment, such as bonfire, and that the overall duration of firing was short. Unfortunately, the majority of samples studied do not allow such inferences and the most one can argue is that they remain consistent with an interpretation of firing as fast and open.

CHAPTER NINE

QUANTIFYING PRODUCTION AND CONSUMPTION

9.1 The Relevance of Existing Quantitative Data for the Study of Ceramic Consumption

For his study of the 1957-60 excavations Evans collected an impressive array of quantitative data, recording the frequency with which different ceramic types and traits recurred in the different strata (see Evans 1964:192-229; 1973:139-49). The aim of this was to use the new relative stratigraphy defined by these excavations (strata X-I) as a more accurate check on ceramic variation and change. The results of this quantitative analysis of seriation "confirmed to a remarkable degree" the original ceramic phasing produced by Furness on the basis of A. Evans' more arbitrary stratigraphy (Evans 1964:194; Furness 1953). More recently an attempt has been made to interpret Evans' quantitative data in terms of consumption (see Broodbank 1992). This study identified a number of very basic patterns, several of which, such as the MN increase in carinated bowls, had been noted by Evans himself.

Although not without its own problems of interpretation (see Whitelaw 1992), Broodbank's study is notable for being the first serious attempt to consider the EN pottery from Knossos in terms of consumption and social strategy. That said, however, it must be stressed that any 'simple' reading of consumption from Evans' data is extremely problematic, largely because such a direct reading relies on the integrity of several key assumptions, which are open to question:

- (1) *The breakage of pots occurs at a regular rate.* It is in fact extremely unlikely that all pots will have the same breakage rates; rather life-spans are relative to the construction, use and perceived value of various ceramic vessels. Such information is context specific and *a priori* unknowable.
- (2) *Each studied deposit has the same level of brokenness.* This omits to take into account how the measurement of the proportion of types between assemblages in terms of sherd quantity may be further distorted if one type in one assemblage happens to be particularly broken or particularly whole in

comparison to other types within the assemblage, and to the same type in other assemblages.

- (3) *All contexts within each stratum are characterised by similar depositional practices.* This is even more debatable when one considers the variety of depositional factors, which may be influential on the composition and character of an archaeological deposit.

Evans recognised the problems associated with these assumptions but argued that they were largely negated by the high degrees of mixing and brokenness within each context as well as the likelihood (to Evans) that almost all the pottery was locally produced (Evans 1973:133). Such issues regarding depositional context matter much less for a study of seriation than they do for a study of consumption and Evans cannot be blamed for not pursuing them further. These assumptions will however be explored further below. Certainly in at least one of these assumptions, Evans can now be shown to be wrong. As Chapters 6-7 demonstrate, the Knossos EN assemblage is characterised not by homogeneity and a single production location, but rather by considerable variation in fabric, form and finish, which seems to represent a number of sources. As a result the different relative proportions in which different fabrics and their respective forms and finishes recur lie buried within Evans' basic quantification data. This lack of homogeneity also increases the likelihood that there will be different breakage rates and different patterns of deposition within a single context (cf. (2) and (3) above).

From the perspective of consumption, rather than seriation, there are also problems with the level at which Evans chose to measure ceramic variation. A feature of seriation studies is that they study variation at the level of the single sherd and thus it is usually sufficient (as Evans did) to count and weigh sherds and to base analysis of seriation on simple percentages of sherds in different contexts (Orton et al. 1993:21). However, consumption studies, because they are largely interested in information about the use of pottery prior to destruction and deposition, require variation to be studied at the level of the original vessel. Thus Evans did not explore how different traits, such as types of form and finish, might

relate together at the level of the vessel. Indeed further elaboration of the recording procedure to allow for the measurement of the relatedness of certain attributes was deemed too time-consuming and unlikely to produce results which would justify such effort (Evans 1973:135). However, although wasted effort in terms of seriation, the relatedness of certain attributes is important to the study of consumption, since it restores emphasis to the original vessel. Moreover such relationships clearly exist: Evans noted in passing that ripple decoration seemed to be confined to carinated bowls, and incised/pointillé decoration to vertical-sided dishes (Evans 1973:135).

And so, what emerges is that Evans' seriation data cannot be used as a straightforward measure of consumption. Instead further study of EN ceramic consumption requires the collection of new data, which not only relates form, finish and fabric in an overall study of production but also, through quantification, measures the frequencies and proportions in which these different production groupings occur in different contexts over space and time. However, a prerequisite of such a study is the isolation of potentially meaningful deposits through a consideration of some of the processes which contributed to their formation.

9.2 Defining Meaningful Contexts

It is an unfortunate general feature of the Knossos Neolithic sequence that occupation surfaces are either completely clean when internal (houses) and contain little direct evidence for consumption or else, if external (yards, pathways), are filled with a generally undifferentiated mixture of broken pottery, bone, ash, stone, organic matter, and resemble rubbish deposits (Evans 1994:7, 14). Sherd size is usually small, as one would expect on well-trampled surfaces, and contexts are usually highly mixed with completed vessels or profiles either very rare or absent. Only occasionally do some deposits (e.g. stratum VIII) contain larger sherds, which mend up into profiles or even semi-complete vessels, and such deposits are likely to have accumulated *in situ* (see Appendix I).

In general, therefore, the EN sequence is characterised by an absence of 'destruction' deposits, where an occupation surface is fortuitously preserved intact. As a result study of consumption is restricted both spatially and temporally in the

extent to which it can define individual acts of consumption. The undifferentiated mixed deposits, which characterise much of the EN sequence, therefore force consumption to be viewed at a broad spatial (i.e. community) and temporal resolution (i.e. a single ceramic phase). The only exceptions to this being a number of pit deposits, which are suggestive of more spatially and temporally restricted acts of consumption (see Appendix I). One might wish to argue that mixed rubbish deposits, which lie immediately outside an otherwise 'clean' house, are very likely to have originated from a single household within it. Unfortunately, however, owing to the small size of the EN soundings, it is not possible to even guess at how many architecturally discrete structures could have been disposing rubbish into the same area.

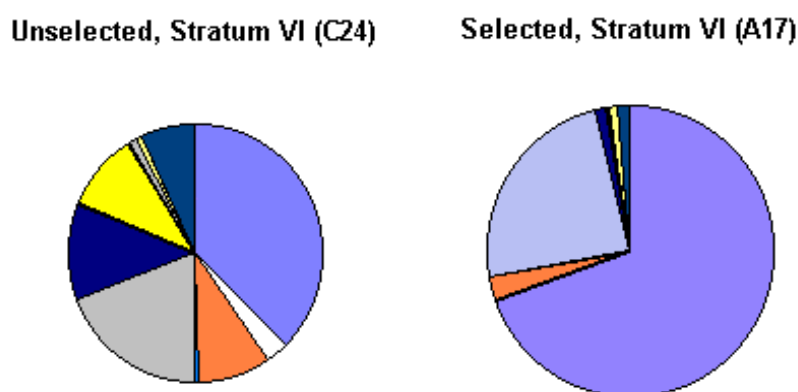


Figure 9.1 Comparison of Range and Proportion of Fabrics Represented in Parallel Selected and Non-Selected Deposits (Stratum VI).

A further restriction on resolution is imposed by alterations to the integrity of deposits through post-excavation activities. Due to restrictions on storage space many contexts excavated during 1957-60 were immediately strewn, studied, the feature sherds selected and the rest discarded. All sherds were, however, retained from area AC (strata X-VII) and trench C (strata VI-I) (Evans 1964:192). As an experiment to test just how much data has been lost through post-excavation selection of assemblages, the range and relative proportions of different fabric groups were measured using sherd counts in both a selected and unselected assemblage (see fig.9.1). Both contexts were from the same highly mixed stratum

(stratum V) and should show broadly the same range and proportions¹⁰⁹. Each slice of the pie chart represents a single fabric, the size of the slice being dependent upon the relative quantity of that fabric present in the context. As Figure 9.1 demonstrates, post-excavation selection has had an irredeemable effect both upon the number of fabrics represented and their relative proportions and as a result only non-selected assemblages were targeted for detailed study.

9.3 Developing a Methodology for Quantification: Vessel Equivalents, Sherd Counts, Sherd Weights?

Central to any form of quantification is the selection of an appropriate measurement of variation. Ideally, only when ceramic material within contexts can be related back to equivalent vessels, can different contexts, if formed by different processes, be compared in a manner meaningful in terms of consumption (see Orton et al. 1993:166-72). However in reality, relating broken sherd material back to the original vessels is extremely difficult. This is particularly so with large visually homogenous assemblages (high similarity in form and finish between vessels in different fabrics), such as Neolithic Knossos, where joins are rare or at least very difficult and time-consuming to make, making it extremely difficult to be sure how many different vessels are represented.

Orton et al. (1993:169-173) suggest several possible methods of estimating vessel counts:

- (1) *Sorting into 'Sherd Families'*: i.e. collect together all the sherds from the same pot. However the potential for a single pot to be represented in different contexts and the practical difficulty of actually assigning non-joining sherds to single vessels make this technique difficult to apply.
- (2) *Estimate of Vessels Represented*: estimate the minimum number of vessels by assigning unattached sherds to the same pot wherever feasible; then estimate

¹⁰⁹ All unselected contexts within this stratum, as with other contexts within a single stratum, proved to be highly comparable/identical in composition, suggesting a generally high degree of mixing.

the maximum number of vessels by assigning unattached sherds, whenever there is doubt, to different vessels; finally take average of the two figures.

- (3) *Estimated Vessel Equivalents*: estimate the percentage in which different types are represented by calculating the percentage of vessel represented by each rim sherd and then adding up the quantities for each type.

Of the three methods (2) and (3) seem to be the most useful, with (3) the most preferable. However, during preliminary sorting of the Knossos EN assemblage, it rapidly became clear that idealism was set to clash with practicality. The general rarity with which sherds mended up into profiles or vessels (see above) made a simple pursuit of (2) or (3) an extremely lengthy process, too time-consuming in fact to be accommodated within the time available for fieldwork.

A version of (2) was tried on ENIa deposits, which contain considerably smaller quantities of pottery in comparison to later deposits. Instead of calculating maximum and minimum quantities and averaging, only a minimum count was taken. It was found that even with relatively small deposits, such as stratum IX (total 542 sherds), the restriction of vessel quantification to a minimum count still took too long, when balanced against the need to collect other types of information. Unfortunately, this problem was never fully resolved. That is not to say that estimating equivalent vessels is by any means difficult, it is just that it remains a very time-consuming activity, which would require much greater resources of time and/or manpower.

Disappointment at this failure may nevertheless be partly offset by the recognition that data relevant to consumption can be gathered through more time-efficient measures. Where contexts are very large, very mixed and very broken, representing many different acts of consumption over a very long period of time (one ceramic phase), all but the most general patterns of consuming behaviour have been lost, victims of mixing and the undifferentiated nature of the contexts. In such circumstances, if contexts are large, truly mixed, with different types

exhibiting similar degrees of brokenness¹¹⁰, then simple average proportions of different types of shape and decoration per fabric and per context can give a very crude idea of basic trends in ceramic consumption. Thus although vessel equivalents remain the ultimate goal, meaningful data can, under certain circumstances, be provided by studying basic proportions of sherds.

Much of this relies on the demonstration that EN deposits at Knossos really are very mixed and very broken. A crude but effective way of gaining an appreciation of the degree of mixing and brokenness, is to compare the representation of different fabrics within a single context in terms of sherd counts, sherd weights and vessel counts. Figure 9.2 compares the proportions of fabrics represented in strata IX and VIII variously produced by sherd counts, sherd weights and maximum vessel counts. The most obvious feature of this comparison is the similarity in the overall proportions produced by each measure. This strongly suggests that these contexts exhibit a high level of brokenness and mixing and that in general each fabric group exhibits similar patterns of breakage. Macroscopic observations of sherd size and fracture would also support this.

Of the three measures, sherd count and sherd weight parallel each other most closely. In stratum IX minimum vessel count is proportionally close to the sherd counts and weights. This is also true in stratum VIII for the well represented fabrics. However, the minimum vessel count for those fabrics which are rare (10 o'clock-12 o'clock) is quite different. This anomaly can be explained with regard to the special nature of stratum VIII: unlike other strata, sherds in stratum VIII often mend up into complete profiles and even semi-complete vessels. Normally a rare fabric will be represented by one or two sherds, however in stratum VIII several rare or unique fabrics are extremely well-represented (e.g. single vessel in unique fabric 35 represented by 25 sherds weighing 2400g). This seems to support an interpretation of stratum VIII as having accumulated *in situ* (see Appendix I)

¹¹⁰ cf. Orton et al (1993:169) note that within any single context, sherd counts reflect two things: "(1) the proportion of the type counted in the population; and (2) the average number of sherds into which pots of that type have broken (known as their *brokenness*)". Thus if all pots of all types show similar degrees of brokenness then the proportions of types represented by sherd counts will reflect the actual proportions of different types within that context.

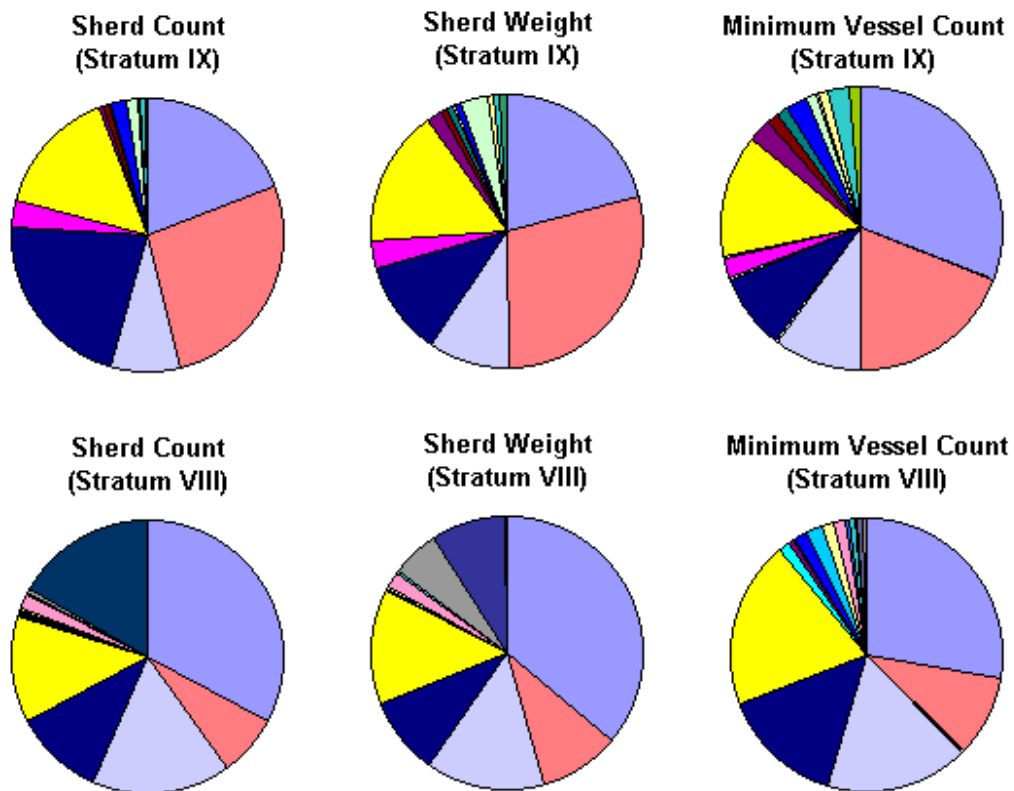


Figure 9.2 Comparison of the Proportionate Representation of Different Fabrics in Terms Of Sherd Counts, Sherd Weights and Maximum Vessel Counts (Strata IX-VIII)

The high degree of equivalence between the various measures of quantity therefore suggests that simple vessel counts or even weights can give a crude indication of the proportions in which vessels in different fabrics are represented at Knossos within a single stratigraphic phase. These proportions may be expressed in terms of the frequency with which different fabrics occur in different strata (see Figures 9.3-4). Unfortunately, however, these measures on their own do not give an idea of the quantities of vessels in use at any one time. In order to investigate the possibility that sherd counts or weights might be converted to meaningful vessel counts through the use of a multiplier (vessels/sherd count; vessels/sherd weight), a comparison was made between strata IX-VII (see Figure 9.5).

	1a	1b/c	1d 111	1e	1f	2a/b 112	2c	4	5a	5b	5c	6	7	8	9	10	11	12	13	14
IX	193. 7	0	0	0	0	218. 2	0	29. 5	103. 3	7.4	0	232. 5	15. 1	119. 9	0	0	14. 8	3.7	3.7	12.9
VII	311.	0	0	0	0	73.7	0	15.	160.	0	4.9	171.	0	119.	7.6	0.3	1.2	0.3	0	0.9
I	5							8	8			8		1						
VII	365. 6	0	0	0	0	53.1	0	23. 8	101. 8	0	8.7	197. 6	0	91.7	43. 3	1.1	0.3	0.3	0	0.3
VI	373. 6	0	29.4	0	0	94.3	0.3	0	186. 8	0	5.8	118. 7	0	86.6	13. 2	0.7	0	0	0	0.3
V	0	135. 2	314. 3	49.6	79. 1	215. 4	12. 4	45. 9	71.3	0	1.4	27.8	0	33.3	0.7	1.0	0.5	2.6	0	0
IV	0	233. 2	22.8	406.6	86. 8	62.2	38. 5	22. 9	27.9	0	0.1	5.6	0	25.4	0.7	1.3	0	5.5	0	0

Figure 9.3 Frequency/1000 of Fabrics 1-15 in Sounding AC

¹¹¹ Since these figures were collected, the presence of Fabric 1d in stratum VII has been established through restudy of sherds originally assigned to Fabric 1a. Thus the frequency figure for Fabric 1a in stratum VI is likely also to include Fabric 1d. NB Fabrics 1g, 1h and 1i are not measured separately: instead the figure for Fabrics 1h and 1i are included within Fabric 1d, while that for Fabric 1g is included in Fabric 1e.

¹¹² NB Restudy of sherds, originally assigned to Fabric 1a, in strata VIII-VI suggests that the frequency figures for Fabric 3a in Figure 9.3 are artificially low and the value for Fabric 1a consequently too high. NB Fabrics 2d and 2e, which are not included in this table are incorporated with the figures for Fabrics 2a/b.

	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	unid/int rus
IX	0	0	0	12.9	0	0	2.3	0	0	0	0	0	0	7.4	1.9	0	0	0	0	0	0	20.8
VII I	2.4	0	0	0	0.9	0.3	3.7	0	0	15.8	0	0	0.3	1.2	0.3	0	0	0	0.3	0	7.6	99.3
VII	3.7	0	0	0	0.5	0	5.3	0	0	4.2	0	0.5	0	1.9	0	0	0	0	0	0.3	0.5	95.5
VI	2.2	1.5	0	8.2	0.2	0	6.5	0	0.3	0.3	0	0	0	0	0.2	0	0.2	0.2	0	0	0	70.5
V	5.5	0.5	0.2	0.5	0	0	0	0	0	0.3	0	0	0	0	0	0	0.2	0	0	1.6	0	0
IV	2.2	0	0	0	0	0	0	3.0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	55.1

Figure 9.4 Frequency/1000 of Fabrics 16-37 in Sounding AC

	Total Sherds	Total Weight (g)	Total Vessels	Sherds /Vessel	Weight /Vessel (g)
Stratum IX	542	7170	78	6.95	91.92
Stratum VIII	3281	43820	205	16.01	213.76
Stratum VII ¹¹³	3785	54130	302	12.53	179.24

Figure 9.5 A Comparison of Average Sherds Per Represented Vessel and Average Weight Per Represented Vessel for Strata IX-VII

Strata IX, VIII and VII exhibit striking differences in sherds/vessel and weight/vessel and produce very different multipliers. This would seem to suggest that different contexts exhibit different degrees of brokenness. To some extent these differences can be related to the observed characteristics of the different deposits. Strata IX and VII are extremely broken and mixed and appear to be secondary deposits (see Appendix I), whereas stratum VIII is probably the least broken deposit in the entire EN sequence in sounding AC and most likely accumulated *in situ* (see Appendix I). Therefore in order to gain some appreciation, however crude, of the total vessels represented *within the excavated area of sounding AC* for each ceramic phase, it was decided to apply minimum and maximum multipliers¹¹⁴ to Evans' original sherd counts and sherd weights per stratum (see below and Figure 9.2). Once again, it must be stressed that this sort of calculation produces only a very crude estimate since, above all, it assumes that later deposits exhibit a range of mixing and brokenness, which fits within the range established for strata IX-VII.

¹¹³ NB not all contexts in stratum VII were studied in the level of detail necessary for these calculations.

¹¹⁴ i.e. maximum sherds/vessel = 7, minimum sherds/vessel = 15; maximum weight/vessel = 100g, minimum weight/vessel = 200g.

9.4 Estimating Vessels in Circulation

9.4.1 Past Approaches to Quantifying Neolithic Ceramic Assemblages in the Aegean

Previous attempts to quantify the total vessels in circulation for Neolithic assemblages have varied considerably in both method and results. For EN Franchthi Vitelli used the weight of typical middle-sized EN vessel (c.1kg) together with the total weight of pottery from EN contexts (c100kg) and then adjusted these figures to take account of the estimated percentage of site excavated (c.2%) and length of time represented by EN deposits (min. c.400 years) to produce a figure of c.12.5 pots per year *for the whole site* (Vitelli 1993a:210). The same method for MN produced an estimate of 125-150 pots per year. In contrast for EN Nea Nikomedeia Yiouni used an existing measurement of the total surface area of excavated ceramic material, divided this by a calculated average surface area for a single vessel, adjusted this figure to take account of the estimated recovery rate and then divided this total by an estimation of the total duration of occupation to arrive at a figure of c.25-90 pots per year *for the excavated area* (Yiouni 1996b:181-5). Since Yiouni's estimate is only for a proportion of the total area of the site, while Vitelli's estimate is for the whole of Franchthi these estimates are likely to be even further apart from each other than they first appear. Inevitably these estimates are crude and open to criticism. Of the two, Vitelli's calculation is most problematic since it assumes a 100% recovery rate for vessels and is therefore likely to grossly underestimate the total number of vessels represented. However, these calculations are nevertheless useful for the indications they give, however general, of the scale at which ceramics were consumed during EN.

9.4.2 Estimating Total Vessels Per Stratum Within Sounding AC

For EN Knossos yet another variation was used. Using Evans' own figures for the total weight of sherds per stratum in sounding AC (Evans 1973:tables I) and by applying a maximum and minimum multiplier as described in Section 9.3, a maximum estimated vessel count and a minimum estimated vessel count was

made of the total vessels represented in each stratum of sounding AC¹¹⁵ (see Figure 9.6).

Stratum	Weight (g)	Minimum Vessels (weight/200)	Maximum Vessels (weight/100)
IX	10,000	50	100
VIII	45,000	225	450
VII	135,000	675	1350
VI	270,000	1350	2700
V	385,000	1925	3850
IV	630,000	3150	6300

Figure 9.6 Estimated Minimum and Maximum Vessels Per Stratum Based on Data in Evans 1973:table I)

9.4.3 Estimating the Maximum Total Vessels in Circulation Per Ceramic Phase for the Whole Site

On their own these figures seem to suggest that different strata saw quite different levels of ceramic consumption. However, in their present format a simple comparison between strata is not possible since the various strata accumulated over different periods of time, in different densities and may have been subject to different formation processes. In order to try to get beyond the problem of non-comparability, it was decided to use these figures as the basis of an estimate of the *maximum* total vessels in circulation *for the whole site* within each ceramic phase (see Figure 9.7). This was achieved by dividing the estimated maximum site size per ceramic phase (see Appendix II) by the size of sounding AC (5m x 11m = 55m²) and then multiplying by the estimated maximum vessel count for sounding AC. By working at the level of the site and within ceramic phases rather than strata, one must inevitably accept a loss of potential resolution as well as a greater risk of substantial error. In order to offset partly the risk of error it was decided to pursue only a maximum estimate.

¹¹⁵ Unfortunately a similar calculation using Evans' figures for total sherds proved problematic since Evans' figures for strata IX-VII do not correspond in any way to the total sherd counts produced for this study. Since the figures for weight do correspond, the only explanation for this difference is that significant amounts of breakage have occurred since Evans made his original study.

The most likely source of error lies in seeking to extrapolate to the level of the site on the basis of a single excavated context, since such an estimate assumes that sherd density per stratum will be the same across the entire site. That this is not true is demonstrated by the significantly different densities noted by Evans for EN deposits in the Central Court and West Court soundings (Evans 1973:tables I, III; 134)¹¹⁶. Evans' calculations suggest that sherds are more frequent in Central Court soundings than in West Court soundings. Thus by calculating on the basis of the Central Court data, the total estimate produced is more likely to over-estimate than under-estimate the total vessels in circulation in any one year. Since only a maximum estimate was sought this increases the likelihood that the final estimate represents a true maximum.

Phase	Max. Size (m ²)	Max. Site Size /55m ²	Max. Est. Vessels/Phase (sounding AC) ¹¹⁷	Max. Est. Vessels For Site
ENIa	3000	54.55	275	15001.25
ENIb	15000	272.73	2025	552278.25
ENIc	25000	454.55	3850	1750017.5
ENII	30000	545.45	6300	3436335

Figure 9.7 Maximum Estimated Total of Vessels/Ceramic Phase For the Whole Site

9.4.4 Estimating Average Maximum Vessels in Circulation Per Year For Each Ceramic Phase

Ceramic phases are of course relative measures and in absolute chronological terms, different phases will have different durations. As a result the maximum estimates per phase expressed in Figure 9.7 cannot be considered

¹¹⁶ The degree to which vessels are under or over-represented may be closely related to how rubbish was disposed. Thus if most rubbish was dumped near occupation areas then areas within the settlement but outside houses are likely to have higher sherd densities than areas on the edge of the settlement (see general discussion in P. Arnold 1991:120-137). This would be a plausible explanation for the lower densities in the West Court soundings, since only the upper ENI contexts contained evidence for built structures.

¹¹⁷ The figures for ENIa were arrived at by taking an average of the maximum estimates for strata IX and VIII. A similar average was taken for ENIb (strata VII and VI).

comparable until some account is taken of the different periods of time over which ceramic material could potentially accumulate during each phase. An attempt was made to account for this by dividing the maximum estimated vessel count *for the whole site* by the estimated duration of each ceramic phase (see Appendix I), thus producing a crude estimate of average maximum vessels per year per phase (see Figure 9.8).

Phase	Estimated Duration of Phase (yrs.)	Max. Est. Vessels For Site	Est. Average Max. Vessels /year
ENIa	600	15001.25	25.0
ENIb	700	552278.25	788.9
ENIc	200	1750017.5	8750.1
ENII	400	3436335	8590.8

Figure 9.8 Estimated Average Maximum Vessels/Year For Each Ceramic Phase

This figure may also be expressed in terms of maximum vessels per person by dividing by the estimated minimum and maximum population for each phase (see Appendix II) (see Figure 9.9).

Phase	Est. Average Max. Vessels /year	Min. Population /Phase	Max. Population /Phase	Average Est. Max. Vessels /Year/Person
ENIa	25.0	30	60	0.42-0.83
ENIb	788.9	150	300	2.63-5.26
ENIc	8750.1	250	500	17.5-35.0
ENII	8590.8	300	600	14.32-28.64

Figure 9.9 Estimated Average Maximum Vessels/Year/Person For Each Ceramic Phase

9.4.5 Problems of Interpretation

Obviously such estimates give only a crude idea of the total number of ceramic vessels in circulation at any one time. Since they are based on not one

estimate but several (total vessels in excavated area, area of settlement, duration of phase, estimated maximum population) there are many points at which errors can enter the calculation. The most obvious drawback is that these figures extrapolate data from one, admittedly large, sounding to produce figures for the whole site. This assumes that the vessels and vessel fragments deposited within each stratum in sounding AC are representative of site-wide patterns of consumption and deposition.

In addition some comment must be made about how these estimates are interpreted in terms of production and consumption. Previous studies have used such estimates as a direct indication of the rate of production (Vitelli 1989:21; 1993a:210; Yiouni 1996b:184-5). In doing so they assume that all or almost all pottery deposited was produced at the respective sites in question (Franchthi, Nea Nikomedeia). However, at least for EN Knossos this assumption does not hold since, as demonstrated in Chapters 6-7, a significant proportion of the vessels consumed were not produced at the site. In this way, an estimate of the total vessels in circulation at any one time is likely to reflect the scale at which ceramic vessels were *consumed* rather than produced. Indeed if any locally-produced ceramic vessels were exchanged out of Knossos and deposited at other sites, it then becomes even more difficult to estimate the rate at which vessels were produced locally. Only by assuming that the general rate of consumption also reflects the scale of local production can one arrive at an indirect indication of production rate. For example, if the total number of vessels (local and non-local) consumed at Knossos in any one year during ENIa was in the region of 25 (see Figure 9.8), then this may suggest that the rate of production of ceramic vessels was equally low. In contrast, in strata ENIc and ENII, the numbers of vessels in circulation are significantly higher at the same time as the proportion of non-local vessels are significantly lower (see Chapter 12), which together seem to suggest a significant increase in the scale of production (see Chapter 11).

Summary

Although the quantitative data, originally collected by Evans for seriation purposes, has been used as a straightforward measure of patterns of consumption

(cf. Broodbank 1992), such a use entails the acceptance of a number of key assumptions, which, although of low importance for seriation, are of considerable relevance for the study of consumption. Moreover, it was argued that the level at which Evans chose to measure ceramic variation (the sherd), although suitable for seriation studies, is quite inappropriate to studies of consumption, where variation should be studied at the level of the original vessel. As a result it was concluded that study of EN ceramic consumption required the collection of additional quantitative data detailing ceramic variation in terms of vessel quantities. A number of methods were tried, but owing to restrictions of time and labour a compromise method was employed, which *estimated* minimum and maximum vessels in circulation per stratum using Evans' original sherd weights.

Consideration of the particular nature and formation of EN deposits suggested that consumption could only be studied at a very broad spatial and temporal resolution. In other words, although one would like to be able to isolate individual acts of consumption to a particular time and place, one can only at best characterise basic trends in consumption occurring over the course of a ceramic phase and at the level of the entire site. In this way the basic vessel estimates per stratum for sounding AC are relatively meaningless on their own. Moreover vessel estimates for one stratum cannot be simply compared with those of another. As a result the original maximum estimated vessels per stratum for sounding AC were used as the basis for additional calculations, which for the whole site estimated maximum vessels per ceramic phase, maximum vessels per year and maximum vessels per year per person; thus yielding very crude figures, which nevertheless could be compared with each other.

Although the potential for error in this second round of calculations is especially high, it is considered likely that the estimates produced represent an absolute maximum and that such figures overestimate rather than underestimate the actual levels of consumption. This factor is very important since it suggests that the figure of approximately 25 vessels per year for ENIa, however incorrect, is nevertheless unlikely to have been higher. This would therefore seem to indicate a very low level of ceramic consumption for this phase. Also worthy of comment are the relatively high figures produced for ENIc and ENII. Even if these figures

were to overestimate the actual level of consumption by a factor of two or three, they would still suggest a substantial increase in the level of ceramic consumption in comparison to ENIa or ENIb. Moreover, it may be more than simple coincidence that the maximum figure arrived at for ENIc is so close to that of ENII. The possible implications of these estimates will be further explored in the context of EN ceramic production and consumption in Chapters 11 and 13.

CHAPTER TEN

EARLY CERAMIC TECHNOLOGY AT KNOSSOS

In the absence of direct observation or oral testimony, study of the materials, techniques, concepts and individuals which constituted ancient ceramic production, must necessarily rely on indirect evidence. Conventionally, this has taken several forms from evidence of excavated production locations, firing installations, tools and wasters, to the study and analysis of finished ceramics (e.g. Wilson & Day 1994; Whitelaw et al. 1997; Shaw et al. 1977, 2001). In addition to these, however, much can also be gained from an analysis of the social, economic and environmental context within which production activities must be situated (Costin 1991:2-3; see Chapters 3-4): this includes consideration of such things as distribution of raw materials, how ceramic vessels were consumed, the scale of the community in which production was taking place, the potential relationship to other production activities, as well as concepts of value. Thus, this discussion of EN ceramic production will proceed from direct analysis of ceramic material, via other forms of archaeological evidence to a more general contextual analysis of the changing ways in which ceramic vessels were produced at Knossos and, as will be argued, at other settlements on Crete during the various phases of EN.

10.1 Previous Approaches to Early Neolithic Ceramic Production

Early Neolithic ceramic production at Knossos is currently understood to have been almost entirely local to the site. Clay is thought to have been selected from 'the immediate vicinity', processed and then tempered with powdered gypsum from the nearby Gypsades Hill (Furness 1953:95; 103; n.16). This was essentially the only ceramic technology in use: "there is no example of tempering with sand or organic material" (Furness 1953:103). This view is also supported by Evans: "virtually all [sherds are] from locally made pottery of very similar fabric" (Evans 1973:133). EN vessels were carefully formed and generally better burnished than later vessels, their surfaces varying in quality from coarse to fine burnish with no prior use of slip (1953:95, 103, 110). Fine ware only differs from coarse ware in its thinner walls and better 'levigation' and more careful burnish: only later did clear

coarse and fine categories emerge (1953:109). Furness considers EN firing to be poor and more irregular than in later phases, but still sufficient to produce adequate strength (1953:103). Coarse ware is often variegated due to irregular firing, to a greater extent than fine ware (1953:95). Consistent with an evolutionary perspective, the next phase, ENII, sees some improvements in firing and clay processing with less variation in colour on the same surface and with 'large white grits' less often visible in the break (1953:117). ENII also sees changes both in the range of finishing methods used and in the types of design (see Washburn 1983:144ff.; Broodbank 1992:53-7).

Evans supports Furness' observations of fabric, forming and firing adding little that is new (Evans 1964:194; 196). He does, however, emphasise how the very earliest pottery at the site "bears all the marks of being the product of a fully developed tradition of potting" (cf. also A. Evans 1921:35), and by that he appears to mean a complex range of shapes, with 'much arbitrary detail' and a complex range of handle types, all skilfully formed and fired (1964:196; 1968:271). Since occupation of the site precedes the first appearance of pottery, Evans argues that ceramic technology must therefore have been introduced in this developed form from elsewhere, the most likely candidate, in view of stylistic similarities, being south-west or coastal Anatolia (Evans 1968:273-4; 1971:115). This view has been challenged by Broodbank, who prefers to explain the development of ceramic technology purely in terms of indigenous processes (Broodbank 1992:49; see Chapter 2).

All previous studies have emphasised the stylistic homogeneity of the Neolithic sequence at Knossos, from the earliest to latest levels (Mackenzie 1903:158-9; Furness 1953; Evans J.D. 1964:194; Manteli 1993a:42). This is conventionally viewed as indicating a very gradual process of change (cf. Vagnetti & Belli 1978:126), often characterised as conservative (e.g. Evans 1971:114; Manteli 1996:132). Ceramic styles are commonly held to show no evidence for contact with other areas of the Aegean and thus demonstrate the *isolation* of Knossos until the end of the Neolithic (see Section 12.1).

These statements, when collected together constitute a clear picture of ceramic production and may be summarised thus:

- EN ceramic technology was first developed elsewhere (Anatolia?) and then later introduced 'fully developed' to Knossos/Crete (but cf. Broodbank 1992:49);
- Most if not all EN pottery at Knossos was locally made, using a single technology (single 'gypsum tempered' fabric; consistent low-firing; restricted range of shapes);
- Production was essentially in the household domestic mode: variations within the assemblage merely represented variations between different households producing within this mode over space and time;
- Ceramic development during EN was *conservative* or undynamic in the way it adhered to a restricted shape repertoire over a millennium;
- Pottery styles demonstrate an *isolation* from the rest of the Aegean and indeed from the rest of Crete.

Thus, the current picture for EN Knossos/Crete views ceramic production as comprising a *single* production technology, which, following its initial adoption, was maintained in *isolation*. All pottery consumed at Knossos was produced at the site. Change was so slow as to merit the description *conservative*; there was a *curation* of a restricted set of techniques for over a millennium with possible technological 'improvements' only occurring during ENII.

In the next section an analysis of the different production technologies present in the EN sequence at Knossos will be presented. Beginning with clay selection and paste preparation and ending with firing practices, this will draw together the results of the various macroscopic and microscopic analyses, which have already been presented in detail in previous chapters. In the process the validity of previous views of EN ceramic production will be assessed.

10.2 Clay Selection and Paste Preparation

Thin-section petrology has allowed the characterisation of around fifty different fabrics within the ENI-II assemblage at Knossos (see Chapter 6). Each fabric has been characterised as separate on the basis of differences in clay groundmass and/or large non-plastic inclusions. In the majority of cases these fabrics, which have been defined at a microscopic level, can also be distinguished macroscopically (see Section 6.3). Contrary to what was previously thought about

EN ceramics (single 'gypsum' source), these fabrics testify to the selection and utilisation of a wide range of different clays and tempers (cf. Plates 1-18) and therefore the presence at EN Knossos of not one ceramic technology but many.

10.2.1 Exploring EN Paste Variation: Differences and Consistencies

Careful petrographic study of groundmass and non-plastics suggests that in many cases EN fabrics exhibit distinct mineralogical differences. In the majority of these cases the most obviously distinctive feature of the fabric is the non-plastics present. However in some instances there are strong indications that the clay groundmasses of these fabrics are also different. For example, since Fabrics 6 (altered igneous rocks) and 10 (serpentinite) are both characterised by the presence of altered igneous rocks, which probably both link to the same geological series (i.e. the Ophiolite series; see Appendix III), one might conceivably expect to see a close relationship between them. However, serpentinite is entirely absent from Fabric 6 and the altered igneous rocks characteristic of Fabric 6 are entirely absent from Fabric 10. Moreover the clay groundmass of Fabric 6 contains doleritic rock fragments, while that of Fabric 10 contains mafic rocks. In this way Fabrics 6 and 10 not only testify to the selection and utilisation of quite different clay and temper sources, neither of which occur within the immediate area of Knossos (<5km), but also that this selection apparently remained consistent within either fabric over the duration of EN1a-b (c.1400 years). Other fabrics which exhibit some sort of mineralogical association between clay and temper are Fabric 12, which comprises a groundmass rich in quartz and feldspar in association with large granodiorite rock fragments (see Plate 14) and Fabrics 8, 11, 19, 26, 35 where a clay groundmass containing metamorphic rock fragments is dominated by large metamorphic non-plastics (see Plates 12, 17). Other examples of such distinctiveness and consistency can be found in fabrics described in Chapter 6.

However, not all fabrics are so distinct from each other; in a number of cases different fabrics share the same basic mineralogy. Fabrics 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h and 1i essentially share the same basic groundmass and differ primarily in the form and distribution of their limestone tempers (see Plates 1-6). The closeness of the mineralogical links between Fabrics 1a-i is best demonstrated by Fabric 3, which shows a join between a coil in Fabric 1b and a coil in Fabric 1d. Fabrics 2a-

e also have very similar groundmasses and again these fabrics differ primarily in the form of their limestone tempers and the presence or absence of grog (see Plates 7-10). To complicate matters further there are also close links in the form of limestone inclusions between some fabrics in 1a-i and fabrics in 2a-e. However despite the existence of clear links between these fabrics and the consequent potential for overlap it is striking that in relatively few cases do Fabrics 1a-i and 2a-e threaten to merge completely with one another; moreover when this happens most clearly, such as in Fabrics 1a-c or 1d-e, it occurs in circumstances which suggest the chronological development (ENIc-II) of a finer fabric out of an earlier (ENIa/ENIb) coarser one.

In other words despite the existence of clear links between Fabrics 1a-i, individual fabrics also demonstrate some consistently reproduced differences. Thus Fabrics 1a-c do not contain grog or types of biomicrite, which are such a feature of Fabrics 1d, 1e and 1g (cf. Plates 1-3). Moreover Fabrics 1a-c consistently contain a finer-grained sparite than the sparite found in Fabrics 1d, 1e, 1f, 1g and in Fabrics 2a and 2c. This consistency is underlined by the ease with which these technologically similar fabrics can be separated macroscopically (see Chapter 6). These more subtle fabric differences also correlate with subtle differences in form and finish. Although a broadly similar range of forms and finishes are found in each of Fabrics 1a-i and 2a-e, certain forms and finishes are nevertheless specific to certain groups of fabrics (see Chapter 7): for example during ENIc-II a distinctive miniature offset rim is confined to Fabrics 1b/c, while painted and brushed decoration is confined to Fabrics 1d/e. The meaning of these more subtle differences and consistencies in form, fabric and finish remains unclear: certainly the close links in mineralogy and the presence of coils of Fabric 1b and 1d together in the same vessel strongly suggest a common provenance for Fabrics 1a-i.

And so it would seem that an important, general feature of EN fabrics is their consistency. While some variation within individual petrographic groups occurs (e.g. see Chapter 6, Fabric 5a), this internal variation is never so great as to compromise the grouping¹¹⁸. Thus in many cases fabrics testify to a consistency in

¹¹⁸ In a number of such cases it was suggested that this internal variation may plausibly relate to the practice of clay mixing (see Chapter 6).

the association of particular clays with particular tempers. Moreover this consistency can in many cases be traced for over a millennium from ENIa to ENIc and often into ENII. As has already been demonstrated in Chapter 7, this consistency often also extends to particular forms and finishes, with some fabrics proving to correlate closely to groupings based on form, finish and frequency. Here it is worth noting that a very similar pattern of consistency occurs at EN (Greek) Franchthi, where "the consistency in the formulation of the clay bodies and their relative frequencies over a very long period of time indicate that the choice of materials was neither random or uninformed" (Vitelli 1989:19).

10.2.2 Fabric Diversity, Frequency and Provenance

Fabric diversity would appear to be a consistent feature of early Aegean ceramic assemblages, however in previous studies it has been interpreted largely in terms of the selection of a wide variety of raw materials by potters *local* to the site in question (see Chapter 2). Such interpretations were criticised for failing to consider the validity of alternative explanations, such as non-local production and exchange. The results of the detailed macroscopic and microscopic study of the EN ceramic assemblage at Knossos (presented in Chapters 6-9) provide an ideal opportunity to explore the validity of the TLP hypothesis with respect to ceramic production and consumption at Knossos.

In order for the TLP hypothesis to be valid for Knossos, petrographic analysis would have to be able to demonstrate for most, if not all fabrics, that their clay groundmasses and/or large non-plastics are compatible with a provenance within the local area of Knossos (<5km). However, in a number of cases both clay and temper are incompatible with such a provenance: good examples of this are Fabrics 10 (serpentine and a clay groundmass rich in mafic rocks) and 12 (granodiorite rocks and a clay rich in quartz and feldspar). The raw materials in Fabric 12 are only compatible with a source in the Mirabello Bay, East Crete (c.70km from Knossos); moreover petrographic samples of Fabric 12 match Neolithic comparative from this area (see Chapters 6-7). Other fabrics would appear to have even more distant sources: for example Fabrics 31 (rich in biotite mica) and

35 (blueschist) are most likely to originate from raw material sources located beyond Crete (see Plates 16 and 17).

In order to explain the production of these fabrics under the TLP model, one has to postulate a model of long distance radiating procurement of *both* clay *and* temper by local Knossian potters, perhaps involving round trips of between 150 and 500km. Unfortunately, such a model for procurement receives no support from comparative ethnography. In his well-known cross-cultural comparison of ethnographic studies of ceramic raw material exploitation Arnold noted (1985:32-52) that from a sample of 111 individual cases c.33% of potters travel less than 1km for their clay, while 84% travel less than 7km. The most common maximum is a round-trip from the production location to the raw material source and back of around one day. Those potters that travel further than 7km only very rarely travel longer than one day, but have access to better forms of transportation, such as canoes. For temper, in a smaller sample of 31 cases, 52% of potters travel less than 1km, while 97% travel less than 6-9km.

These examples therefore strongly suggest that the production of at least some fabrics took place at locations situated at some distance from Knossos. In view of the strong ethnographic data in favour of a close link between the resident location of groups of potters and the raw materials which they use for pottery production it seems likely that these different production locations correlate closely with the existence of different settlements. The correlation of ceramic production locations with settlement locations is also suggested by:

- (i) the presence of suitable tools within a settlement context (Knossos): rubbers, burnishers, schist pot stands, needles¹¹⁹;
- (ii) the availability of crushing/grinding tools for the processing of clay and temper; it is most likely that tools normally associated with food processing, such as querns, were used;

¹¹⁹ Discovery of production debris, however, need not mean that production took place as the place of discard: comparative ethnographic data suggest that waste from production in sedentary communities is usually collected and discarded away from work areas (Murray 1980).

- (iii) the accidental incorporation of organic matter into ceramic pastes may indicate that paste preparation forming took place within the same environment as the processing of cereals (cf. also the use of organic temper in Fabric 15);
- (iv) the local availability of suitable raw materials;
- (v) the likelihood that permanent open settlements were the main centres for the consumption of ceramics.

If this identification of non-local production is correct then the presence of these fabrics at Knossos can only be explained in terms of exchange (see Chapter 12).

Those rare examples, where provenance is more clear, open up the possibility that other fabrics, which are equally rare but of unclear provenance, could also have been produced in settlements other than Knossos. This in turn suggests that the opposite might also be true, namely that those fabrics which occur most frequently at Knossos are most likely to be locally produced. Fabrics 1a-i and 2a-e comprise the most frequently occurring single group of fabrics and together account for c.40-80% of the EN assemblage during any one period (see Figures 9.3-4). The close mineralogical and technological links between these fabrics and their compatibility with the geology local to Knossos would also indicate a local provenance for this group. Other frequently occurring fabrics (i.e. Fabrics 5a, 6 and 8), exhibit strong similarities in form and finish with Fabrics 1a-i, 2a-e and are broadly consistent with a north-central Cretan provenance, although inconsistent with an origin within the local area (<5km) of Knossos (see Section 7.6 Group 1).

Indirect support for such interpretations of provenance is provided by a consideration of the form and finish of the rarer fabrics. In general it is the rare or unique fabrics (i.e. Group 3, Fabrics 24-35), which exhibit the greatest differences in form and finish from those fabrics whose frequency and mineralogy would suggest were produced locally to Knossos (i.e. Fabrics 1a-i, 2a-e).

If correct this interpretation of fabric diversity at EN Knossos also has a number of serious wider implications:

- (1) It suggests the possibility that previous studies of early ceramic assemblages from sites around the Aegean may have seriously underestimated not just the

nature, dynamics and complexity of ceramic production and consumption, but also the importance of ceramics as exchange items and even the extent of exchange itself (cf. Chapter 2).

- (2) It implies that intensive/extensive surveys have consistently failed to detect early (Aceramic - EN) settlement on Crete, as well as possibly in other parts of the southern Aegean¹²⁰. It would appear that Neolithic settlements are often discovered either where the Neolithic land surface is close to the modern (e.g. caves) or where earlier surfaces are accidentally discovered during excavation below or near later remains, such as Knossos, Katsambas, Pelekita, Nerokourou, Phaistos (see Appendix I).
- (3) These results also suggest the possibility that fabrics, which have been identified as consistently occurring in very low quantities at other Neolithic sites in the Aegean, may, contrary to previous interpretations, have provenances which are not local to the site in question: for example at EN Franchthi a consistent pattern of fabric occurrence has been established with 'Lime Ware' and 'Sandy Ware' consistently frequent (c.80-90%) and 'Andesite Ware', 'Ungritted Ware', 'Serpentinite Ware' and 'White Ware' consistently rare (Vitelli 1989:19; 1993:208-9).

10.2.3 Clay Processing and Clay Mixing

The clarity with which individual fabrics can be distinguished is partly a function of the coarseness of the clays used. In most cases clays, once selected, seem not to have been subject to intensive processing designed to produce a very fine clay (e.g. levigation). Large non-plastic inclusions rarely exceed 3-4mm, which suggests that if any larger material existed it was either removed or broken down during crushing and grinding. The process of crushing and grinding up a clay may be compared to the almost identical domestic activity of crushing and grinding

¹²⁰ Recent discussion of the types and quantities of material, which surveys in the southern Aegean normally find, has led to the recognition that early prehistoric material is significantly under-represented (see Bintliff et al. 1999). In this respect the early Neolithic landscape of southern Greece largely remains a 'hidden landscape'.

cereals: it is likely that the same tools and techniques for crushing and grinding were used in each case (see Sillar 1996:265-71; Runnels 1985:33). Mortars are found from the very earliest pottery-bearing stratum (stratum IX) (Evans 1964:144-6), although wooden vessels could also have been used¹²¹.

A feature of many EN fabrics is the phenomenon of clay mixing (see Chapter 6, Fabrics 1a-i, 5a-b, 6, 8, 19)¹²². The presence of clay streaks and more often clay pellets of different composition may suggest the incomplete mixing of two clays. For example Fabric 5a consistently testifies to the mixing of quartz-rich red clay containing mica (biotite, muscovite) and metamorphic rock fragments with another perhaps quartz-poor clay (see Plates 11, 21-2). The composition of the red clay can clearly be seen in the large darker-coloured clay pellets which are a particular feature of this fabric. In other fabrics, such as Fabric 1a, two very similar clays appear to have been mixed, namely a fine calcareous clay containing very few inclusions and a fine calcareous clay rich in ostracods and foraminifera. In sample 97/92 (Fabric 19), the incomplete mixing of a calcareous clay rich in foraminifera and a red clay rich in quartz can clearly be seen in the form of a large clay pellet.

10.2.4 Tempering

Large non-plastics, whether deliberately added as temper or naturally occurring in a clay, act to promote an even loss of water, to reduce the degree of shrinkage during air and heat-assisted (firing) drying and to increase clay workability (Rye 1976). They thus help to minimise the risk of failure in the clay body during ceramic production. In this way the deliberate addition of temper acts to make a clay more coarse and thus constitutes a deliberate manipulation of the natural properties of a clay.

Petrographic study of the non-plastics present in each EN fabric at Knossos strongly suggests that in the majority of cases crushed large non-plastics were added to the prepared clay or clay mix as temper. The crushing of temper may, like the crushing of clay, have been achieved using stone mortars. A number of fabrics,

¹²¹ cf. the use of the wooden *koitano* by present day potters in Greece (P. Day pers. comm.).

¹²² Clay mixing was found to be a feature of EN (West Mediterranean) ceramics from the site of Balma Margineda in Andorra, where in a small sample (11 vessels) Barnett found that 2 in local fabrics may testify to clay mixing (1991:27-32; cf. also Wijnen 1993:322 on clay preparation at EN (Greek) Sesklo).

well-represented at Knossos, are tempered with different forms of limestone (fine-grained sparite, coarse-grained sparite, bioclastic, calcareous siltstone, euhedral calcite), occasionally some of these limestone tempered fabrics also received small quantities of grog (cf. Fabrics 1d, 2b, 2e) (see Plates 1-10). The existence of a number of limestone-tempered fabrics, which are likely to originate in and around Knossos, raises the possibility that there might have been a local limestone tempering tradition. It has been suggested that a limestone-tempering tradition may have existed in the vicinity of Franchthi (Vitelli 1993a:208; cf. Weinberg 1962:168). However, the degree to which such a 'tradition' around Knossos might more simply reflect those types of raw materials which were available in the local area, should caution against over-confidence (see Appendix III). Certainly limestone is only one of a wide variety of types of temper which have been identified in EN fabrics at Knossos: other fabrics are tempered with igneous rocks (e.g. granodiorite), metamorphic rocks (phyllite, schist) or grog (see Plates 11-18). In addition, and contrary to previous assessments (see Furness 1953:103), there are also fabrics which testify to the use of sand (Fabrics 16, 18) or organic temper (Fabric 15). The EN ceramic assemblage at Knossos therefore indicates the use of an extremely wide variety of tempers.

10.2.5 Raw Material Selection

The general continuity shown in the choice and processing of clays and tempers suggests that these practices answered well to the demands of ENI ceramic production. Certainly the general coarseness of the fabrics is likely to have facilitated the rapid forming of large vessels and to have helped a vessel to survive the stresses of fast firing (see Sections 10.3, 10.5; Rye 1981:31). Some studies of early ceramic production have claimed that early ceramics constituted a revolution in the processing of food and/or in container technology (e.g. Brown 1989; see Chapter 2). In this way ceramic containers are viewed as economically or functionally optimising. If optimisation was indeed a factor in the adoption of pottery then one might expect to see it influence the selection of particular raw materials for particular categories of vessel intended for a particular function. However, in the few examples where study of use-alteration suggests that a certain

type of vessel may have been used for cooking or heating (cf. Fabrics 1d, 1i, 4, 8; see Section 13.3.1), this function generally seems not to have influenced choice or processing of raw materials. Rather in all cases there are other vessel types in the same fabrics which show no signs of heating and would have been put to a variety of uses (see Section 13.3.1).

The only possible exception to this rule is provided by the restricted range of vessels produced in an organic-tempered fabric (Fabric 15) (see Plates 16, 45). Although these vessels are very fragmentary with usually only the rims surviving, it would appear that they correspond to large, coarsely finished, open shapes. Some sherds in this fabric have traces of burning on their interiors suggesting the possibility that these vessels were used for some form of cooking activity involving indirect heating (see Section 13.3.1); this would also help to explain their very fragmentary nature. Examples of the use of organic-tempered fabrics for cooking pots can be found in both the ethnographic and archaeological literature (see Sassaman 1995:225). In terms of performance characteristics, organic-tempered vessels weigh less than equivalent rock-tempered vessels, require less time and care to make and, although both types can withstand the same amount of repeated heating, organic-tempered vessels will abrade more rapidly and when heated externally will transfer heat more slowly to the vessel contents (see Skibo et al. 1989:122-46). Organic-tempered vessels are therefore not good conductors of heat and are therefore not appropriate for direct methods of heating. However, it has been argued that organic-tempered vessels could have acted as good insulators of heat and would thus have been more suited to indirect methods of heating, such as 'stone boiling' (Reid 1989:174). In addition the use of organic temper produces a high number of voids which increase toughness (Kilikoglou et al. 1998). In this way the EN use of organic temper may have facilitated the construction of these very large vessels, increased their manoeuvrability through gains in the ratio of size to weight as well as increased their effectiveness as insulators for indirect heat cooking, a use which is suggested by the confinement of traces of burning to their interiors. In this way the choice of organic material as temper for vessels produced in Fabric 15 may have had some relationship to the function of these vessels, whether storage or cooking.

In all other cases, however, macroscopic and microscopic study of the relationship between fabric, form and finish (see Chapter 7) indicates that a comparatively similar range of shapes (open and closed) and forms of decoration (burnished, polished, incised etc.) can be found in each fabric. A similar conclusion was reached in Yiouni's study of MN (Greek) ceramics from Makri (Yiouni 1995; see Chapter 2):

"preliminary research on the correlation between the shapes of the Makri vessels and their fabrics, was negative. All fabric types were used for the manufacture of various shapes" (1995:619).

Likewise for the MN (Greek) Peloponnese, Phelps has noted that every type of vessel - "even the large storage jars" - were constructed using basically the same 'fine Urfinis fabric' (Phelps 1975:124). Outside the Aegean, a similar situation obtains at the Early Neolithic (West Mediterranean) site of Balma Margineda in Andorra, where Barnett notes that "both highly decorated and undecorated vessels of various forms and wall thicknesses" were produced in each fabric (Barnett 1991:32). And so in all of these examples of earlier Neolithic ceramic production, including also now the data from Knossos, there is almost no clear correlation between fabric, form or function. In other words, although these different vessel categories were used in a variety of ways (storage, cooking, serving, transportation; see Section 13.3), which necessitated different performance requirements and subjected vessels to a variety of different stresses, no differences in paste preparation can be identified for different shapes. This situation stands in sharp contrast to that observed for later Bronze Age ceramic production in the prehistoric Aegean (Kilikoglou, Vekinis, Maniatis & Day 1998:274): for example study of ceramic production in and around Knossos during the LN and EBA periods suggests that different vessel forms and finishes correspond to different paste recipes (Wilson & Day 2000:57). In this way study of EN fabrics suggests a much simpler picture of paste production and reveals little evidence to suggest that EN raw material selection and paste preparation was *preoccupied* with either structural

mechanics or functional optimisation¹²³. This in turn suggests that raw-material selection was governed by an altogether different set of constraints.

It has been argued above that for some fabrics the selection of raw materials can be *demonstrated* to have taken place at distant locations outside Knossos. This interpretation relies on the likelihood that EN potters were as influenced by factors of time and distance as potters of the ethnographic present or near-present (Arnold 1985). It is inevitable, therefore, in view of this reliance on the principle of local procurement, that proximity to production location emerges as a significant factor behind raw material selection. The degree of circularity inherent in this argument is acknowledged, however additional support for a local procurement of raw materials is suggested by the frequency with which different fabrics occur at Knossos and how that correlates with geological source (see Section 10.2.2): the most frequently occurring fabrics (Fabrics 1a-i, 2a-e) are compatible with a local provenance, while those fabrics, whose raw material sources must lie at some distance, such as Fabric 12 (Mirabello Bay) or Fabric 35 (off-island), are extremely rare.

A notable feature of a number of fabrics represented at Knossos is the presence of tempers that may bear some relationship to the non-local raw materials used to manufacture other artefacts, such as ground stone axes¹²⁴. A similar relationship was noted at Franchthi between 'Andesite Ware' and the presence of millstones made from Aeginetan andesite and it was proposed that the millstones were selected as a temper source by local Franchthi potters (Vitelli 1993a:208; see below). Such an explanation, cannot, however hold for Knossos, since in many cases study of the clays, which comprise phyllite-tempered fabrics, indicates that they are also contain phyllite fragments and thus cannot be immediately local (<5km) to Knossos. Thus, despite the potential availability of phyllite and other

¹²³ Similar conclusions have been independently reached in ethnographic studies by Day (1991; forthcoming) on East Cretan potters and Livingstone Smith on Faro potters in northern Cameroon (Livingstone Smith 2000:36-8): clay processing techniques could not be explained in terms of adaptation to performance-related and/or environmental constraints, rather it would seem that choice of clay preparation techniques was more a question of habit and specifically where a potter first learnt to process clay.

¹²⁴ For example, during ENI most stone axes at Knossos were made from either 'serpentine, greenstone or chlorite' (cf. Fabrics 10, 6 and 13 respectively), while phyllite of various types regularly occurs during the EN sequence, both as rock fragments and as large rounded worked lids or platforms (Warren 1968:239-40; Evans 1968:270).

rock types at Knossos in the form of finished artefacts, there is no evidence to suggest that local potters ever made use of such objects as sources for temper.

The work of Arnold and other ceramic ecologists has stressed the prime importance of the availability of *suitable* clay, temper and fuel sources, along with other environmental factors such as climate (e.g. Arnold 1985:20-98). These factors have at times been viewed as acting as constraints on the ceramic production. However, as the diversity of approaches to paste preparation identified at EN Knossos suggests, the Cretan environment presented a variety of options for raw material selection that varied in accordance with landscape location. The different fabrics represented at Knossos testify to the use of a wide range of rock tempers as well as grog and organics. All proved adequate to the task of making pottery, with many fabrics showing a consistent selection of the same or very similar raw materials for the entire duration of ENIa-b (up to c1000 years). ENI-II pastes are almost always¹²⁵ very coarse with large non-plastics, a general feature which suited the methods of forming and firing used. This sort of paste technology places few demands on the supposed suitability of local clays and tempers and in turn suggest that distribution of clay sources was not a constraint on production. In this way the requirements of EN potters seem to have been straightforward and fairly easily accommodated by whatever was available locally. Thus, when sites were first established or sources first selected, it is most unlikely that proximity to suitable clay sources was ever a factor in site choice; rather, *vice versa*, the exploitation of a particular raw material sources depended largely on their proximity to settlement.

Simple ceramic ecology therefore constitutes only the background to the question of raw material selection. Rather the evidence suggests that potters producing in a particular fabric consistently selected similar raw materials to those used by their predecessors. In this way the knowledge and techniques of clay-preparation, temper selection and paste production, once established may have become *doxa*, i.e. knowledge or values which are beyond dispute (see Chapter 2)¹²⁶. Such knowledge may have been passed on from generation to generation, with

¹²⁵ Exceptions to this are Fabrics 1b, 1e, 1f and 2c, which appear during ENIc-II.

¹²⁶ In her experimental work Vitelli has also noted that familiarity with the performance characteristics of a clay might also act to mediate against the adoption of new clay sources (Vitelli 1984:114-5). This may even encourage potters to frequently use materials which they know to be unsuitable (Day, forthcoming).

powerful constraints mediating against change. As a result the original ideas and motivation which lay behind the first selection of clay and raw materials may have become less important to subsequent producers as time went on, while the maintenance of knowledge and values which linked them with the past may have grown in importance¹²⁷. Indeed in view of the suggested connection between different fabrics and different ceramic-producing communities, it is worth considering the possibility that knowledge of raw material sources and paste preparation was maintained over generations, not passively as a simple reflection of 'tradition' (i.e. that is how things are done), but rather were actively maintained because an association with particular sources and perhaps particular locations in the landscape had become bound up with notions of individual and group identity (i.e. that is how we as a group of producers do things). For example such a situation would more easily explain the practice noted in Fabric 1d of occasionally adding small quantities of grog to an already tempered paste: the small amounts of grog perform no mechanical function, since the fabric is already tempered. Such a practice thus makes little sense in terms of functional optimisation and must therefore have had some other significance. In this way against a backdrop of raw material availability, the maintenance of traditional forms of knowledge and values as well as possibly group identity emerge as potentially the most significant factors in the selection of raw materials.

10.2.6 ENIc/ENII Technological Changes in Paste Preparation

During ENIc/ENII (strata V-IV), the majority of fabrics appear to continue without apparent change. This period, however, sees the gradual disappearance of coarser limestone tempered fabrics (Fabrics 1a, 1d) and the simultaneous appearance of finer crushed limestone fabric (Fabrics 1b, 1e, 1f, 2c) (see Plates 1-10). A close mineralogical relationship both in groundmass and non-plastics can be observed between these new finer fabrics and the previous coarser ones: thus Fabric 1b relates most closely to Fabric 1a, while Fabrics 1e and 1f relate to Fabric 1d and Fabric 2c relates to Fabric 2a. By ENII these finer fabrics dominate the ceramic

¹²⁷ cf. also similar conclusions to be found in ethnographic work by Day (1991; forthcoming) and Livingstone Smith (2000:23-31).

assemblage and it is probably these which Furness had in mind when she noted that during ENII 'large white grits' were less often visible in the break (1953:117). These changes in fabric texture and packing cannot be identified in other fabrics and would seem to be a feature peculiar to Fabrics 1a-i, 2a-e. The occurrence of essentially the same paste change in these fabrics constitutes yet another link between these groups.

10.3 Forming Methods

Unfortunately the fragmentary nature of EN ceramic material and the rarity with which some fabrics occur restricts detailed comparison of forming methods to the more frequently represented fabrics (i.e. Fabrics 1a, 1b, 1d, 1e, 1f, 1i, 2a, 2b, 5a, 6, 7, 8). A notable exception to this are the rare and clearly coil-built vessels in Fabric 24, whose coil joins are often not fully smoothed over on their interior surfaces. This technique is not found on vessels in other fabrics. For more frequently represented fabrics study of the location and orientation of primary and secondary fractures, particularly horizontal fractures, combined with petrographic examination, can be used to provide an identification of the forming methods used (see Chapter 5).

10.3.1 Coil-Building vs. 'Sequential Slab Construction'

A frequent feature of EN ceramics, particularly for larger vessels, is the occurrence of horizontal fractures. These usually occur at regular intervals down the profile of the vessel (cf. Plate 46-7). It is striking that if a vessel is carinated, horizontal fractures tend to occur at the point of carination. These fractures would seem to indicate the location of structurally weaker areas, which most likely result from the joining of two clay sections. In addition the occurrence of these horizontal fractures at regular intervals down the vessel profile suggests that such vessels were built up in stages.

When described in such terms this sequence of forming could recall that identified by Vandiver for early organic-tempered pottery from the Near East, which she termed "sequential slab construction" (Vandiver 1987; cf. 'ring-forming' in Rye 1981:67). This technique involved the "building of vessels by stacking slabs

on top of one another" (Vandiver 1987:18). Sequential slab construction has subsequently been suggested as the principle forming technique used for early pottery throughout Anatolia (Moore 1995:46). A similar technique, where pots were also built up in sections or slabs, has also been identified for EN (Greek) pottery from Sesklo (Wijnen 1993:322). However, such identifications are not without their problems. For example although 'sequential slab' has been thought to characterise all ceramic production in Neolithic Anatolia (Moore), more detailed studies of ceramics from particular regions, such as the Elmalı Plain (south-west Anatolia) or Ilipinar (north-west Anatolia) have instead argued that vessels were coil-built, often on pinch-pot bases (Eslick 1992:81ff.; Thissen 1993:297). Likewise in Greece, although Wijnen identifies 'sequential slab' at EN (Greek) Sesklo, coiling and pinching has been identified for EN Nea Nikomedeia and EN Franchthi (Yiouni 1996a:60-1; Vitelli 1993a). Moore has even suggested that identifications of coiling may be incorrect and that 'sequential slab construction' was much more widespread (Moore 1995:46-7).

And so, while it remains possible that different forming methods were practised at different sites, the existence of disagreements between studies of otherwise similar material assemblages (e.g. Moore and Eslick for Anatolia, Wijnen and Yiouni for northern Greece) indicates that there may also be issues of identification and interpretation to be addressed. Here the EN ceramic material from Knossos proves illustrative. As outlined above, preliminary observations of horizontal fracture lines suggest that vessels were built up in an irregular series of stages, as one might expect with 'sequential slab'. In the majority of cases little else can be added to this characterisation. However, macroscopic study allowed the identification of some sherds which preserve more information: for example a frequent feature of vessels with offset rims is the detachment of the offset rim from the body, which seems to indicate that the offset rim it was added as a coil ; in some horizontal fractures on body sherds it is clear that the join was originally between two curved elements, which had then been smoothed over; while on very rare occasions poorly-jointed coils are visible in the sherd break, indicating variously a coil-built base or a coil-built body (see Plates 47-8). Support for these observations is provided by a number of examples of coil-joints identified petrographically in

thin-section (see Plates 23-5). In this way, one can argue that although EN ceramic vessels might appear to have been constructed in stages, detailed macroscopic and microscopic examination suggests that wherever there is sufficient information to determine the forming method used, this is always consistent with the use of some sort of coiling technique. The only possible exceptions to this are the decorated 'trays' of ENI, which seem to be formed from a single pinched-out piece of clay, and the 'house-models' produced during ENIc and ENII, which may have been slab-built. This study therefore suggests that identifications of 'sequential slab' should rely not just on the observation of the construction of vessels in stages or sections, but should also actively demonstrate the *absence* of coil joins. Here it is worth contrasting the methodological rigour of Vandiver's original study (1987) (xeroradiography, microscopy and experimental replication) with later identifications of 'sequential slab construction', which rely solely on macroscopic observations (e.g. Wijnen 1993; Moore 1995).

Identification of coil-building, however, does not on its own account for the regular stages at which horizontal fracture lines occur along a vessel profile. Although such fractures may now be understood as indicating the location of the weakest coil joins, this does not explain why some coil joins should be weaker than others nor why these weaker joins should occur at regular intervals along a vessel profile. The most plausible explanation for this is that vessels were coil-built in stages: i.e. once several layers of coils had been joined, these were left to harden slightly so as to be better able to take the weight of the next series of coils without being distorted. Experimental attempts to replicate this method of construction of large diameter vessels¹²⁸ confirmed that once 3-5 layers of coils had been added such vessels began to sag noticeably: study of fracture lines and sherd breaks confirms this number of coils as an approximate optimum¹²⁹. It remains unclear whether each layer was added as a single coil or whether a much longer coil was used which was then wound round several times (cf. Blandino 1984:46).

¹²⁸ The existence of horizontal fractures is noticeably more common in larger vessels than in smaller ones. This may be because smaller vessels are much less likely to suffer from the problem of sagging and may have been built up more quickly.

¹²⁹ The tendency for large vessels to sag was also a problem for potters on the Greek mainland: Vitelli notes that in order to prevent sagging, some large 'coarse urf' vessels at EN Franchthi were formed in two halves which were later joined (Vitelli 1993a:183-4).

Experimental work also suggested that the amount of time allowed between different stages of coil-building could vary only within certain limits: too soon and the vessel would sag, too long and the join between new plastic clay and old leather-hard clay would be extremely weak with the added danger of cracking between the two sections due to different degrees of shrinkage. These observations serve to emphasise how coil-building is 'essentially rhythmical', involving a feel for both time and material (Blandino 1984: 49, 63): it is crucial that the potter knows the feel of the clay so as to know when to stop to allow the work to harden (Blandino 1984:54).

During experimentation with coil building it was noticed that while a coil was being created, either by rolling or pinching in the hand, it tended to pick up any additional material with which it might come into contact. This tendency might help explain the regular presence of small amounts of organic material in most fabrics; such organic material may have become accidentally incorporated into the coil as it was being rolled. If so this might suggest that pottery production took place in a location where loose organic material was also present.

10.3.2 Bases

Macroscopic study of fracture lines and sherd breaks in and around bases suggests the existence of two main forming methods, which seem to correlate with the two most frequent types of base. Rounded bases were created using coils coiled round in a spiral (see Plate 47); in this way large round-based vessels were created entirely by coil-building. Parallels may be drawn between this method of construction and basketry techniques, where a coil of reeds is twisted together and then a vessel is built from this coil by tying each coil on to the next (see Section 13.4.1). Rounded bases are never well preserved or easy to identify since they usually fracture close to the base of the vessel and look similar to body sherds. In contrast flat-bases are more distinctive, usually fracture at a higher point above the base and, moreover, show no evidence for coil-building. The characteristic higher

fracture for flat-bases and the absence of coil joins suggest that flat-based vessels began life as pinch-pots, which were subsequently built up with coils¹³⁰.

Attempts to replicate this method of forming strongly suggest that the construction of flat-based vessels, particularly large ones, was considerably helped by the use of a portable flat surface (see Plates 49-50), which helped keep the base flat and allowed the part-finished vessel to be easily moved around without putting stresses on the unfired vessel (see similar comments by Vitelli 1984:119). In the experiments a round flat wooden board was used, but other materials would equally suffice and it is tempting to connect this activity with the stone 'pot lids', which first appear in stratum VII (Evans 1964:231). Comparison of the diameters of these 'lids' with vessel rim and base diameters suggests that the majority of these could not have served as the lids for ceramic vessels, but could well have been stands of some sort.

10.3.3 Handles

Macroscopic study suggests that during ENIa-b strap handles are added flat against the wall of a vessel. Little attempt seems to have been made to 'key' either the surface of the vessel or the area of the handle to be attached prior to the application of the handle. A similarly weak attachment method was also used for wishbone handles. These handles consistently fracture in half at the tip of the handle as well as at each of the two joints with the vessel rim, which suggests that they were formed from two short coils of clay, joined at the tip of the handle that were then added to the rims of vessels together with the final rim coil.

10.3.4 Secondary Forming Techniques?

Large thick-walled vessels, once formed and roughly smoothed, are usually burnished and although this burnish is usually of high quality, the surface which is created usually remains uneven. In contrast, thinner walled vessels with polished surfaces usually have extremely smooth surfaces; indeed this distinction between coarse burnished and smooth polished effectively facilitates the clear macroscopic

¹³⁰ Thick-walled flat-bases are rare in EN (see Chapter 9) and suggest that most large thick-walled vessels were probably formed with coil-built bases, although the rare occurrence of some thick-walled flat-bases suggests that this need not always be the case.

separation of these two types of finish. It would appear, therefore that polished vessels were subject to a secondary forming technique, which served to create a very smooth surface prior to polishing. In general such secondary forming or finishing techniques are crucial to the final quality of the polished surface and experimental work suggests that they may required much more time than the actual initial construction of the vessel (Vitelli 1984:121). These secondary forming techniques probably to a large extent comprised techniques of smoothing, scraping and carving¹³¹, which served to create a very smooth vessel surface (cf. Vitelli 1984:120-1; Blandino 1984:57-9). Such a technique would have allowed vessels to be created which, although large in diameter, could have walls as thin as 5mm.

In one or two cases, however, petrographic examination has resulted in the identification of thin clay layers (0.2mm to 0.9mm) on the exterior surface of polished vessels (i.e. Fabrics 1b, 2a, 28). Such layers may result from the process of smoothing the vessel or alternatively may have been created through the application of a thin layer of clay to the vessel. In most cases the clay used appears to be compatible with the composition of the rest of the body, although sometimes with fewer large non-plastics. This added clay may have been more plastic than would be used for normal construction in order to facilitate the creation of a very smooth surface.

10.3.5 ENIc/ENII Technological Changes in Forming Methods

During ENIc/ENII a new method of coil joining can be identified in some fabrics (i.e. Fabrics 1b, 1d, 1e, 1f, 2a, 2b, 5a), while other fabrics show no change. In the new method each coil, once applied is then pinched up around the diameter of the vessel, prior to receiving the next coil (see Plates 49, 51). Experiments with coil joins showed that this considerably improves the success and overall strength of the join. From ENIc this method of coil-joining becomes standard amongst those fabrics which are consistently the most frequently represented at Knossos (i.e. Fabrics 1b, 1d, 1e, 2a, 2b, 5a). A similar type of coil join can be seen on a coil-built base from MN Sesklo (Papathanassopoulos 1996:245 no.75).

¹³¹ Techniques, such as carving, smoothing and polishing may be paralleled in the manufacture of wooden containers (see Chapter 13).

ENIc-II also sees the introduction of a new method of strap-handle attachment (e.g. Fabric 1b): some strap handles are now formed with a plug at their point of attachment to the vessel body and this plug is then located in a specially-created socket on the vessel (see Plate 51). It is striking that in both method and chronology the appearance of the technique of plug-attachment at Knossos closely parallels similar developments in handle attachment in the Elmalı Plain in south-west Anatolia (see Eslick 1992:78, 81). During LN-MC (Anatolia) vessels are coil-built with handles applied flat against the wall of the vessel (Eslick 1992:81). Eslick notes that plug-attachment first appears during the course of MC and becomes common during LC (1992:78; cf. Duru 1996:142-4). Anatolian MC/LC dates approximately to the end of the sixth and the first half of the fifth millennia BC making it broadly contemporary with Cretan ENIc/ENII (see Appendices I, IV). This parallel between Knossos and south-west Anatolia is made all the more striking because the development of plug-attachment in south-west Anatolia is closely associated with the appearance of a new handle form - the strap handle - which previously had been almost entirely confined to Crete (see Appendix I). These developments may therefore be a sign of some sort of connection between Crete and this region.

10.3.6 Knowledge, Skill and Learning

The forming methods, which characterise EN ceramic production, comprise a simple but very effective set of techniques, which could be used to create a variety of basic shapes. This effectiveness was most obvious during experimental attempts at pot construction using these techniques. Previous attempts at forming, owing perhaps to my general lack of practical experience in potting, had not led to any significant successes, however as soon as I began my own replication experiments, which sought to put into practice the main sequence of forming techniques identified for EN Knossos, I was immediately successful in producing some of the larger and more complex EN forms (e.g. large diameter thin-walled high carinated bowls with offset rim; see Plates 49-50). This success can, I think, be put down to having a clear idea of firstly which ceramic form I was constructing and secondly which sequence of techniques I should use.

These experiences have encouraged me to view EN forming methods as comprising a highly effective and practical set of techniques. It was suggested in Chapter 7 that most variation in form could be achieved through the manipulation of a restricted group of dimensions of variability (rim, base, handle, location of curve/carination, size). For example most bowl types are simple variations on the curved open bowl and such distinctions are easily created during coil forming through variations in the angle and orientation of coils added. In addition the distinction between bowl types with or without an offset rim is easily achieved through the addition of an offset rim using the final coil. And so, although openness and accessibility to technology, may be as much in the perception of 'ease' as in the practical ease with which a technology is learnt, one might nevertheless conclude that the basic EN forming technology had at least the potential to be easily and relatively quickly learnt through observation of and participation in vessel forming. In this respect it does not resemble the sort of technology of exclusion, where the knowledge and skills required for pottery production are deliberately complex so as to enforce and protect a distinction between potter and non-potter. Open access to knowledge and techniques is also implied by the close similarities in forming techniques (and forms) exhibited between fabrics, which are most likely to have been produced at Knossos (e.g. Fabrics 1a-i, 2a-e) and fabrics which were produced at some considerable distance (e.g. Fabric 12, Mirabello Bay, c.70km).

10.4 Finishing Methods

EN vessels, once formed, could be subjected to a variety of finishing methods (see Chapter 7). However, in most fabrics during EN1a-b vessels may be separated into two categories of surface finish, namely burnish and polish. Within these two basic coarse/fine categories of finish vessels could be subject to additional forms of decoration such as incised or plastic decoration. Burnishing and polishing are time-consuming activities, comprising probably the longest single stage during ceramic production (Vitelli 1995:59). Even the most coarsely burnished vessel probably required a long period of effort, with the finely smoothed and polished

vessels, found in almost every fabric represented at Knossos, requiring even greater amounts of time.

10.4.1 Burnished Vessels

This finish is most often reserved for large thick-walled vessels. These were usually roughly smoothed during construction and then burnished using a smooth hard material, such as a rounded pebble, bone or shell (see Plate 52), producing a dull slightly uneven burnished surface. Microscopic study (petrographic, SEM) of surface structure suggests that burnishing often resulted in a highly compacted surface. Interiors and exteriors could be finished in this way, but usually more care was taken with the exterior. In some fabrics, the exterior or interior might be scribble burnished (e.g. Fabrics 2b, 6, 8) or scraped (e.g. Fabrics 19, 35) (see Plate 53). The colour of these burnished surfaces varies from buff or red to dark brown or grey, depending on firing atmosphere and/or the degree to which fabrics are calcareous. Frequently colour may vary across a single surface.

Burnished vessels in Fabric 4 are particularly worthy of mention because microscopic analysis of their surfaces (petrographic, SEM) reveals that they have been covered with a calcareous slip prior to burnishing (see Chapters 6, 8; see Plate 54). This practice later (ENIc-II) also becomes a feature of Fabrics 1d and 1e. Compositional analysis of Fabric 4 indicates that this fabric is low to non-calcareous (see Chapter 8). In this way the addition of a calcareous slip to a non-calcareous body seems to have been a deliberate attempt to create a light-coloured surface. Certainly, without such a treatment burnished vessels in Fabric 4 would have tended to fire to a red or dark brown. The shape of these vessels is difficult to determine exactly owing to their fragmentary nature, however surviving diagnostic fragments suggest that these vessels were hole-mouth (straight-sided) jars with coil-built bases and strap handles (see Appendix VI). The reasons for the special surface treatment are far from clear. However it must be noted these vessels almost always show signs of burning on their *interior* along with traces of burnt residues, which suggest a possible use as indirect-heat cooking pots (see Section 13.3.1). As the deliberate use of slip would suggest, colour seems to have formed a particularly important part of this type vessel: there are fragments of vessels in other fabrics, which exhibit

similar traces of burning on their interior, and which are also grey burnished with coil-built rounded bases and strap handles (cf. Fabrics 6, 8, 12, 21).

10.4.2 Polished Vessels

This type of finish is most often found on smaller thinner-walled vessels, however occasionally large thick-walled vessels were also given this type of finish. As described above, such vessels appear to have been treated to a secondary forming stage, which involved careful preparation (smoothing) of the vessel surface prior to polishing. This smoothing stage probably involved scraping, carving and perhaps on rare occasions the addition of a thin layer of clay to the vessel surface. Indeed the very smoothness of the polish depends to a large extent on how well-formed and smoothed such vessels were prior to polishing. Macroscopic examination of surfaces under a hand lens (x10) identified very fine striations in the surfaces of some polished vessels, suggesting that polishing was achieved using a fine soft material, such as leather (cf. Vitelli 1984:122).

In her study of EN fine ware from Knossos Furness contends that "none of the sherds is slipped, although in some cases the effect of burnishing was to cover the vessel with a hard coating of a different colour, which sometimes flakes off and has the appearance of a slip" (1953:110). However, microscopic study (petrographic, SEM) has indicated that many vessels were slipped¹³². (see Plates 27, 39) Aside from vessels in Fabric 4, which are slipped and burnished, the use of slips is almost always confined to the production of polished vessels. In some fabrics high quality slips are used which comprise a fine *non-calcareous*, illite-rich surface layer have been applied over a *calcareous* body, while in others the surface comprises a slip probably made from the same clay as the body. A particularly unusual surface treatment is found in Fabric 28, where the surface is coated not with a non-calcareous slip, but with a clay of different composition.

In a number of cases the use of slips seems to represent a deliberate attempt to manipulate vessel colour. This is particularly striking in polished vessels in Fabrics 1a-i and 19, where a non-calcareous slip is applied over a highly calcareous

¹³² The use of slips is also attested on the earliest pottery from northern (Wijnen 1993) and southern Greece (Phelps 1975:74, 126).

body in order to ensure a dark polished surface with the final colour varying from red to black according to firing atmosphere (see Plate 31). Without this slip these vessels would fire buff to grey. Sometimes fine brushmarks are visible on the surface of vessels in Fabrics 1b, 1d and 1e (see below on Painting/Brushing). Other polished vessels in these fabrics which have light surfaces provide evidence for the use also of calcareous slip. In these fabrics the use of slips seems to be largely confined to polished vessels.

However, polished vessels need not always involve the use of slips: for example polished vessels in Fabrics 5a and 12, consistently exhibit a high quality finish (see Plates 32, 34) but show no evidence (macroscopic, petrographic, SEM) for the use of slips and it would seem that their smooth polished surfaces were created simply through careful surface preparation and polishing. In other fabrics, such as Fabric 8, slips (illitic) may be used on the surface of burnished and polished vessels alike (see Plate 39). In this way, although the general range of surface finishes appears small, with most vessels being burnished or polished, macroscopic and microscopic examination of surfaces reveals that these finishes were achieved in a variety of ways.

A variety of tools were probably used for burnishing and polishing, such as shells (Evans 1964:231; Shackleton 1968:264), pebbles (Evans 1964:231, 1968:271), wood, bone, leather and even sherds: re-examination of pottery disks first identified by Evans (stratum VII-IV; Evans 1964:235), along with the discovery of previously unidentified examples in contexts from strata V-IV indicates that a large number of the unpierced examples are worn in a way consistent with their use as burnishers. Both shells and pebbles seem to have been collected ready-worn, probably from a beach environment (Reese 1987:207). Worn shells and pebbles both appear from stratum VI (Evans 1964:231). Generally, there appears to have been a marked preference for dark blue polished pebbles (limestone?), particularly during ENIc/ENII (see Plate 52).

10.4.3 Plastic Decoration

This involves the application of plastic cordons or pellets of clay to the vessel body. In the case of barbotine decoration a clay layer was applied to an area

of the vessel surface, out of which the decoration could be modelled (e.g. Fabrics 1d, 1e, 5a). The most common forms of ENI plastic decoration are the U-shaped cordon or rounded pellets applied either in a row on or below the rim or singly on the body of vessels; both of these types are frequently found on large diameter deep burnished bowls or jars (e.g. Fabrics 1a, 1d, 1e, 2a/b, 5a-8, 15, 18). More unusual and sometimes unique forms of plastic decoration are found in Fabrics 5a, 10, 11, 23, 24, 26, 28, 30 and 34.

10.4.4 Scribble Burnish

This technique is basically a less complete form of burnishing, where the interior or exterior surface of a vessel is rubbed with a hard object, such as a pebble, leaving a scribble or criss-cross design (cf. Plate 53). During ENI this method was used most often on large vessels (bowls and jars), especially on the interior (cf. Fabrics 1d, 2a/b, 6, 8). During ENIc/ENII it becomes more common as a finish on large vessels in Fabrics 1e, 2a/b, 6, 8 and 12 as well as more rarely on finer vessels in Fabrics 1b and 1e.

10.4.5 Incised/Pointillé Decoration

This technique, usually confined to polished vessels, involves incision (pre-firing) of the vessel surface, normally in conjunction with very careful dotting or pointillé (e.g. Fabrics 1d, 2a/b, 2e, 5a, 6, 8, 11). Often a white paste is present in the incised design. However, as has also been noted in connection with the similarly decorated EN figurines from Knossos, it is not always clear whether this white-filling is always intentional, since it may equally have been produced through burial in the 'kouskouras' layers which are such a feature of the Knossos Neolithic deposit (Ucko 1968:310). Unfortunately, although analysis was conducted by Dr André Rosenfield at the Institute of Archaeology (London) both on the white-filled incision of a broken sherd and on the white 'kouskouras' material on the surface of another sherd, the results proved inconclusive (Ucko 1968:310 n.1): the white incrustation in the incision was found to be indistinguishable from the white matter on the surface of the pottery. Nevertheless, the rare occasions, in which red ochre filling is used, demonstrate that filling was added to accentuate this form of

decoration and it therefore remains likely that at least some of the white infilling is deliberate.

A variety of designs were employed during EN, although most frequently in ENI this took the form of incised triangles or linear shapes filled with dots (e.g. Fabrics 2a/b, 5a, 6, 11) or incised 'ladder' or 'lattice' patterns (e.g. Fabrics 2a/b, 5a). In ENII incised geometric patterns, such as chevron, lattice, ladder, slashed line, branch predominate (e.g. Fabrics 1d, 1e, 1f, 2a/b, 5a). More unusual or even unique forms of incised decoration (without pointillé) are found in Fabrics 27, 28 and 34¹³³.

Incised/pointillé decoration is restricted to relatively few forms. The majority of examples in Fabrics 2a/b and 5a (c.90% of incised decoration in ENI) are confined to flat-based mugs or dishes. Although undecorated examples of these forms exist, they are very much in the minority. It would seem therefore that there exists a close relationship here between form and finish, which hints at a special significance for this type of vessel (see Section 13.3.4). A similar situation seems to have also existed for the rare incised/pointillé 'trays' in Fabrics 2a/b and 6. Within other, less well-represented fabrics this form of decoration is similarly confined to unusual forms: for example, in Fabric 6 this is found on an unusual type of bowl, while in Fabric 11 it appears on pedestalled bowls/stands (see Appendix VII).

In addition to ceramic vessels, this type of decoration also occurs on 'shuttles'¹³⁴, figurines and a fragment of an unidentifiable clay model. In addition an unusual mace in a "uniform dark stone, much less heavy than that of other examples" has pointillé-type decoration (Evans 1964:231, fig. 52.13, pl. 55.4 no.6). With the exception of the mace, all these examples are ceramic. Where possible¹³⁵, the fabric of each of these was examined and the majority of instances in ENIa-b proved to be in Fabrics 1a, 1d and 2a/b, while during ENIc-II all examples were in Fabrics 1e and 1f.

¹³³ For detail of designs and their relationship to fabric see Appendix VII.

¹³⁴ NB Evans regards the only 'shuttle' fragment from an ENI level (stratum V) as being of dubious context (Evans 1964:233). However, in view of the close associations between ENIc (stratum V) and ENII (stratum IV), there seems little reason to disassociate this shuttle fragment from stratum V.

¹³⁵ Unfortunately, study access was not granted to the 35 figurines excavated by J.D. Evans between 1957-60, currently stored in the Herakleion Museum. Thus all technological comments regarding figurines are restricted to those examples, excavated between 1969-70, stored in the Stratigraphical Museum, Knossos.

While the meanings which lay behind this type of decoration are lost, significant patterning in its application does occur, which will be explored further in Section 13.3.4. Here, it suffices to say that incised/pointillé decoration on a number of figurines seem to represent actual forms of body decoration, such as tattooing. By this token, incised/pointillé decoration may be viewed in terms of the tattooing of a ceramic vessel. Certainly the technique of very careful regular application of incised lines and dots seen, for example, on flat-based vessels in Fabrics 2a/b and 5a would be consistent with actual tattooing. Furthermore, microscopic examination of incision/pointillé on vessels in Fabrics 2a/b and 5a suggests that they were incised using a fine pointed tool. The tip of this tool appears to be rounded, possibly through use, and was c.0.2-0.3mm in diameter. This would be consistent with a bone or wooden pin. Suitable bone pins occur in 'considerable numbers' throughout the Knossos sequence (Evans 1964:1964:236; plate 60.1, plate 61). It is perhaps worth noting that Hood drew a similar conclusion regarding the possible use of bone tools to produce the incised/pointillé decoration from Emporio (Hood 1981).

10.4.6 Grooved

This technique, closely related to incision, involves the use of a wide tool, which is sufficiently blunt to produce wide grooves rather than sharp incised lines. This form of decoration is confined to a single dark polished sherd in Fabric 14.

10.4.7 Punched

This technique involved the use of a narrow rectangular shaped tool to punch individual vertical or diagonal incisions, usually in a sequence running just below the rim or in one instance in combination to produce a V shape running around the carination of a large straight-sided hole-mouth jar. This very rare technique is confined to Fabrics 8 and 9 and is mostly restricted to ENIa, although a single example of punched decoration using a small V-shaped punch comes from ENII.

10.4.8 Wiped/Scored

With this technique the vessel surface was wiped or scored roughly with some sort of rough material leaving locally parallel striations. This technique is confined to Fabrics 1d, 2a/b, 5a and 8.

10.4.9 Combed

Here the surface of the vessel was scraped horizontally with some sort of fine-grooved tool, such as the surface of a shell, producing fine regular horizontal ridges. This very rare finish is only found on two sherds, both in Fabric 29.

10.4.10 Ripple Burnish

This involved the creation of a parallel series of wide vertical grooves, running around the rim or upper register of vessels, which had already been finely polished. The tool used was probably the same sort of rounded instrument, such as a beach pebble. Ripple burnishing begins in stratum VI (Fabrics 5a, 6, 8, 11) and is a relatively infrequent feature of ENIc and ENII (cf. Fabrics 1d, 1e, 1f, 5a, 6, 8, 10, 12).

10.4.11 Painted/Brushed Decoration

Painted vessels are extremely rare in the EN Knossos sequence and stratigraphically restricted to strata VII-IV (see Plate 55). Most examples occur in rare or unique fabrics (e.g. Fabrics 17, 25, 32, 34): a single example of bichrome (red and white painted on orange) comes from stratum VI (Fabric 32); a single example of dark-on-dark dribbled decoration is attested in stratum VI (Fabric 17); dark-on-dark diagonal lines decorate the rim of a vessel in Fabric 34 (stratum VII); dark-on-light painted crosshatching decorates the exterior of a heavily reduced vessel in Fabric 25. Finally a single dark-on-light painted sherd, in an unknown and unfortunately unsampled fabric comes from an ENII context.

In addition to these rare or unique examples, rare examples of red/dark brown-on-light painted sherds are also known in Fabrics 1d and 1e. These are mostly confined to stratum V, although isolated examples can be found in stratum VI and stratum IV. Although the material is fragmentary, designs appear to be simple and are usually confined to isolated brush-marks or dribbles of paint (98/98,

Fabric 1d). In one example (97/121, Fabric 1e) the interior surface of a bowl has divided into dark and light zones, while the exterior has been lightly brushed with a dark paint to create a smeary dark and light brushed finish. Only on sample 98/79 (Fabric 1e) can a more complex dark-on-light dotted design be identified. A related and more frequent type of painted decoration is a brushed finish, similar to that described above for the exterior of sample 97/121, where a white or buff exterior is lightly brushed with a dark firing (red to black) paint. This brushed finish seems to have been created using a fine brush, perhaps similar to that used to apply the calcareous and non-calcareous slips used on polished vessels in these fabrics (i.e. Fabrics 1d, 1e) (see Section 10.4.2). Further investigation of the nature of the paints or slips used, although important, was unfortunately beyond the limits of the current research programme. However it is likely that the dark paint/slip used for the examples of painting and brushing in Fabrics 1d and 1e was identical to that used to create the dark firing polished finish in Fabrics 1a-i (see Section 10.4.2).

10.4.12 ENIc/ENII Technological Changes in Finishing Methods

During ENIc-II most fabrics see no obvious change in methods of finishing. However in Fabrics 1a-i there is a significant increase in the range of finishing methods identifiable. During ENIa-b vessels were either burnished or polished with some also receiving incised or plastic decoration. ENIc-II sees the maintenance of these techniques of finishing alongside a new range of finishes not previously found in Fabrics 1a-i: red scribble-burnished, brushed, painted, ripple burnished, white slipped/burnished. In addition there is significant increase in the occurrence of incision and in the range of motifs rendered (see Chapter 7; Appendix VII; Washburn 1983). On the basis of Washburn's original study, Broodbank has argued that the "transition from ENI-II is marked by an almost complete discontinuity in designs, a major widening of the repertoire, and a commensurate increase in the number of 'symmetry structures' determining how designs are multiplied to generate patterning on the vessel" (Broodbank 1992:55; Washburn 1983:146 fig.9.5). Whitelaw has noted that "ENI saw a broadly balanced distribution of decoration amongst plastic (27%), pointillé (30%) and incised (43%) options, and ENII saw a massive contraction onto incised wares (86%)" (Whitelaw 1992:230).

In general these new techniques of finishing seem to represent more efficient (time and labour) ways of finishing a vessel. For example the increase in 'symmetry structures' means that incised designs can be reproduced across a vessel more quickly. In addition, the more labour-intensive method of incised/pointillé decoration declines in favour of simple incision (cf. Whitelaw 1992:230). Likewise the increase in scribble burnish and the introduction of white slipping and dribble painted and brushed decoration would also seem to represent less labour-intensive methods of giving a vessel a distinctive finish.

10.5 Firing Methods

10.5.1 Previous Studies

Previous studies of Neolithic firing methods have not made use of microscopic analysis (petrology, SEM), but have instead been confined to macroscopic observation of firing effects. For example, firing circles have been identified on the exterior of Urf round-bottomed vessels from EN Franchthi, which closely resembled firing circles re-produced by 'stacking' vessels during experimental firings (Vitelli 1993a:150, 199). Although, this suggests the existence of multiple-vessel firings during the Greek EN, it does not demonstrate that firing was necessarily fast or in an open environment. The only previous discussion of EN firing practices at Knossos is relatively brief and impressionistic (Furness 1953:103). On the basis of macroscopic observation Furness suggested that:

- the majority of EN sherds from Knossos were competently fired, but at relatively low temperatures;
- sometimes firing atmosphere varied across the same surface;
- sometimes there were differences in oxidation and reduction between the interior and exterior of vessels, with grading visible in the sherd break;
- sometimes both surfaces remained light with a dark core - the so-called 'sandwich effect'.

Furness' observations, namely, the low temperature of the firing and the presence of a mixed oxidising-reducing atmosphere, particularly across a single ceramic surface, provide some hints about firing environment. However these inferences remain unsubstantiated. In addition, Furness' observations of variation in firing atmosphere hints at greater variety in firing behaviour. Since Furness considered all EN vessels to be the result of a single production technology, one must presume that she felt this heterogeneity to be explicable in terms of the variability in temperature and atmosphere present in a bonfire firing and/or in a sort of randomness in practice to be expected at such an early stage in ceramic 'evolution'.

10.5.2 Direct Evidence of Firing Environment?

No direct and unequivocal evidence for the environment in which EN vessels were fired was ever identified during any excavation of Neolithic Knossos¹³⁶. There does exist, however, plentiful evidence for pyrotechnology in general: most common are ash-filled hollows (stratum X onwards), occasionally stone-lined, which, to judge by their association with animal bone and their location in house floors, were probably used for cooking (Evans 1964:140, 153, 155). In addition to these, in stratum VIII the bases of two clay structures, possibly ovens, were found in the centre of house D (Evans 1964:136, 148, fig. 10, pl. 31.1). All of these fire-installations are small: the majority of the ash-filled hollows are no larger than 0.25-0.5m in diameter, with the largest example coming from stratum X measuring 1.2m, while the 'ovens' vary in size from 0.5 to 1.0m. Since most ceramic vessels are large in diameter (0.2-0.6m diam.), the small size of these features strongly suggests that they were not used for the firing of pots.

10.5.3 Exploring Variation in Firing

Macroscopic and microscopic examination, both petrographic and SEM, has allowed EN firing technologies to be investigated in more detail. Broadly speaking the picture of heterogeneity suggested by various macroscopic studies has

¹³⁶ Nor, perhaps, should one expect to find such evidence. As Vitelli has argued, if the firing environment was open (e.g. bonfire), it unlikely that it would leave any permanent trace of its existence (1993a:207-8).

been confirmed. Judging by their softness in hand-specimen, some vessels appear to have been low-fired, although none were so low-fired as to disintegrate during contact with water during cleaning. Other vessels appear to have been so highly fired and so severely reduced that they have become slightly distorted (e.g. 98/55, Fabric 8)¹³⁷. Examination of fabrics in thin-section suggests that both temperature and atmosphere varied within fabric groups: where sufficient samples permit comparison it is possible to identify a range in the degree of optical activity of the clay micromass as well as range in colour from light to dark.

In general macroscopic study produced no clear correlations between fabric and firing effects (e.g. surface colour, hardness etc.). Perhaps the only exception to this is the relatively rare occurrence in sherd breaks of the so-called 'sandwich effect', where a dark core is sandwiched between a lighter outer layer. This phenomenon seems to be a particular feature of a number of rare or unique fabrics (i.e. Fabrics 28, 31, 33, 34). It is possible that this feature may arise from the employment of a set of firing practices which differs from those used to fire the majority of vessels at EN Knossos, which lack evidence for a 'sandwich effect'. Petrographic study of Fabrics 28, 31, 33 and 34 indicate a general absence of organic material, which may suggest that the 'sandwich effect' here is the result not of an incomplete combustion of organic matter but rather of a late and probably short-lived oxidation stage during firing. The general rarity with which this sort of firing horizon occurs in more frequently-occurring fabrics may suggest that its frequent occurrence in these rarer fabrics is significant. In this context it is perhaps worth noting that a similar type of sandwich effect is a frequent feature of broadly contemporary (LN-EC/MC Anatolia) ceramic assemblages in south-west and western Anatolia (see Chapter 7; Appendices I, IV; French 1965:18; Meriç 1993:146; Eslick 1980:8-9; 1992:81).

¹³⁷ Previously, the presence of over-fired vessels in Neolithic assemblages has been used as an indicator of local provenance because it has been assumed that such vessels were unlikely to have been deemed worthy of exchange (e.g. Vitelli 1993a:150, 208). However, as sample 98/55 and others demonstrate, over-fired vessels in non-local fabrics, despite their apparent faults, were nevertheless probably exchanged and put to a similar pattern of usage as other vessels. Such instances should serve to caution us against the transposition of modern value judgements into ancient contexts, where notions of value may have been quite different.

Examination of vitrification structures in selected samples under an SEM allows a more accurate characterisation of firing behaviour including an estimation of maximum firing temperature. Figure 8.1 depicts the maximum estimated firing temperature range per sample. This graph confirms the general impression gained from macroscopic examination and petrology, that EN vessels were fired to a variety of temperatures. Interestingly (*contra* Furness) not all vessels were low-fired with some indicating temperatures exceeding 1000°C. When this firing behaviour is broken down by fabric, it would appear that there is no clear correlation between firing range and fabric (see Chapter 8). This is perhaps not so surprising since within a bonfire (or for that matter a kiln), the temperature may vary considerably over both space and time (see Figure 5.2; Gosselain 1992).

10.5.4 Characterising the Firing Environment

As previously argued (see Section 5.3.5) inferences of firing method and firing environment can proceed from a detailed understanding of the main variables which govern the effects of firing on a clay vessel, namely temperature, physical/chemical properties of the clay, firing atmosphere and time.

10.5.4.1 Calcite Alteration

Several samples, which contain large calcareous (limestone) inclusions (i.e. Fabrics 1d, 1e, 2a/b, 7, 21), when examined in thin-section proved to contain evidence for secondary calcite alteration largely in the form of micritic clots, which exhibit only a relict primary grain texture (see Chapters 6, 8; cf. Plates 19-20). Under normal (kiln) firing conditions (mixed oxidising/reducing atmosphere, slow heating rate, long soaking time), limestone begins to decompose at temperatures exceeding c.800/850°C in a process, which unless arrested or ameliorated will ultimately result in the structural failure of the vessel.

All samples, which exhibit secondary calcite alteration in thin-section, proved upon SEM examination to have been fired beyond c.800/850°C. This inevitably prompts the question of why these vessels show no signs of failure, since if they had been fired under normal (kiln) conditions they should have disintegrated. Since there was no evidence for the addition of salt (see Chapter 8) nor, in these

examples, for the use of lower firing temperatures, the possibility remains that reducing atmosphere and/or a shorter firing time acted to prevent limestone decomposition. Since a reducing atmosphere only delays limestone decomposition for about 50°C, the survival of limestone in those samples fired beyond c.900°C (i.e. samples of Fabrics 1d, 1e, 7, 21) would seem to indicate that firing was fast (see Chapter 8). Additional support for fast-firing is provided by the observation that the majority of the altered calcite visible in thin-section (e.g. Fabrics 1d, 1e, 2a-e, 7, 21) still exhibits a relict primary grain texture, which would seem to suggest that the firing conditions under which calcite alteration took place did not persist long enough for complete alteration to take place.

10.5.4.2 Non-Homogenous Firing and Localised Reduction

For a small group of samples, representing Fabrics 1d, 1e, 5a, 6, 8 and 30, study (SEM) and comparison of clay microstructure in different areas of a sherd break indicated that the microstructure was not homogeneously fired throughout the sample. This was perhaps most severe in sample 97/121 (Fabric 1e), where an initially vitrified exterior (c.800°C) grades into a fully vitrified interior (c.1050°C) (see Plates 35-7). Other samples exhibit a vitrification gradient between centre and edges (e.g. 97/1, 97/9, 97/21, 97/84, 98/90). This seems to correspond to the presence of severe localised reduction in the centre (grey core; fine bloating pores (SEM)) and oxidised or mixed oxidised/reduced edges (cf. the 'sandwich effect'). This gradient in vitrification effectively means that there was an uneven distribution of heat within the ceramic body and/or a very localised reducing atmosphere. Such an uneven distribution is most likely to occur consistently when firing is fast and/or the firing environment unpredictable (atmosphere, temperature range). In the case of sample 97/121 (Fabric 1e) the most likely explanation for the steep vitrification gradient between exterior and interior is that during firing the interior of the vessel (deep bowl) was in contact with the fuel. This would therefore suggest that firing took place in an open environment, such as a bonfire.

10.5.4.3 Conclusions

It would seem that under certain circumstances it is possible to infer firing practices from firing effects. The above discussions of calcite alteration and non-homogenous firing both suggest that firing was fast (at least for those samples discussed). It has been suggested that there exists an inverse relationship between speed of heating and the separation of vessel and fuel (Gosselain 1992:246): a fast heating-rate is therefore a general indication that vessels were fired in contact with fuel, that is in an open firing environment. In this way the identification of a fast heating rate may also imply firing in an open environment and *vice versa*. If so, then it would appear that some, if not all, vessels in Fabrics 1d, 1e, 2a-e, 5a, 6, 7, 8, 21, 30 were fast fired in an open environment. The nature of the firing environment for the remaining fabrics unfortunately cannot be determined with the same confidence. However, it should be stressed that these remaining fabrics exhibit no obvious differences from those samples, for which firing environment is more certain. Moreover, an important feature common to almost all fabrics studied is the consistent presence in thin-section of burnt, partially burnt and even unburnt organic material. The survival of sometimes large amounts of organic material would certainly be consistent with an environment where the heating rate was too quick and/or the soaking time too short to ensure complete combustion of organic matter.

The stresses which fast-firing place on the ceramic body are high. If the heating-rate is very quick and the vessel a little damp then rapid shrinkage and thermal stress are likely to cause a failure in the ceramic body. As a result of these stresses vessels fired in open firings usually suffer from a higher breakage rate than vessels which have been kiln-fired (cf. P. Arnold 1991:56, kiln c.21%, open c.31.5%). Much of this stress may be alleviated by use of the type of coarse fabric that is such a consistent feature of EN ceramics. The frequent presence of large non-plastics produces a body which dries more quickly and which has a low rate of thermal expansion. In addition to this, and largely as a result of the forming methods used, voids are fairly frequent and often large and these contribute to the general resistance (toughness) of these fabrics to thermal stress (Kilikoglou et al. 1998).

10.5.5 Possible ENIc/ENII Technological Changes in Firing Methods?

During ENIc-ENII there are hints of possible changes in firing methods for vessels produced in Fabrics 1b and 1e. Macroscopically this can be seen in the consistent production for the first time of buff burnished and buff polished and dark polished wares which exhibit little or no variation in colour across their surfaces (cf. also similar comments of Furness (1953:117) and Manteli (1993a:61)). At the same time there is a disappearance in these fabrics of heavily vitrified (over-fired) vessels. These features may indicate that there was now greater control over firing atmosphere. Unfortunately, however, further investigation of this possibility would require the analysis (SEM) of more samples of these fabrics and must therefore await further study.

Manteli has argued that "in LN, right from stratum II (LNI Knossos) onwards, the effects of firing improvements are strongly felt. Firing is hard and regular, is done at a higher temperature and in better controlled firing conditions than before and produces a brick red core right through and more uniform surface colouring" (Manteli 1993a:61). Although she preferred to see these improvements in firing as occurring within an existing pit-firing technology, the recent discovery at Knossos (near the South House) of a kiln in association with LN levels (Tomlinson 1994-5:61) would seem to indicate that by this period at least some ceramic vessels were being kiln-fired.

Conclusions

All previous studies of EN ceramics at Knossos have consistently emphasised their stylistic homogeneity (Mackenzie 1903:158-9; Furness 1953:95; Evans 1964:194; Manteli 1993:42; Evans 1994:8). This has encouraged an interpretation of EN ceramic technology, which views it as equally homogenous (single fabric, single source): all previous studies have viewed ceramic production as being almost entirely local to the site, with little or no evidence for imports (Evans 1968:273-6; Vagnetti & Belli 1978:126; Broodbank 1992:47-9; Vagnetti 1996:30; Manteli 1996:132). None of these previous studies went further to investigate technological and mineralogical homogeneity in a systematic fashion.

However, as the results of these new analyses have shown, such a characterisation can no longer be supported. Combined macroscopic and

microscopic (petrology, SEM) study of fabric, form, finish and firing has demonstrated the presence at EN Knossos of not one ceramic technology but many. Consideration of fabric reflects a wide variety of approaches to paste preparation: different fabrics evidence the use of single or multiple clay sources (clay mixing), which vary from calcareous to non-calcareous. Choice of temper shows a similar variety: in addition to a variety of crushed rock tempers, there are also examples of the use of grog, sand and vegetal temper. It should be stressed that such a variety in fabric is quite normal for a Neolithic site: all sites, whose ceramic assemblages have been subject to fabric studies have indicated a similar diversity in fabric (see Chapter 2).

What is perhaps more significant, however, is that this diversity in fabric *cannot* be explained purely in terms of production local to Knossos. Study of the mineralogy of different fabrics indicates the exploitation of a wide variety of raw material sources. While the most frequently occurring fabrics are also those, which are most compatible with a local provenance (marls, limestone; i.e. Fabrics 1a-i, 2a-e), there are others whose nearest possible sources lie within north-central Crete but beyond the local (<c.5km) area of Knossos. These fabrics are dominated by rocks such as calcimudstone and schist/phyllite (Fabric 5a), altered igneous rocks (Fabric 6), phyllite (e.g. Fabric 8) or serpentinite (Fabric 10). Still others must have origins at some considerable distance from Knossos although these occur much more infrequently: for example Fabric 12 (granodiorite) has a likely source in the Mirabello Bay area and also closely matches Neolithic comparanda from that area (Kavousi). Perhaps most significantly, a small number of fabrics, such as Fabric 31 (biotite mica) or Fabric 35 (blueschist) are most likely to originate from off the island.

It has been concluded from this that such diversity in the source of the raw materials of ceramic production must in many cases reflect a diversity in production locations. Comparative ethnography indicates that there exists a close link between the resident location of groups of potters and the raw materials which they use for pottery production. In this way, diversity in raw material sources or diversity in production locations is therefore likely to mean the existence of different EN settlements located within and beyond Crete. Such a conclusion has a number of

significant wider consequences. Firstly, it would imply that intensive/extensive surveys have consistently failed to detect early (Aceramic - EN) settlement on Crete, as well as possibly in other parts of the southern Aegean. Secondly and regarding early ceramics within the Aegean in general, it would suggest the possibility that previous identifications of fabric diversity with Neolithic ceramic assemblages may have seriously underestimated the nature, dynamics and complexity of ceramic production and consumption, the importance of ceramics as exchange items and even the extent of exchange itself.

Although the apparent range of EN surface treatments was narrow, microscopic examination of vessel surfaces reveals that such finishes were achieved in a variety of ways. This variability in some instances corresponds to fabric groupings: for example polished vessels in Fabrics 5a and 12 were not slipped, while those in Fabrics 1a-i were. In this way, by measuring variation in finish and finishing methods against fabric one can discover more subtle differences, which would also seem to have some meaning in terms of provenance.

In contrast to the subtle differences in techniques of finishing between fabrics, study of forming methods suggested that vessels produced in different fabrics were generally formed in the same way. Vessels were mostly coil-built, probably in stages, although flat-based vessels probably began as pinch-pots which were then built up with coils. However, it should be stressed that the results of the studies of finishing and forming methods cannot be directly compared, since it was not possible to reconstruct the sequence of forming methods used for each vessel with the same level of resolution. In most cases finishing methods had removed all direct evidence for forming and even when limited evidence could be found this required the study of a large sample of sherds. This inevitably confined the study to only the most frequently occurring fabrics. Thus, although it would seem that the same basic forming sequence was used for all the most frequently occurring fabrics, it is not possible to be certain whether there were also more subtle differences in gesture or technique. Moreover, the degree to which the rarer fabrics differ from this basic sequence remains unclear: certainly in one or two cases (e.g. Fabric 24) one could argue for more obvious differences in technique.

The same could also be said of the evidence for firing methods. Study of clay microstructure (SEM) suggests that there exists a great variety of firing temperatures within and between fabrics from those clay bodies that are not vitrified (<750-800°C) to others which have an estimated firing temperature of over 1000°C. By combining petrographic and SEM data it proved possible to make inferences regarding the likely firing environment. In a number of cases study of secondary calcite alteration or non-homogeneity in firing both led to the conclusion that firing was likely to have been fast with contact between vessel and fuel. This would indicate firing in an open environment, such as a bonfire or pit. Unfortunately however, as with forming methods, the resolution at which one can reconstruct the sequence of actions which went into firing a vessel cannot match the clarity with which one can identify subtly different surface treatments. Thus the degree to which the firing methods may have differed subtly or markedly between fabrics cannot be assessed.

During ENIc/ENII (strata V-IV), the majority of fabrics appear to continue largely without any apparent changes in ceramic technology. However, in Fabrics 1a-i and 2a-e, whose origin is likely to lie within the local area of Knossos, a series of parallel technological changes take place:

Paste Preparation: ENIc-II sees the gradual disappearance of coarser limestone tempered fabrics (i.e. Fabrics 1a, 1d) and the simultaneous appearance of finer crushed limestone fabric (i.e. Fabrics 1b, 1e, 1f, 2c). By the end of ENII these finer fabrics dominate the ceramic assemblage.

Forming Methods: during ENIc/ENII a new method of coil joining can be identified in Fabrics 1b, 1d, 1e, 1f, 2a and 2b (cf. also Fabric 5a). Each coil is now pinched up around the diameter of the vessel, prior to the addition of the next coil. This period also sees the introduction of a new method of strap-handle attachment (e.g. Fabric 1b), where the join between strap handle and body is strengthened by the use of a plug and socket. This approximately parallels the introduction of plug-attached strap handles in south-west Anatolia.

Finishing Methods: during ENIc-II there is a significant increase in the range of finishing methods identifiable in Fabrics 1a-i. New methods appearing at this

time in these fabrics are red scribble-burnished, brushed, painted, ripple burnished and white slipped/burnished. This period also sees a significant increase in the occurrence of incision and in the range of motifs rendered, with a concomitant decrease in the popularity of incised/pointillé. A striking feature of the new surface finishes introduced at this time is the speed and ease with which they can be used to finish a vessel and as such represent a gain in efficiency over previous ENIa-b more labour intensive finishing methods, such as polishing or incised/pointillé.

Firing Methods (?): during ENIc-ENII there are unconfirmed hints of possible changes in firing methods for vessels produced in Fabrics 1a-i. Macroscopically this can be seen in the consistent production for the first time of buff burnished and buff polished and dark polished wares which exhibit little or no variation in colour across their surfaces (Furness 1953:117; Manteli 1993a:61). At the same time there is a disappearance in these fabrics of over-fired vessels. These features may indicate that there was now greater control over firing atmosphere, although this would require further investigation using SEM.

When viewed in isolation the reason for these changes remains unclear. Certainly most, if not all, could be viewed as representing improvements or gains in efficiency (time, labour) over the pre-existing ENIa-b ceramic technology. However, it should be stressed that the need for such improvement is *not* self-evident, nor is progress sufficient explanation in itself: existing ENIa-b ceramic technology had proved adequate for many generations of previous potters, why should these innovations occur now? Furthermore the simple argument of self-evidential 'progress' does not explain why in many cases (e.g. Fabrics 1d, 2a/b) the ENIa-b ceramic technology continues to be employed alongside the new technology. Combined macroscopic and microscopic study indicates that these technological changes are largely restricted to the finer fabrics introduced during ENIc (i.e. Fabrics 1b, 1e, 1f, 2c). Although in one case (i.e. Fabric 1b) one of these finer fabrics completely replaces an earlier coarser version (Fabric 1a), in other instances the coarser versions continue to be made during ENIc-II. In future chapters, these technological changes

will be considered in the light of evidence for developments in other areas (exchange, consumption, architecture) during this period (see Chapters 11-13).

CHAPTER ELEVEN

THE ORGANISATION OF EARLY CERAMIC PRODUCTION

11.1 Ceramic Variation and its Interpretation

11.1.1 Previous Studies of Neolithic Ceramics

Under the model most consistently applied to Neolithic pottery production, the household is viewed as the principal organisational unit of production (see Section 2.3). Pottery production takes place in individual households, which although largely independent, nevertheless together comprise some sort of wider association (i.e. a community). Household ceramic production is understood to be largely geared towards supplying the needs of the household, although ceramic vessels may have circulated at a local level between households. Some finer vessels may have been exchanged beyond the community, however these are likely to have amounted to a tiny fraction of overall production output.

As a result of the influence of this model, most ceramic studies have explained observable variation in fabric, form and finish purely in terms of local production by one or more groups of potters: For example, the five main recurring fabrics¹³⁸ at Franchthi are considered to reflect local production by five different households (see Section 2.3.1; Vitelli 1993a:208, 207-10). Unfortunately, such an apparently straightforward interpretation of ceramic variation is not easy to substantiate with much depending on the *demonstration* that each fabric was locally produced (TLP). In reality the evidence in favour of TLP is never so incontrovertible, yet somehow it is always the TLP interpretation that receives prominence. For example, in the Franchthi publication the evidence in favour of TLP is described cautiously in terms of its possibility or probability (see Vitelli

¹³⁸ These different fabrics were found to correlate with different techniques of forming and finishing, which prompted Vitelli to conclude that each fabric corresponded to a different tradition of production or in other words that there were different potters working within different traditions (Vitelli 1995:60). Such an interpretation conveniently matches an outcome predicted by the conventional model of Neolithic ceramic production organisation: i.e. a number of local production units (households), which show distinctive differences (independence) and which together account for almost all the ceramic vessels consumed at the site (minimal exchange of ceramic vessels between different settlements).

1993a:208). However, in later articles Vitelli allows herself to be more categorical: for example,

"All the wares [i.e. fabrics], with the possible exception of one, were made from local materials" (1995:60).

In view of these later categorical statements as well as their uncritical incorporation into recent general discussions of Greek Early Neolithic ceramic production (e.g. Demoule & Perlès 1993:377-82; Kalogirou 1997:12-13; but cf. Day 1995a), it is worth re-examining the arguments in favour of TLP at Franchthi in more detail¹³⁹.

In her discussions of provenance Vitelli often relies on a combination of indirect evidence and (modern) assumptions regarding ancient attitudes to distance and mobility (e.g. Vitelli 1989:19) manifest, for example, in a reluctance to countenance the transport of large vessels over long distances (Vitelli 1993a:209). This may be illustrated with reference to her discussion of 'Andesite ware', a fabric which occurs regularly at Franchthi but in such low frequencies as to suggest 'at first glance' non-local production (Vitelli 1993a:208). The possibility of non-local production would seem to further increase since petrographic study of a sample of this fabric identified the island of Aegina¹⁴⁰ as the source of this andesite (Vitelli 1993a:111). Vitelli, however, does not seriously consider the possibility of production elsewhere (Aegina?), but prefers to argue that local potters at Franchthi were crushing up millstones of Aeginetan andesite. Such an interpretation, however, fails to take account of the absence of any andesite flakes from Franchthi, which might indicate primary or secondary working of andesite (Perlès 1992:130). It is clear that the onus of proof in this case lies with anyone seeking to identify such vessels or fabrics as non-local. In this way the full weight of the prevailing model acts as a conceptual boundary

¹³⁹ It should be stressed that the prominence devoted here to the work of Vitelli is simply because hers is by far the most detailed and honest discussion of early Aegean ceramic production. Issues of provenance feature as strongly in other more prosaic discussions (e.g. Jones 1986; Yiouni 1995; 1996a; see Chapter 2).

¹⁴⁰ If it was produced on Aegina, this would be the earliest indication of settlement on this island. In view of its proximity to the mainland, EN settlement is by no means unlikely (see Broodbank 1999).

undermining the legitimacy of alternative interpretations (see Section 2.3.1), even in cases, such as 'Andesite Ware', where a more balanced assessment would suggest a non-local provenance¹⁴¹.

Issues of provenance and interpretation can also be raised concerning 'Lime ware', which is consistently the most frequent fabric at Franchthi. Vitelli notes that "visually similar Lime ware occurs at other roughly contemporary southern Greek sites, including Lerna, Nemea and Corinth" and later that "the raw materials are certainly available in the vicinity of Lerna, and, indeed, almost everywhere in southern Greece" (Vitelli 1993a:208). Vitelli then goes on to acknowledge the possibility that a tradition of making ceramics from calcareous clays and some form of limestone was shared between several sites in the vicinity of Franchthi. In this way, the 'Lime Ware' at Franchthi although macroscopically similar, may have had different sources. Possible support for this is provided by the results of the analysis of selected samples of 'Lime Ware' (OES, petrology), which identified the presence of "visually different, but chemically similar forms of calcium carbonate" (Vitelli 1993a:208). This could suggest that there was some diversity of fabric within the broad macroscopic category of 'Lime Ware'. However, despite this possible evidence in favour of significant variation within the category of 'Lime Ware', Vitelli chose instead to emphasise with some finality, although without further supporting evidence, that it was "likely that most, if not all, Lime ware... was produced *within a few kilometres* of the site" (Vitelli 1993a:208 *my italics*).

It is ironic that if the macroscopic and microscopic methods of analysis and characterisation used on the Franchthi material had been combined more successfully, then they could have offered a means of actually testing the validity of local and non-local hypotheses (see Chapter 5)¹⁴². Petrological analysis facilitates study not just of large non-plastics, but also of the relationship between those non-plastics (often temper) and the clay which hosts them. Thus, if potters were acquiring local or non-local rock tempers and adding them to local clays, as

¹⁴¹ Similar arguments may also be proposed against local production of 'White Ware' (see Section 7.6.4 for provenance work conducted on 'White Ware').

¹⁴² Unfortunately Vitelli experienced problems in combining macroscopic and microscopic methods of analysis, prompting her ultimately to reject them (see Chapter 5).

Vitelli suggests for 'Andesite Ware', then this would be clear in thin section: clay would be compatible with a local provenance and would most likely not have a close mineralogical relationship with the rock temper, unless perhaps by accident. Likewise petrology should be able to identify whether production was more likely to be occurring at other locations in different parts of the landscape, the products of which arrived at Franchthi through exchange: clay would be more likely to be incompatible with a local provenance and would most probably relate more closely in terms of mineralogy to temper. Further exploration of the issue of fabric diversity and provenance is impossible in the context of EN (Greek) Franchthi; although it should be stressed that a careful reading of the published data would suggest that the issue of provenance currently remains unresolved.

11.1.2 The Interpretation of Ceramic Variation at Early Neolithic Knossos

A comparison of the main features of ceramic variation at EN (Greek) Franchthi and EN Knossos reveals a number of striking parallels, which suggest the possibility of direct comparison between these two assemblages (see Figure 11.1).

EN Franchthi	EN Knossos
fabrics consistently reproduced over long periods (c.700-1000 years ¹⁴³)	most fabrics consistently reproduced over long periods (e.g. c.1000 years)
rare fabrics which testify to the exploitation of non-local raw materials e.g. Andesite Ware	rare fabrics which testify to the exploitation of non-local raw materials e.g. Fabric 12, Fabric 35
vessels in each fabric share similar shapes and sizes	vessels in each fabric share similar shapes and sizes
different forming techniques per fabric	some fabrics share forming techniques, others are unique
different finishing techniques per fabric	some fabrics share finishing techniques, others are unique

Figure 11.1 Key Features of Early Ceramic Technologies at Franchthi and Knossos.

Similar parallels, however, cannot be found in the way this variation is interpreted. Detailed petrographic study of the different fabrics represented at Knossos suggests that the relationship between fabric and provenance is far from as straightforward as has been argued for Franchthi (see Chapters 6, 7, 10; Appendix V). The situation at Knossos may be summarised as follows:

- (1) Some fabrics clearly testify to the exploitation of raw material sources, which cannot be local to Knossos (<5km). Some of these can be shown to lie at some considerable distance in Crete (e.g. Fabric 12, Mirabello Bay, c.70km) or beyond the island (e.g. Fabrics 31, 35); all are either unique or occur at Knossos in extremely small quantities (<0.15%). These are considered to be of non-local provenance.
- (2) Other fabrics, similarly testify to the exploitation of raw material sources, which cannot be immediately local to Knossos (<5km), but which are nevertheless likely to originate within the general area of north-central Crete. Some of these occur in very small quantities (<1%), although Fabrics 5a, 6 and 8 consistently occur more frequently (c.10-20%). These fabrics are also considered to be not immediately local to Knossos.

¹⁴³ Vitelli notes that C14 dates for the EN period at Franchthi range from 6680 - 5640BC (Vitelli 1995:60). However Demoule & Perlès prefer a period of c.700 years for the EN period in Greece (1993:366).

- (3) A smaller and closely inter-related group of fabrics are compatible with a provenance in an area immediately local to Knossos. Together these fabrics comprise the largest single group throughout the EN period (c.45-85%) (e.g. Fabrics 1a-i, 2a-e).

From this it would seem that fabric diversity *does* in many cases reflect a diversity of origin and as such has no direct relevance *per se* to the discussion of ceramic production organisation at Knossos. An analogy might be drawn between these fabrics and the rarer fabrics at Franchthi, such as 'Andesite Ware' or 'White Ware', which contain raw materials whose sources are demonstrably not local to Franchthi.

Clearly, however, this is not the whole story: fabric diversity, as the third group of related local fabrics demonstrates, can also exist at a local level. Petrological study of Fabrics 1a-i and 2a-e would suggest that they are closely related (see Section 11.2.1; Chapter 6). The differences that enable each of these fabrics to be separated are mainly textural, but also find expression in the use of different forms of limestone and in the case of Fabrics 2a-e the exploitation of different clays.

How might this be interpreted? One way of thinking about this is to view this diversity at a larger scale. During the course of analysis I have always sought to characterise variation at the lowest possible level. However one could choose to see Fabrics 1a-i more simply as three groups: coarse limestone (Fabrics 1a, 1d, 1g, 1h), finely crushed limestone (1b, 1e, 1f) and coarse limestone and grog (Fabric 1i). Fabrics 2a-e could also be seen in this way: coarse limestone (Fabrics 2a, 2b, 2d), finely crushed limestone (2c) and coarse limestone and grog (Fabric 2e). In this way the variety apparent in Fabrics 1a-i and 2a-e can be reduced to three main paste recipes, which also have some sort of chronological meaning: during ENIa-b the most frequent is the coarse limestone group, with the coarse limestone and grog group a rarer variant; however during ENIc-II, when technological changes are apparent in paste preparation, these two coarse limestone groups are joined and in some instances (Fabric 1a) replaced by a finely crushed calcite group.

Therefore ceramic variation amongst local fabrics at Knossos operates at two levels. At one level Fabrics 1a-i and 2a-e testify to the local existence during ENI-II of usually only one or two basic paste recipes at any one time. However, the consistent maintenance of very subtle textural and technological (raw material selection, clay processing, form, finish) between these different fabrics (see Section 10.2.1), would seem to reflect another lower level of variation. If Fabrics 1a-i and 2a-e reflect ceramic production at Knossos, then such low level variation could reflect the actions of two or three different producing groups within the Knossos community (i.e. Fabrics 1a-c, Fabrics 1d-i, Fabrics 2a-e). Certainly the consistency with which these subtle textural and technological differences are reproduced must in most instances reflect some sort of consistency of action. For example, the consistent selection of particular forms of limestone without, it should be said, significant overlap would seem to suggest that these fabrics were not the product of any sort of random variation in the form or source of limestone temper used. Instead it would seem more likely that firstly there was some sort of consistency in the selection of different forms of limestone and secondly that this consistency parallels subtle differences in form and finish. Obviously one cannot seriously imagine that EN potters acted as geologists in their raw material selection, however one possible explanation for this patterning might be the consistent exploitation of different local limestone sources.

And so, as this discussion would suggest, the interpretation of variation in Neolithic ceramic assemblages is by no means as straightforward as previous studies have assumed. A large proportion of the variation in fabric identified in the EN assemblage from Knossos is explicable not in terms of variation amongst local producing groups, but as the products of other, non-local production locations. Such fabrics therefore have little bearing on the question of the organisation of local production at Knossos. It has been argued that a smaller group of fabrics (Fabrics 1a-i, 2a-e) are compatible with a provenance local to Knossos and it is this smaller group of fabrics within the EN ceramic assemblage at Knossos, which is most likely to have relevance to questions regarding the local organisation of production.

Although this discussion has undermined the validity of Vitelli's interpretation of ceramic variation at EN Franchthi upon which she subsequently based her identification of restricted household production, this does not mean that such a form of production did not exist. That said however, preoccupation with the household as the principle unit of social organisation should not be allowed to obscure the validity of other possible forms of organisation, particularly forms of organisation operating beyond the individual household (see Section 4.4). Thus study of early ceramic production organisation should explore all options including the conventional model of household production.

11.2 Early Ceramic Specialisation?

The conventional definition of household ceramic production in the Aegean, that is household production largely for household consumption, is generally characterised as non-specialised since it fails to accord with even the most basic modes of specialisation. For example, Costin's much-quoted discussion of craft specialisation has offered an eight-part typology, which for lower levels of specialisation offers a choice of the following (Costin 1991:8):

- (1) *Individual Specialisation*: independent individuals/households producing for unrestricted local consumption;
- (2) *Dispersed Workshop*: larger workshops producing for unrestricted local consumption;
- (3) *Community Specialisation*: independent individual or household based production units, aggregated within a single community, producing for unrestricted regional consumption;
- (4) *Nucleated Workshops*: larger workshops aggregated within a single community, producing for unrestricted regional consumption.

None of these definitions would seem to cover a scenario of household production for household consumption (Costin 1986:328; cf. Perlès & Vitelli 1999:96; see Chapters 2, 4).

The absence of any form of specialisation from early Aegean ceramic production has recently been challenged by Vitelli, who has argued that within the EN-MN (Greek) community at Franchthi, ceramic production was restricted to five different households and may already have been in the hands of individual female specialists, who were also healers or diviners (shamans) (see Section 2.3.2; Vitelli 1993a:216-7; Vitelli 1995; Perlès & Vitelli 1999:98, 102). This characterisation of ceramic production would fit Costin's most basic category of individual specialisation: that is independent individuals or households producing for unrestricted local consumption (Costin 1991:8).

Although this identification of early ceramic specialisation has in general achieved a wide acceptance (e.g. Demoule & Perlès 1993:377-82; Kalogirou 1997:12-13; but see Perlès & Vitelli 1999:101), the methodology used is open to dispute and cannot be considered to be a reasonable means through which to make an identification of specialisation (see Section 2.3.2). Furthermore, discussion of the interpretation of ceramic variation at Franchthi (see Section 11.1) has undermined much of the basic premises upon which this identification is based. Vitelli argued that EN ceramic production at Franchthi was specialised because of an 'overproduction' of pots: that is, a low-level of ceramic use (c.12-13 pots/year) could nevertheless support five different local groups of potters (each producing in a different fabric). Such an interpretation, however, relies on all five fabrics being locally produced, an assumption which does not at present appear to be justified (see Section 11.1).

11.3 Why is Specialisation No Longer Special?

Even if one sets issues of correct methodology and interpretation aside, there still remains the more fundamental question of what specialisation might mean in the context of the earlier Neolithic Aegean and what we might gain by identifying it in this context. In general, anthropological and archaeological studies of craft specialisation have focused on craft production in what has been termed 'complex societies', that is societies which are characterised by permanent social hierarchies and marked social, political and economic inequalities (e.g. Brumfiel & Earle 1987; Costin 1991; Sinopoli 1988; Stark 1985). Indeed it was

long thought that craft specialisation could *only* be found in complex societies: for example in studies of prehistoric Crete this was manifest in a marked reluctance to admit the possibility that specialised ceramic production and social ranking might pre-date the appearance of the palaces in the MBA (e.g. Cherry 1983:33-4) or else the EBA period (e.g. Branigan 1983:23-32). Such studies tended to view craft production during the EBA and the LN very much in the same terms as has been suggested for the earlier Neolithic, namely household production for household consumption. In this way both the Neolithic and EBA periods were viewed as long periods which saw little change in production organisation.

More recently, this assessment of LN and EBA ceramic production in the Aegean has been questioned. For example, detailed macroscopic and microscopic analysis of EBA ceramic material from a large number of sites around Crete, including Knossos has argued for the existence of different regionally located ceramic specialists (Wilson & Day 1994; Day et al. 1997). Furthermore preliminary study of LN ceramics from Knossos has indicated the possibility that some form of ceramic specialisation might have been existence before the end of the Neolithic (Day et al. 1997:287). In this way Vitelli's hypothesis of EN ceramic specialisation must be seen very much within the context of this reassessment of the origins of specialisation in the Aegean. Other scholars have sought to identify specialisation in the EN in the production of obsidian tools and shell beads (Perlès 1992; Miller 1996:30). Some have even gone so far as to suggest that "specialists' have always existed" (Perlès & Vitelli 1999:96).

Largely, in response to Vitelli's thesis of specialisation at EN Franchthi, Day, Wilson and Kiriati have questioned whether there was "ever a period in the Aegean when pottery production was not specialised" (Day et al. 1997:287). However, if one is to push specialisation back into the Palaeolithic (cf. Perlès & Vitelli 1999:96) and thus make specialisation simply an attendant feature of craft production¹⁴⁴, then inevitably one must question the utility of the term: what is it that makes specialisation special? Since the concept of specialisation, as originally

¹⁴⁴ e.g. Miller (1996:30) "specialization, then, should be viewed as one common mode of the organization of production".

formulated, implies a relative state and not an absolute one (Costin 1991:2), it cannot exist purely in isolation: if one form of production is characterised as specialised, then this would imply the existence of others which were not¹⁴⁵. One proposed solution to this problem is to view specialisation as a continuum of 'degrees of specialisation', varying from low to high (Brumfiel & Earle 1987:5; cf. Day et al. 1997). However, this dodges the crucial issue of whether specialisation is really a constitutive element of all forms of production or whether forms of production ever existed for which it is an inappropriate or even an irrelevant term. Is specialisation always a matter of degree or are there situations where specialisation is entirely absent?

In her study Costin defined craft specialisation as:

"a differentiated, regularized, permanent, and perhaps institutionalized production system in which producers depend on extra-household exchange relationships at least in part for their livelihood, and consumers depend on them for acquisition of goods they do not produce themselves" (Costin 1991:4).

Specialisation can therefore be recast as the existence of differentiation or separation between producers and consumers, hence subsequent statements made by Costin such as:

"whenever there are fewer producers than consumers of a particular good, we recognise specialized production" (Costin 1991:43).

This latter statement, when taken on its own, encompasses an enormous range of production behaviours. Indeed under this latter formulation the only instance where specialisation could be said not to operate would be where producers produce all that they need for their own personal consumption and never rely on the products of others. Such a situation has arguably never been a feature of human societies and is certainly a theoretical and practical impossibility under the DMP, that is the conventional model for Neolithic production organisation (Sahlins

¹⁴⁵ Costin (1991:3) talks of the characteristics of specialised production which mark it out from production which is non-specialised; elsewhere (1991:12) she talks of the evolution of independent specialisation, thus implying the existence of non-specialised production.

1974:101; see Chapter 4). Unfortunately, however, it is this very all-encompassing statement by Costin, which has been used as a definition of specialisation in several discussions of early Neolithic specialisation (e.g. Miller 1996:30; Perlès & Vitelli 1999:96). The failure of these studies to quote Costin's full definition is a serious error and may, as will be seen, compromise their subsequent identifications of early specialisation.

Such an all-encompassing statement also leaves it unclear as to what level one should pursue specialisation? If, as Costin's full definition suggests (1991:4), specialisation is all about differentiation, then at what scale should one seek to study it: the individual, the household, the community or the region? Vitelli's model of EN-MN ceramic specialisation locates specialisation at the level of the individual (female shamans?) and appears to situate these individual specialist potters within households. This formulation of specialisation is, however, highly problematic, since it is usual in definitions of specialisation to exclude household divisions of labour by age or sex (Costin 1991:4). To pursue specialisation at this level is generally considered inappropriate, since, as Sahlins emphasises, the effect of the pooling of goods and services within the household is to abolish "the differentiation of the parts in favour of the coherence of the whole" (Sahlins 1974:94; see also Sections 2.1.4, 4.2). For example, household-based ceramic production usually involves not just the single actions of one individual, but rather the co-operative efforts of other household members, such as children or the elderly, who often remain invisible in modern ethnographic studies of production (see Section 2.1.4; Wright 1991:198-9; Miller 1985:77, 110; Barley 1994:61-6). In this way, it would seem that any search for specialisation within the household would be unproductive and would merely debase the currency of the term.

In Chapter 4 it was suggested that during the earlier Neolithic (EN-MN Greek), communities, although perhaps notionally composed of individual household units, may have placed a greater emphasis on relationships conducted at a supra-household level. Such communities may have been characterised in their acts of consumption by ideals of sharing (Halstead 1995:16-19). Egalitarian ideals may have also been reflected in shared collective acts of production and an absence of direct household storage and therefore ownership of produce (Chapter

4). It was also argued that within such a socio-economic scenario the household may not act as the primary unit of social organisation and may not therefore be the principle unit of production and consumption. Instead one should perhaps look to larger social groupings which transcend individual households.

And so, where might one legitimately seek specialisation within such a formulation? If specialisation is primarily about differentiation then how or where might one locate specialisation within egalitarianist communities? If communities, although notionally composed of households, largely organise acts of production and consumption at a higher communal level, then it would seem to make little sense to seek specialisation within these higher supra-household groupings. And so, as with household-based societies where the seeking of specialisation within the internal divisions of the household is widely considered to be inappropriate (Costin 1991:4), so perhaps a similar approach to specialisation in 'communal' societies might also be misguided. To reformulate Sahlins' original proposition regarding internal differentiation within the household (1974:94), the effect of the *communal* pooling of goods and services within larger egalitarianist groups might also be to abolish the differentiation of the parts in favour of the coherence of the whole. In this way the level at which specialisation can legitimately be sought emerges as something that is context-specific since it depends on how and at what scale specific societies principally organise themselves.

And so, if one is to retain specialisation as a useful analytical term, rather than seeking simply to broaden its chronological sweep (e.g. Miller 1996:30; Perlès & Vitelli 1999:96), one must recognise and embrace the potential problems surrounding its application to production in egalitarian communities. Recognising this is not an exercise in defeatism so much as the acknowledgement of something potentially fundamental and different about how earlier Neolithic communities might have organised themselves. Furthermore, this formulation of specialisation rescues it from becoming a meaningless term and instead restores its focus to situations where its perspective on aspects of differentiation, whether political, social or economic, provides a means of identifying and understanding where important social/power relationships and differences are negotiated.

For these reasons I would prefer Costin's main definition of specialisation, putting special weight on her adjectives, 'differentiated', 'regularised', 'permanent', 'institutionalised', noting also the explicit nature of the relationship between producer and consumer, where "producers depend on extra-household exchange relationships..., and consumers depend on them for acquisition of goods they do not produce themselves" (Costin 1991:4). Here the term 'depend' requires explicit comment. A natural relationship of dependence has always existed between producers and consumers; namely that there have always been people who consume products which they themselves did not produce. In the most simple circumstances production itself is oriented primarily towards securing livelihood and not towards the production of surplus product for exchange (Sahlins 1974:82-6; see Chapter 4). Thus the relationship of dependence associated with specialised production should exceed this basic level. As Costin has stressed:

"The characteristics that distinguish it [specialisation] from nonspecialized production - generally or the Domestic Mode of Production... - are the amount of time spent in the activity; the proportion of subsistence obtained from the activity; the presence of a recognised title, name or office for the person or activity; and the payment in money or in kind for the products of the specialist" (Costin 1991:3).

Specialised production, as described here, is suggestive of production *specifically* for exchange. Indeed it is largely for this reason that specialisation has been understood as denoting "a measure of economic intensification" (Day et al. 1997:287). It remains to be demonstrated whether such a form of economic intensification, characterised by production for exchange, is an inappropriate characterisation of the earliest Neolithic forms of ceramic production.

11.4 Characterising the Organisation of Ceramic Production at ENIa-b Knossos

It has recently been recognised that current typologies of craft specialisation, particularly when applied to Neolithic production, often seem to obscure much more than they reveal (Perlès & Vitelli 1999:99-100). This is largely because typological models of social organisation exist at a higher level of generalisation and thus always suffer from an in-built insensitivity to the

specific characteristics of individual case scenarios (see Section 4.1). Regarding typological models of production in particular, Costin has argued in favour of a move beyond typologies of specialisation to a detailed analysis of production organisation, through the consideration of four main parameters (Costin 1991:8-18):

- (1) *Context* of production (affiliation of producers; control of production; demand);
- (2) Relative regional *concentration* of production facilities (unequal/equal distribution of producers through the landscape; local/regional location of markets; availability of transport);
- (3) *Scale* of production units (size of production unit; constitution of production unit; efficiency);
- (4) *Intensity* of production (part-time or full-time).

Clearly production must not be studied in isolation, but must be placed in its specific context which must always include an awareness of aspects of distribution and consumption (cf. Day et al. 1997:275).

In this section the organisation of ENI-II ceramic production will be assessed diachronically using these four parameters. It should be stressed that discussion will always seek to focus on local ceramic production at Knossos, since not only is this the only site for which contextual information exists, but also because combined macroscopic, microscopic and quantitative analyses have allowed a group of fabrics to be isolated (i.e. Fabrics 1a-i, 2a-e), whose production in the immediate locality (<5km) of Knossos seems assured.

11.4.1 The Context of Ceramic Production (ENIa-b)

The context of production refers specifically to the position that producers and their production activities occupy within wider social, political and economic networks. Thus in the context of specialisation, Costin discusses whether certain producers might have been affiliated to other social groups (e.g. elites) or

otherwise independent. Affiliated specialists¹⁴⁶ often produce a different range of products (luxury, prestige, wealth goods) from independent specialists (daily, 'utilitarian') (Costin 1991:11). However, at EN Knossos no such a distinction could be observed, even where different producing groups could be shown to be producing in separate locations (e.g. Fabric 12 produced in the Mirabello Bay and Fabrics 1a-i produced locally to Knossos). Rather, in all cases where a fabric is sufficiently well-represented it is clear that a range of forms and finishes were made, which were highly similar or identical to those made in other fabrics. Therefore, during ENIa-b, there is no obvious distinction in the types of products made so as to suggest the existence of different types of ceramic producers, whether of different affiliation or of different status.

And so, if different ceramic producers during ENIa-b largely produced a similar or identical range of products, what might this tell us about their status or their social context? Was ceramic production at Knossos, to use Vitelli's model for EN Franchthi, restricted to certain individual specialists, who may have been specifically gendered (female) and who may have enjoyed a special status (shamans?)? If production was restricted to high status individuals, one might plausibly expect to find evidence to suggest that producers were deliberately trying to mark themselves out as different from others. For example, during EMI-II on Crete, a period for which the existence of ceramic specialists has been plausibly argued (Day et al. 1997), ceramic technologies are extremely diverse, with choice of raw materials being made according to the shape, size and decorative technique of the vessel to be produced (Wilson & Day 1999:38; 2000:57; Whitelaw et al. 1997) and with different surface finishes being achieved using a variety of finishing and firing methods (Day & Wilson 1994). Several of the wares analysed, although indicating different combinations of raw materials and exhibiting quite different finishing methods, seem to originate from the same area (Wilson & Day 1999:38-40; 2000:57); in some cases these areas correspond to different regions within Crete (e.g. Mesara). Here one could argue that

¹⁴⁶ Admittedly discussion of affiliated specialists is somewhat irrelevant to earlier Neolithic communities, since by definition there can be no affiliated specialists in egalitarian societies which lack elites (Costin 1991:12). However, the comparison serves to emphasise how earlier Neolithic ceramic production differs from later Bronze Age scenarios.

specialist producers were consciously seeking to differentiate themselves by the adoption of complicated techniques of production which serve to exclude the participation of non-specialists and by the visual marking of their products as different by the use of distinctive forms and finishes. In the very least these technological features suggest the existence of a "sophisticated way of conceiving of and producing ceramics" (Wilson & Day 2000:57).

The situation for ENIa-b ceramic production could not be more different. Here choice of raw materials does not appear to have been based on considerations of form, size or finish. Instead each fabric demonstrates a comparable range of forms and finishes. Although there are obvious differences in the types of raw materials used, the type of fabric produced is almost always the same (coarse, tempered). Study of forming methods concluded that, although some form types had different forming sequences from others, within each fabric specific vessel types seem to have had the same basic forming sequence. Moreover, after experimental replication work it was observed that these forming techniques and sequences were simple to operationalise and presumably therefore equally simple to learn.

The striking feature of these different fabric groups is, therefore, the absence of profound differences in the basic ceramic technology used. Although subtle differences in form and finish can sometime exist, in most cases it is quite impossible to tell the products in one fabric, from those in another. This low level of external differentiation would seem to suggest that different EN producers did not prioritise the marking out of differences between each other. In this way ENIa-b ceramic technology could not be described as a closed technology of exclusion, but rather an open or shared one of incorporation.

The temporal context of EN ceramic production is also important. In most instances, different fabrics (and those forms and finishes specific to them) seem to have been re-produced consistently without significant change over an extremely long period of time (c.1000-1300 years). In previous studies of EN ceramics, this stability in methods of forming and finishing has been glossed as a 'conservative' feature of EN ceramic production. However, within more recent ceramic studies, such a lack of innovation has come to be understood as a dynamic

process in its own right (see van der Leeuw & Torrence 1989). If one seeks to reconstruct past behaviour as arising from the deliberate actions of knowledgeable actors, then the successive recreation of the same vessel types using the same series of techniques over many centuries might be re-cast as a *deliberate* attempt to maintain continuity between the past and the present.

It is commonplace amongst pre-modern societies of the ethnographic present to find very different attitudes to the past, where time itself is viewed as not purely successive and potentially looking both forward and back (see Section 3.3.1; Shanks & Tilley 1987:125ff). In such societies production (and consumption) may be seen as a deliberate act of recreation, which links present with past via the reproduction of past knowledge and techniques, and which situates the producer in a timeless state which is at once past, present and future. In this way acts of production and the objects produced are the means by which traditional knowledge is reproduced. In this way acts of production contain an important ceremonial aspect in the way they transform and create by enacting the 'nature of cosmic reality'. They may therefore reflect a desire to emphasise common memory, ancestry or ownership. It has recently been suggested, within the context of the social dynamics of Neolithic house destruction, that the "struggle for social and material continuity might have been a leading mobilizing force in creating and maintaining social practices and beliefs in the Neolithic society" (Stevanovic 1997:334).

And so, within such societies it is through acts of production - or rather the individuals behind them - that traditional or doxic forms of knowledge are maintained. However, individuals and households alone do not constitute stable mechanisms for the transfer of knowledge over countless generations. During ENIa-b Knossos, like EN-MN (Greek) Franchthi, was a small¹⁴⁷ community probably containing relatively few households. As Sahlins remarked, individual households are in the long-term extremely unstable (Sahlins 1974; see Chapter 4) and may suffer from an array of potential destabilising factors, such as periodic fluctuations in labour availability or uncertainty in food supply caused by

¹⁴⁷ Maximum population at the end of ENIa was c.60 and at the end of ENIb c.300 (see Appendix II).

fluctuations in climate (Halstead 1999:89). This inherent weakness is usually partly offset by a variety of strategies, which usually rely on the cultivation of ties beyond the household within the wider community (Halstead 1989). In this way over very long periods individuals, families, lineages and households will all come and go. It is therefore difficult to see how any of these *alone* could constitute a stable mechanism for the long-term transfer of knowledge, as evidenced in EN ceramic production. Rather it makes better sense, particularly within communities as small as that at Knossos and when acts of production were infrequent or seasonal (see Section 11.4.4), to see the community as a whole or at least a very large proportion of it as the reservoir or custodian of this knowledge. It is therefore the existence of this knowledge at a communal-level that provides the stable mechanism for its continued maintenance. As Childe long ago remarked:

"The neolithic crafts have been presented as household industries. Yet the craft traditions are not individual, but collective traditions. The experience and wisdom of all community members are constantly being pooled. In a modern African village the housewife does not retire into seclusion in order to build up and fire her pots. All of the women of the village work together, chatting and comparing notes; they even help one another. The occupation is public; its rules are the result of communal experience... [The pots] bear the stamp of a strong collective tradition rather than of individuality" (Childe 1981:87-8, reprint of 1956 edition).

And so, if the knowledge required for ceramic production was restricted to a few individual specialists, as argued by Vitelli, then it is difficult to see how sets of production practices could have survived *intact* and *unaltered* over such a long period of time, when they depended for their survival on such a narrow restricted line of inheritance. ENIa-b production is therefore unlikely to be *restricted* in the way Vitelli argues, but was most likely *shared* amongst producers working within a single community.

It has been suggested (see Section 11.1.2) that local production at Knossos in Fabrics 1a-i, 2a-e could be interpreted at one level as embodying two or three paste recipes, which at a lower level may represent two or three producing groups (i.e. Fabrics 1a-c, Fabrics 1d-i, Fabrics 2a-e). These groupings have a significant

temporal dimension: during ENIa only Fabrics 1a and 2a/b¹⁴⁸ are found at Knossos¹⁴⁹, suggesting the possibility that the earliest phase of ceramic production at Knossos may have been characterised by only one or two fabrics and by inference one or two producing groups. Since we have no idea of social organisation at Knossos during this period it is difficult to see how this patterning could translate into different social groupings. However, if - for the sake of argument - one assumes a DMP scenario of individual households, perhaps composed of 5-6 members, then ENIa Knossos with a population of 30-60 (see Appendix II) is likely to consist of 5-10 households. If ceramic production was taking place in each household, then one might expect to see between 5-10 different production groupings. However, during ENIa there is petrographic evidence for only one or two.

This of course relies on the ascription of past significance to present-day petrographic groupings and should therefore be treated with some caution. However, at the risk of speculating further, one might note that when the petrographic evidence for one or two production groupings is taken together with the evidence in favour of a shared communal basis for the knowledge and techniques of ceramic production, very low levels of production (see Section 11.4.3) and a lack of differentiation on the part of producers, then a coherent picture emerges for the earliest phase of ceramic production at Knossos. Rather than being restricted to one or two households, it seems on balance more likely that the earliest ceramic production (ENIa) took place at a supra-household or communal level involving the co-operative effort of a large proportion of the community. It remains open as to what sort of social formation this might represent.

11.4.2 The Concentration of Ceramic Production (ENIa-b)

¹⁴⁸ Fabrics 2a-e were produced using a low to non-calcareous quartz-rich clay, which is different from the two calcareous clays used to produce Fabrics 1a-i (see Appendix V). NB If Fabric 2a/b was produced at another location very close to Knossos, then this would leave only one main local fabric (Fabric 1a) at Knossos during ENIa.

¹⁴⁹ Fabric 1d only appears during ENIb and Fabrics 1b-c, 1e, 1f, 1g and 2c during ENIc-II (see Figures 9.3-4).

Concentration refers to the geographic organisation of ceramic production and the spatial relationship between producers and consumers. For example it has been noted that independent specialists often evolve under conditions of unequal resource distribution (Costin 1991:12). However, as has been argued (see Section 10.2.5), such a scenario could not be said to characterise ENIa-b ceramic production. ENIa-b ceramic technology did not place a heavy demand on clay and temper suitability and perhaps as a result the ENIa-b assemblage at Knossos testifies to the exploitation of a wide variety of raw materials. In many cases this exploitation suggests the production of ceramic vessels in a variety of landscape locations, which has been interpreted as having taken place at settlements. If correct this interpretation suggests that suitable clays and tempers were available within the immediate area of most EN settlements. For example at Knossos local Fabrics 1a-i were created using one or two calcareous clays, which were then tempered with limestone, all of which are compatible with a local provenance. During ENIa-b therefore the evidence is consistent with ceramic production taking place in most if not all open settlements, even ones as small as ENIa Knossos (0.25-0.3 ha.). This suggests that the spatial relationship between producers and consumers was close. This is more than likely since production and consumption on such a small scale suggests that the producers must also have been the main consumers. Consideration of the circulation of ceramics (see Chapter 12) also supports this, with 45-85% of the ceramics consumed at EN Knossos being locally-produced and most of the remaining 15-55% probably produced within the immediate vicinity.

11.4.3 The Scale of Ceramic Production (ENIa-b)

Costin has observed that specialist producers, above all independent specialists, are usually heavily influenced by profit or efficiency motives (i.e. production for exchange) (1991:11-12, 15-16). Indeed independent specialists generally rely for their existence on the sort of large general demand for their products that would result from dense population, regional political integration and/or the availability of cheap transportation (Costin 1991:11-12). However,

notions of profit or efficiency seem to have little relevance in the context of ENIa-b ceramic production:

- rough estimates of the level of ceramic consumption at ENIa-b Knossos suggest that demand for ceramic vessels was low, perhaps as low as c.25 vessels per year during ENIa and c.789 during ENIb (see Chapter 9);
- notions of functional efficiency do not seem to have been a feature of ENIa-b paste preparation: there is little or no evidence to suggest that the performance characteristics of a vessel influenced choice and combination of raw materials (see Section 10.2.5);
- although essentially the same series of forms are reproduced this does not represent any sort of gain in efficiency via standardisation¹⁵⁰, since the forming and finishing procedure for each vessel, especially fine polished vessels, was extremely time-consuming (see Section 10.4). In this respect ENIa-b production is extremely inefficient since it produces small quantities in a labour-intensive production sequence.

Production at this scale and at this sort of level of efficiency could not be considered to be overproduction or production for exchange; rather ENIa-b ceramic production could be characterised as production for livelihood. This characteristic of ENI production is well-illustrated if one considers the important role played by ceramic vessels in acts of exchange (see Chapter 12). If ceramic production were specialised then one would expect to see the role played by ceramics in exchange translating into significant increases in production. During ENIa-b, ceramic production was production for use or livelihood and in the exchange of ceramic vessels it was not quantity (or rather the power of access to vessels in large quantities) which was important but rather quality. Vessels were exchanged because of specific qualities, of which one seems to be an association

¹⁵⁰ Standardisation has been used to infer specialisation in complex societies, however it is as well to bear in mind that standardisation is equally possible in less complex societies: for example potters are quite capable of producing surprisingly uniform vessels without production regulations and administrative overseers (Hodder 1981:231-2; Welbourn 1985). It should also be stressed that standardisation as a concept has no meaning unless a clearly more variable type of ceramic exists with which to establish its existence; it is therefore a relative state and not an absolute one.

with distant sources (see Chapter 12). Since in many cases the origin of a vessel was masked or at least rendered ambiguous by its form and finish (cf. large style zones), this quality of the vessel must have always to some extent been provided or at least supported by oral information (see Chapter 12). Such a scenario helps to explain the underproduction of ceramics, despite their clear role in exchange: one cannot mass-produce pot biographies, they can only be acquired through time and circumstance. It is therefore interesting that significant increases in output only take place in ENIc-II at the same time as the role played by ceramic vessels in non-local exchanges seems to have been diminished (see below; Chapter 12).

11.4.4 The Intensity of Ceramic Production (ENIa-b)

If one assumes that the level of consumption also reflects the level of production output (see Section 9.4.5), then during ENIa-b ceramic production had an extremely low output, too low to suggest anything other than part-time, seasonal production¹⁵¹. During ENIc-II output would appear to rise significantly, admitting the possibility that production could have been a full-time or at least year-round activity (see below). In contrast, ceramic production during ENIa-b would seem to be characterised by an extremely low intensity. This is particularly clear during ENIa, where the entire yearly output, if in the region of c.25 vessels, could be accommodated within one large open firing. Such a low intensity would be extremely hard to accommodate within conventional definitions of specialisation.

11.5 Changes in the Organisation of Ceramic Production at Knossos (ENIc-ENII)

11.5.1 Changes in Scale and Intensity

During ENIa-b the main local fabrics (Fabrics 1a-i, 2a-e) together comprise c.45% of the Knossos assemblage, however during ENIc-II this figure

¹⁵¹ Indirect support for a low level of production is provided by the general absence from ENIa levels of tools that could be connected with ceramic production: e.g. sherd burnishers are only found from stratum VII (ENIb), while suitably worn pebbles and shells are found only from stratum VI. While one can never be sure whether differential patterning of artefact distribution between Neolithic strata at Knossos is an accident of sample size (see Whitelaw 1992), the complete absence of potential ceramic production tools below stratum VII remains striking.

risers to c.85%. At the same time as this increase in the proportion of local fabrics represented, the estimated number of vessels in circulation also sees a significant increase from c.789 in ENIb to c.8750 in ENIc (see Section 9.4.4). Although ENIc probably also sees a significant increase in population, even when some allowance is made for this (see Figure 9.8), this still amounts to an approximate ten-fold increase in the quantities of ceramic vessels in circulation. As emphasised in Chapter 9, considerable caution must be exercised in the use of these estimates, however although the quantities are surely incorrect the quantitative increase in ceramic consumption over ENIa-b must in some way be real. Furthermore, some support for the high number of vessels estimated for ENIc is provided by the estimate for ENII which is approximately equivalent.

These striking increases in consumption imply a significant increase in local production output during ENIc-II, which in turn suggests an increase in the intensity of ceramic production. An increase in intensity would also be supported by the evidence for the development and introduction of less labour-intensive finishing methods at this time (see Section 10.4.12). Other technological changes in paste preparation and forming could be interpreted in terms of improvements or gains in efficiency (see Chapter 10). These changes occur alongside an apparent decrease in the degree to which ceramic vessels were moving between other communities and Knossos (see Chapter 12). When taken together all these changes might indicate that the role of ceramic vessels in consumption had changed, with less importance attached to qualities, such as distant origins, and more importance assigned to quantity and availability (see Chapter 13). During this period ceramic vessels may have been used more frequently and the development of new types of finish may signify the creation of new vessel categories. Together these may suggest that ceramic vessels also began to take on new roles.

11.5.2 Changes in Context: The Architectural/Ideological Isolation of the Household (ENIc-II)

During ENIc-II the settlement at Knossos went through a series of important quantitative and qualitative changes. During this period it would appear that the estimated occupied area of the settlement doubled to c.2.5-3.0ha (see

Appendix II). This relatively sudden increase in size suggests an increase in population, possibly in the same order. However the ENIc-II period does not just represent a quantitative change in settlement size, but also a qualitative change in house design and construction. ENIa-b structures are generally characterised by thin irregular often insubstantial walls which although exhibiting a general orientation are never truly parallel to each other (cf. Evans 1964:figs. 7, 9-11). Such structures usually exhibit many phases of alteration, addition and abandonment (see Appendix I). During ENI the space of the household is not delimited or clearly marked, inside space flows into outside space and different structures merge with one another.

In contrast, ENII structures are much more substantially constructed (Evans 1994:11; cf. Evans 1964:fig. 15; 1994:figs. 5-6) with much thicker walls, which have clear inner and outer faces and which are invariably parallel or at right angles to each other. In addition during ENII the stone foundation for the pisé superstructure now becomes much more substantial reaching a height of c.1.0m (Evans 1994:11). Houses now stand more apart and there now appears to be a marked distinction between inside and outside space, emphasised by straight well-built walls and narrow entrances. Moreover Evans has noted that some of the ENII structures "might have had small enclosed yards attached" (Evans 1994:14). In addition ENII houses seem to be more complex consisting of an assortment of small and large rooms. Thus, in terms of the quality of their construction and the regularity and complexity of their design, ENII structures more closely resemble the large well-built complexes of rooms characteristic of MN and LN than anything that might have preceded them.

It is within the context of this new isolation and elaboration of the household dwelling that one might understand the appearance for the first time in the Cretan Neolithic of what appear to be house models (see Plate 61). These objects first appear in ENII and continue at least as far as LN (Furness 1953). All examples studied proved to be in local fabrics (Fabrics 1d, 1e, 1f). Previously, fragments of these objects have been considered to derive from rectangular 'legged receptacles', however study of an unpublished semi-complete example from the 1968-1970 excavations suggests that they should be considered to

somehow represent built structures. One might note in particular the niche to the side of the large opening, the side windows/doors and details of roofing. Furthermore, like these 'models' ENII built structures are rectilinear and single-storeyed (no evidence for staircases). If this interpretation of these models is correct it would suggest that the architectural isolation of the household may also have had an ideological dimension. Neolithic house models also occur on the Greek mainland and it has been suggested that these may "represent, among other things, an emphasis on the productive unit and its members" (Andreou et al. 1996:558).

When these features are taken together they seem to suggest a growing self-consciousness on the part of the household. Similar (and chronologically parallel) changes in the spatial organisation of LN (Greek) households have been interpreted as signifying a change from an ideology of sharing to an ideology of hoarding (cf. Halstead 1995; see Chapter 4). In Chapter 4 it was suggested that this period may actually see the emergence of the household as *the* primary social and economic unit and a concomitant decline in the importance of supra-household groupings. At Knossos the reasons why this change came about during ENIc-II are largely hidden, however it is perhaps significant that by the end of the preceding period (ENIb), Knossos had already probably reached the upper limits for Neolithic settlement (i.e. c.1.0-1.5ha with a population of 150-300), as defined by Halstead (1989:70; c.1.5ha, 300 people). It is generally accepted that once communities reach a population of more than c.300 it becomes harder/impossible for them to function on a face-to-face basis (see references in Broodbank 1992). If so then this would have further weakened the ability of the community to act as one, something which would have had severe consequences for any ideology of sharing or communal action.

11.5.3 The Organisation of Ceramic Production During ENI-II

In the context of ENIa-b it has been argued that one of the main factors promoting stability and continuity in production was the communal context in which ceramic production probably took place: production was visible and public with the production act probably being seen in terms of an active recreation of the

past, carrying forward communal ideals, values and categories into the future. Such values and categories are likely to have been considered doxic or beyond dispute. Within such a context opportunities for innovation were probably very restricted and possibly actively discouraged.

The apparent emergence during ENII of the household as a distinct architectural and symbolic entity and the weakening of any ideology promoting communal action, which such an emergence might represent, is likely to have had an effect on the way ceramic production was organised. In this way such a restructuring of values (and society?) might provide a context within which the ENIc-II changes in production might be situated. For example, if the context of production moved from being public to private, or from the communal to the household, then the influence of communally-held values, particularly social controls inhibiting innovation, is likely to be weakened, precisely because they were no longer being reproduced in a communal environment. In this way the timing of these technological changes in production could reflect a wider shift in emphasis from the communal to the private. This must, however, remain merely plausible conjecture. The increases in scale, intensity and efficiency of ENIc-II ceramic production certainly suggest that changes took place and it remains theoretically possible that ceramic production at this time took on a new restricted, differentiated and thus specialised character. Ultimately, however, the degree to which these changes may or may not imply changes in organisation remains unclear.

Conclusions

In this chapter it has been argued that previous attempts to characterise earlier Neolithic ceramic production as specialised can be challenged theoretically, methodologically and in the overly simplistic way they interpret ceramic variation. These studies have generally not sought to understand specialisation nor how it relates, among other things, to how we conceive the relationship between producers and consumers under the DMP. Often there also seems to be confusion between the consumption by non-producers of items produced *for livelihood* and the consumption by non-producers of products

produced specifically *for exchange*; only in the latter case need specialisation be implied. In Chapters 4-5 it was argued that with the great detail available from the integration of various categories of ceramic data (macroscopic and microscopic) one need no longer occupy oneself with self-serving assessments of where the EN situation accords with or differs from different generalised types of production organisation. Rather, as this discussion of ceramic variation has demonstrated there is sufficient detail available to allow one to move beyond typology and to explore the subtleties and potential uniqueness of the way ceramic production was organised during the earlier Neolithic¹⁵².

Although the ceramic data from ENIa-b Knossos exhibit a degree of variation which is comparable to that found at EN-MN Franchthi, at Knossos macroscopic and microscopic study indicated that a large proportion of this variation could not be correlated with local production and thus could not be used to demonstrate that local ceramic production was restricted and in the hands of individual or household specialists. Instead a considerable proportion of the ceramic variation identified maps out, not as production by different producing groups within a single site, but as production across the wider landscape at a much larger spatial scale: during ENIa-b pottery was produced at a number of different and probably settled locations around Crete.

Detailed contextual study of EN ceramic variation at Knossos, suggested that during ENIa and possibly during ENIb ceramic production was non-specialised and organised at a higher communal level than the individual household. Producers seem to have operated as a group with their primary affiliation being to the community. Production itself was probably regulated by the group but operated within powerful notions of suitability and fitness, which may have been shared with other communities. Production units were small, as would befit small communities, and probably comprised a proportion of the total population of the community. Demand was relatively low and production, although highly labour-intensive, was probably seasonal and part-time. Ceramic

¹⁵² cf. similar comments made in reference to the study of EBA specialisation (Day, Wilson & Kiriati 1997:276).

technology itself seems to have been simple but highly-effective¹⁵³ both in the way it was easily learnt and in the quality of its product.

These conclusions bear comparison with a recent study of EN¹⁵⁴ (Greek) shell bead production at Franchthi (Miller 1996; Perlès & Vitelli 1999:104-5). Previously thought to represent the remains of a specialised workshop (e.g. Perlès 1992; Demoule & Perlès 1993), detailed re-analysis and experimental replication suggested that production was characterised by high labour input, low overall output and, a low skill requirement (Miller 1996). It is striking how many of the features of EN bead production at Franchthi recall those identified in ENIa-b ceramic production at Knossos: high labour input, low output, relatively low skill requirement, low efficiency, with the high labour investment hinting at the high value of both beads and pots. Regarding EN shell bead production at Franchthi it has been suggested that the enormous labour investment involved in making one necklace could indicate that production of bead necklaces was "a collective undertaking by some portion of the Franchthi community" (Perlès & Vitelli 1999:104-5). This form of organisation parallels that suggested here for ENIa-b ceramic production at Knossos.

In this way ceramic production may have been one of the mechanisms active during the earlier Neolithic which affirmed the importance of the community over that of individual households. ENIa-b ceramic production was shown to exhibit striking stability and continuity. This was interpreted as something that was *actively* created. During ENIa-b communal acts of production may have served to maintain existing social values and categories through their reproduction in material objects and specifically to promote them as ancestral values reflecting an idealised socio-economic scenario of egalitarianism, where all individuals or households work together as equals. Ceramic production may therefore have functioned like other co-operative acts of production, such as sowing and harvesting, in promoting group cohesion and defining group identity. The seasonal nature of early ceramic production may furthermore suggest the

¹⁵³ cf. Perlès (1992:148): EN (Greek) ceramic technology was "local, limited and technologically simple".

¹⁵⁴ Miller (1996:10-11, 23) notes that none of this material was found in primary deposits, although there was a clear association with EN material in contexts dating to the early seventh millennium. Thus this material spans not just the EN, as Miller suggest, but could date back into the Aceramic.

possibility that ceramic production, like harvesting and sowing, may have played a significant part in the ritual calendar.

Within this context any attempt to privilege specific individuals as specialists seems to out of place and perhaps even anachronistic. Desire to isolate significant individuals within the earlier Neolithic may have more to do with our modern obsession with individuality, than any ancient reality (Thomas 1990). Certainly there is no overt signalling of individual identity in ceramic production during this period: form and finish remain remarkably constant, with the same limited set of designs consistently reproduced over dimensions of time and space, which transcend the individual. Under such circumstances it is therefore difficult to find a place for Vitelli's individual specialists¹⁵⁵; rather it is possible that within communities of the earlier Neolithic, such as ENIa-b Knossos, individuality was suppressed in favour of corporate solidarity, as would be expected in an egalitarianist society. Within such a scenario the community or a large proportion of it may have somehow functioned as the 'household of all', making the pursuit of specialisation at an inter-household level as meaningless as its pursuit within the household along lines of age or gender.

If acts of ceramic production expressed in some way a communal ideology of sharing and equality, then presumably the vessels produced belonged in some way to all. Consequently after production, the initial distribution of vessels was most probably not controlled by a restricted group of producers, seeking recompense for their investment of time and labour and with a sense of personal ownership engendered by having been responsible for their production. Instead access to vessels after the completion of firing may have been determined by individual or household status within the community and/or age and gender. Alternatively the very low quantities of vessels in circulation during ENIa may indicate that individual households did not directly own their own sets of vessels and instead that ceramic vessels were instead the property of the community and were perhaps centrally stored ready for use only on special occasions (see Chapter 13).

¹⁵⁵ Here it is perhaps worth noting that in Rice's typology of specialisation individual specialists occupy her fourth category and imply a specific social and economic scenario which does not resemble that of ENIa-b (Rice 1981).

The relevance and utility of the term specialisation in an EN context really only begins when more obvious changes in production occur during ENIc-II, which allow comparison with the situation described for ENIa-b. Specialisation is, after all, "a relative state, not an absolute one" (Costin 1991:2). These changes could only be identified in fabrics, which mineralogy and frequency would suggest were locally produced at Knossos. However, since the ENIc-II period sees a sharp drop in the proportion of non-local fabrics represented at Knossos, with such a small sample it is impossible to be certain that parallel changes did not take place at other production locations outside Knossos. At the same time as these technological changes take place, there are also significant increases in the scale of ceramic consumption and by implication ceramic production, which would indicate a significant increase in output and intensity over the previous phase (ENIb). Such an increase in intensity provides a context within which to understand some of the technological changes, such as the introduction of more efficient (time, labour) techniques of forming and finishing.

It was suggested that these changes could not be properly understood without an appreciation of the possible social changes taking place during this period. Qualitative and quantitative changes in architecture and the appearance of symbolic representations of built structures may suggest the emergence of the household as a distinct architectural and symbolic entity and thus a weakening of any ideology promoting the rights of the community over that of the household. If during ENIa-b ceramic production was concerned with the reproduction of communally-held values with powerful social restrictions on change, then the fact that a wide series of technological changes could take place during ENIc-II suggests that the values which communal acts of ceramic production reproduced were no longer considered to be beyond dispute, but rather had become open to doubt, manipulation and innovation. It was suggested that one way that this might have been achieved was if ceramic production moved from being a public activity to being a private one. A possible parallel at ENII Knossos for such a move could be the enclosing of previously open public areas between houses to create private yards or enclosures attached to individual houses. This development has near contemporary parallels (LNI Greek = ENIc-II) on the Greek mainland and seems

to have reflected a move in the shared consumption of food from public to private (see Halstead 1995; see Appendix I).

It is possible, therefore that ceramic production during ENIc-II moved from being a communal activity to being a household activity. These changes in technology, scale and intensity may indicate that ceramic production took place more frequently and was conducted with more efficiency. Although this could still be explained if ceramic production remained an unrestricted practice, it is equally possible that the ENIc-II period sees the very beginnings of some sort of (household?) specialisation in ceramic production. In view of this possibility it is instructive to compare ENIc-II ceramic production with what comes later. Broodbank has argued that the succeeding MN phase is "characterised by a permanent contraction in the number of types of open shape in use, and the overwhelming popularity of a single carinated bowl form", moreover the period also sees an increased restriction in the range of design types represented, a restriction which only increases during LN (Broodbank 1992:54-5)¹⁵⁶. These observations led him to draw a "contrast between 'ENII diversity and MN high-volume uniformity'" (Broodbank 1992:65). These statements are at least partly corroborated by my own preliminary observations of changes in ripple burnish between ENII and MN: during ENII (and ENIb-c) ripple-burnish is characterised by well polished surfaces and deep wide carefully applied ripples; however during MN it is characterised by less well-polished surfaces and shallow thin ripples. The latter development would seem to represent a quicker and more efficient method of applying such a finish. Regarding the LN phase Manteli has argued that the development of an 'open style' of design syntax, an increase in pattern-burnishing and the abandonment of 'time-consuming' forms of decoration, such as ripple or 'dense style' incised/pointillé, should be understood as a sign that 'mass production forces' have taken over (Manteli 1993a:69; cf. Manteli & Evely 1995:5). In addition by LN at least some ceramic vessels were now being kiln-fired (see above). These features would seem to confirm the likelihood that LN ceramic production at Knossos was specialised in some way (Day et al. 1997:287).

¹⁵⁶ Whitelaw, however, has argued that the drop in the range of MN designs may be a result of smaller sample size (1992:230).

These observations of MN-LN ceramic production, although not backed up by more detailed technological and mineralogical analyses at least suggest a coherent picture. It would appear that the series of changes which characterise ENIc-II ceramic production represent the beginnings of a process whereby ceramic production became increasingly more efficient in terms of time and effort. If ENIc-II represent the beginnings of some sort of specialisation, then it would appear that ceramic specialisation continued to be a feature of ceramic production in later phases of the Neolithic at Knossos, although quite what form this specialisation took remains impossible to determine without further study. Vitelli has argued that during the later Neolithic ceramic production in Greece actually became a non-specialised craft activity (Vitelli 1993b:252). However, these preliminary observations regarding later Neolithic phases of ceramic production at Knossos would seem to support those of Kalogirou, who has argued (*contra* Vitelli) that Greek LN and FN ceramic vessels required as much skill and labour investment as earlier EN-MN vessels and as such cannot be used as evidence for non-specialised production (Kalogirou 1997).

CHAPTER TWELVE

THE CIRCULATION OF CERAMIC VESSELS DURING THE EARLY NEOLITHIC

12.1 The Cretan/Knossian Isolation Hypothesis

"While a few earlier pottery imports may be hidden in the mass of material from the site [Knossos], their incidence cannot but be negligible" (Broodbank 1992:48).

"In no system is everything so singular as to preclude even the hint of exchange... such a construction of the world -... as totally heterogeneous... - would be humanly and culturally impossible" (Kopytoff 1986:70)

"Whether stemming from economic need or social strategy, ...the use of objects and materials from distant sources seems to be an integral part of human behaviour which can be traced back at least as far as the Middle Palaeolithic" (Scarre 1993:3)

It has become commonplace in studies of southern Aegean in the seventh, sixth and even fifth millennia BC to find Knossos and Crete described in terms of isolation and not interaction. Thus Sampson in his study of the Neolithic of the Dodecanese and its relationship to other regions of the southern Aegean, emphasised that Crete was culturally isolated during the Greek EN and MN periods (Sampson 1984:239; cf. Rackham & Moody 1996:2). Likewise Manteli has argued that Crete was isolated until the LN-FN period, when there is evidence for a much closer relationship with the Aegean (Manteli 1993a:158-168). Broodbank has gone even further in down-dating the period of earliest interaction arguing that "until the 4th millennium (the FN period), it is intrinsically quite probable that Crete constituted a largely self-contained world" (1992:48, 47-8). Vagnetti has similarly highlighted the FN period as the phase in which Crete joins the wider Aegean and has pointed to parallels (baking pans/cheese-pots) between Nerokourou in West Crete and the Alepotrypa Cave (Peloponnese), the Attic-Kephala culture at Emporio VII-VI, the Ayio Gala Cave, Tigani (Samos) and other sites in the Dodecanese (Leros, Yiali, Kastro, Kalythies, Koumelo, Aspri Petra, Vathy) (Vagnetti 1996:34-6)¹⁵⁷.

¹⁵⁷ Many of these parallels (e.g. Emporio VII-VI, Ayo Gala, Tigani etc.) date to LN, thus appearing to undermine the significance of any synchronism with Nerokourou. However, it seems

An integral part of the isolation hypothesis is the common view that during the earlier Neolithic it was not so much Crete that was isolated as Knossos itself (cf. Evans 1968:273-6; 1971:114; Vagnetti & Belli 1978:126; Cherry 1985:24,27; Broodbank 1992:47-9; Vagnetti 1996:30; Manteli 1996:132; Rackham & Moody 1996:97; Manning 1999:470). Most recently Manning has argued that

"Whilst no comprehensive survey will ever be possible, it nonetheless appears likely that Knossos was the only large, significant settlement on Crete during the entire Neolithic period... Indeed there were very few other settlements until the LN-Final Neolithic (FN), when a number of small sites appeared around the island" (Manning 1999:469).

Manning also considers that, if one ignores the circulation of Melian obsidian, "there is almost no (cultural) evidence of contact between Knossos - or anywhere on Crete - and the rest of the Aegean (or beyond) until the FN period" (1999:470).

Naturally the conclusions reached in previous studies of EN ceramics at Knossos have played an important part in the formation of these ideas. The statements of a whole series of scholars regarding the overall homogeneity of the EN sequence at Knossos have left little room for the development of alternative hypotheses (cf. Mackenzie 1903:158-9; Furness 1953:95, 103, n.16; Evans 1964:194; Manteli 1993a:42; Evans 1994:8). In addition the failure to identify or publish other EN sequences from around the island has also prevented further insight (see Appendix I). Compounding all this is the general failure amongst scholars working on material from around the southern Aegean to include Crete in their thinking or even in their references (e.g. Perlès 1992; see Appendix I). Such factors have conspired to make Knossos' isolation as much intellectual as practical.

By now, however, it should be clear that the homogeneity view of the EN Knossos assemblage cannot be sustained any longer. In Chapters 6-7 a considerable degree of variation in fabric, form and finish was identified and

likely that Nerokourou dates earlier than FN: the presence of wishbone handles (absent from latest LN/FN deposits at Knossos) strongly suggests an LN date for at least some of the Nerokourou material (see Appendix I). This gives new significance to the parallels and suggests that Cretan-Aegean interaction cannot be confined purely to the FN period, but must date back at least to the Greek LN (see also Appendix I).

significant correlations between fabric, form and finish were noted. In Chapter 10 it was argued that a large proportion of this variation/correlation can only be accounted for if production was taking place at different locations around Crete. It has also been demonstrated that contrary to previous estimations Aceramic and ENIa Knossos remained too small to be demographically self-sufficient, thus further implying the existence of other undiscovered Aceramic and EN settlements (see Appendix II). In this way it becomes clear that Knossos, far from existing in isolation, must have been and indeed was interacting with other settlements. In this chapter an attempt will be made to characterise the nature of this interaction and to trace its development over time. Discussion will focus primarily upon the circulation of ceramic vessels, however reference will also be made to the circulation of other goods in order that a more holistic picture of EN exchange might be built up. Finally, previous attempts to model earlier Neolithic Aegean exchange will be assessed in the light of this new data.

12.2 Understanding the Circulation of EN Ceramic Vessels

In this thesis ceramic provenance has been approached from several angles. Firstly petrographic study can at times lead to the identification of the raw materials employed with specific areas in the landscape (e.g. Fabric 12 Mirabello Bay) and even in less favourable circumstances petrology at least allows source areas to be characterised in terms of basic geology. Secondly, macroscopic study has allowed fabrics to also be characterised in terms of their features of form and finish. These features can be compared with material from other sequences in Crete and the southern Aegean in order to assess degrees of similarity and difference. Thirdly when the frequency in which fabrics, forms and finishes occur is calculated, it becomes possible to identify not only particular fabrics, forms and finishes which are common, but also those which are rare or unique. All these data have been presented in detail in previous chapters; in particular, assessments of likely provenance, some of which are used below, can be found in Chapters 6-7 and Appendix V. In this section through a combination of these three different perspectives on provenance, an attempt will be made to establish the approximate

scale, distance and directions in which ceramic vessels circulated in the various phases of EN (see Appendix I).

12.2.1 Scale and Distance

The frequency (per 1000 sherds) with which the main fabrics occur in the different EN strata at Knossos is presented in Figure 12.1.

	Fabrics 1-4	Fabric 5a	Fabric 6	Fabric 8	Total Rare ($<15/1000$)
IX	441.4	103.3	232.5	119.9	102.9
VIII	401.0	160.8	171.8	119.1	147.3
VII	442.5	101.8	197.6	91.7	166.4
VI	497.6	186.8	118.7	86.6	110.3
V	851.9	71.3	27.8	33.3	15.7
IV	873.0	27.9	5.6	25.4	69.1

Figure 12.1 Frequency (/1000sherds) of Most Common Fabrics (Strata IX-IV)

Fabrics 1-4 are frequently represented fabrics which petrological analysis suggests would be most consistent with an origin in the area immediately local ($<5\text{km}$) to Knossos. Petrological study of Fabrics 5a, 6 and 8 concluded that these were inconsistent with an origin within this immediate area, but could have originated within the general area of Knossos (Herakleion basin). The clear mineralogical links between Fabric 6 and the most common EMII cooking pot wares from Knossos may seem to confirm this. The remaining rare fabrics combined together account for only a small proportion of the total assemblage in each stratum. These are never more frequent than c.15/1000 sherds, with frequencies of less than 1/1000 being common. This rare group comprises around 25 fabrics in total over the whole EN sequence.

In Chapter 7 it was demonstrated that several of the rarest fabrics have unusual forms and/or finishes which find no parallel within the more frequently represented fabrics. On the basis of similarities with published sequences from various parts of the southern Aegean and/or an incompatibility with Cretan geology, this group of fabrics was tentatively interpreted as off-island. In contrast the majority of this rare group of fabrics present features of form and finish which

are so closely comparable with Fabrics 1-6, 8 as to make a Cretan provenance hard to doubt. Amongst these fabrics is Fabric 12, for which petrological analysis has indicated a provenance in the Mirabello Bay, east Crete. This would suggest that certainly in this case, the rarity with which this fabric occurs at Knossos is directly related to the distance from its place of manufacture (c.70km.). This in turn suggests that other fabrics in this rare group of 'Cretan' fabrics, which remain unsourced might also originate on Crete but at a greater distance from Knossos than Fabrics 1-4 or 5a, 6 and 8.

	Fabric 10	Fabric 12	Fabric 14	Fabric 24	Fabric 28
IX	0	3.7	12.9	0	7.4
VIII	0.3	0.3	0.9	15.8	1.2
VII	1.1	0.3	0.3	4.2	1.9
VI	0.7	0	0.3	0.3	0
V	1.0	2.6	0	0.3	0
IV	1.3	5.5	0	0.2	0

Figure 12.2 Frequency (/1000sherds) of Fabrics 10, 12, 14, 24 and 28 (Strata IX-IV)

A number of considerations suggest that this distance need not always have been as great as that indicated by Fabric 12. Close mineralogical links are apparent between Fabric 14 and one of the cooking pot fabrics at EMII Knossos, a link which may indicate a provenance somewhere within the Herakleion Basin. Likewise, the closest source for the serpentinite in Fabric 10 is to be found in the foothills of Mount Ida, at the far west edge of the Herakleion Basin. Figure 12.2 records the frequency with which these fabrics occur at Knossos during EN. Although consistently represented, it is striking that Fabrics 10 and 14 occur as rarely as Fabric 12 (Mirabello Bay) and others which may be off-island (Fabrics 24, 28). And so, if either of these two fabrics do indeed have a provenance in the Herakleion Basin, then this would suggest that there was a very significant fall-off in the frequency with which fabrics occur at Knossos after only a relatively short distance from source.

If this interpretation of frequency and provenance is correct, then it would seem to indicate that vessels from more distant areas of the Herakleion Basin and other regions of Crete, such as the Mirabello Bay, are as rare at Knossos as those

vessels, which are likely to have come from off the island. If so, then it would seem that ceramic vessels circulated most intensely and were most likely to be consumed and discarded at sites close to their location of production. The other important implication is that on the rare occasions when a vessel was exchanged beyond this zone, distance from source was no longer a factor and such vessels could potentially circulate over great distances.

The changing circulation of ceramics can also be expressed in terms of fabric diversity. By dividing the total number of fabrics within a single stratum (see Figures 9.3-4) by the total number of sherds in that stratum and then multiplying by one thousand one can produce a measure of the range of fabrics in each stratum (see Figures 12.3-4).

Stratum	Fabrics/1000 sherds
IX	31.37
VIII	7.00
VII	5.28
VI	3.84
V	4.99
IV	1.39

Figure 12.3 Fabric Diversity Per Stratum

This measure reflects very well the surprising range of fabrics present in stratum IX despite its relatively small size (total 542 sherds). Since only Fabrics 1a-i, 2a-e in stratum IX are likely to be local to Knossos, this suggests that the very first phase of ceramics saw a particularly intense circulation of ceramic vessels. In contrast for stratum IV (ENII) Figures 12.3-4 suggest a decline in fabric diversity. This would seem to suggest a decrease in the circulation of ceramics; an impression only reinforced by the knowledge that almost half of the different fabrics represented in stratum IV are actually variants of local Fabrics 1-4 (i.e. 1b, 1d, 1e, 1f, 2a/b, 2c, 3, 4).

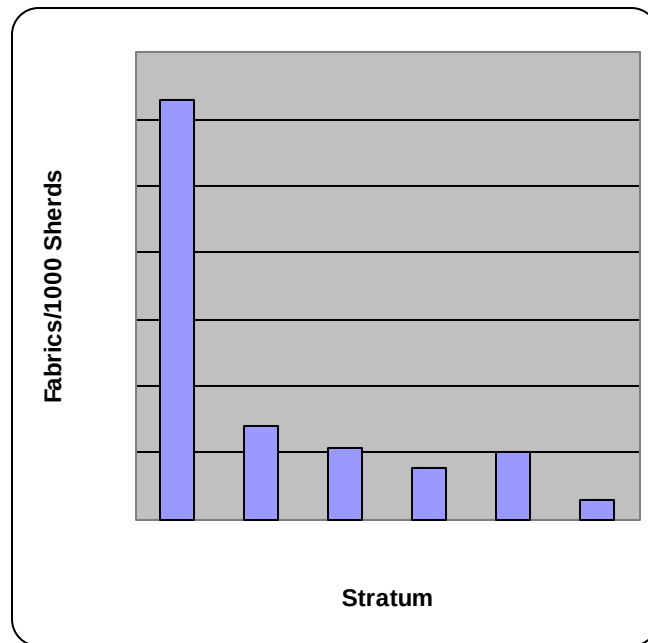


Figure 12.4 Fabric Diversity Per 1000 Sherds Per Stratum

12.2.2 Temporal Changes in Circulation (ENI-II)

A comparison of the frequency with which Fabrics 1-4, 5a, 6, 8 recur in different strata (Figure 12.1) indicates a high degree of consistency between strata IX-VI and again between strata V-IV. This chronological distinction, taken in conjunction with the basic conclusions reached above, suggests the existence of two chronologically distinct patterns of circulation during the course of EN:

- (1) Consistently during ENIa-b ceramic vessels circulated widely between sites, which probably lay within the vicinity of Knossos, perhaps within the Herakleion basin. This circulation may have reached a peak in stratum IX. During ENIa-b at Knossos vessels, produced in the immediate area (<5km) account for under half of the total assemblage, vessels produced in Fabrics 5a, 6 and 8 comprise between c.11-23% each, leaving less than 10% of the assemblage from possibly more distant sources.
- (2) In ENIc there is a significant change to this pattern of circulation. During ENIc-II at Knossos vessels produced in the immediate area (<5km) now consistently account for over 85% of the assemblage, vessels produced in Fabrics 5a, 6 and 8 only comprise between c.2-7% each, leaving only c.1.5% of the assemblage possibly from more distant sources.

12.2.3 What Types of Vessels Circulated?

Careful scrutiny of the types of vessels in circulation reveals little in the way of clear patterning. If, for example, one compares the types of vessels which occur in Fabrics 5a, 6 and 8 (>5km distant), then it is clear that a variety of vessel types, coarse burnished or fine polished vessels, open or closed, are present at Knossos in non-local fabrics. While it is true that a good proportion of these vessels are fine polished open bowls of various types, this being especially true of Fabric 5a, there are always coarse burnished deep bowls and/or collared/necked jars present in reasonable quantities. This variety is also apparent in rarer fabrics. Thus although Fabric 12 (Mirabello Bay) is most often present in different types of very fine dark polished open bowl, there are also coarse burnished vessels, one of which (stratum VIII) is round-based and has been burnt on the interior (see Chapter 13 on cooking pots). Likely off-island vessels are variously coarse (cf. coarse burnished hole-mouth jar in Fabric 24 (98/43, 98/44), coarse burnished red-slipped tubular-lugged vessel in Fabric 28 (97/36)) or fine (cf. shallow bowl in Fabric 31 (97/101), painted vessels in Fabrics 25, 32 and 34).

This is a surprising but very important conclusion, since previously it has been thought that only decorated/fine pottery was likely to circulate during this period (Halstead 1999:80). Rather the evidence from Knossos suggests that a wide variety of different vessels could circulate, indeed as wide a variety of forms and finishes as is found in local fabrics (Fabrics 1a-i, 2a-e). In the next chapter the ways in which some of these vessels might have been consumed are discussed in detail. Here it suffices to note that fine polished open bowls are very likely to have been used for serving and display, while the collared or necked jars with flared or normal strap handles would have made containers suitable for both liquids and solid foods as well as other items. Such containers could have served equally well for storage or transport and it seems likely that they served both purposes (see Chapter 13). In this way the movement of ceramic vessels, in at least some cases, probably also testifies to the movement of other commodities which comprised

the contents of these vessels. The implication of this variety¹⁵⁸ in the types of vessels in circulation is that models of exchange which emphasise the importance of distinguishing between fine and coarse vessels or luxury and utilitarian vessels may be imposing a *fixed* 'modern' set of value categories upon vessels which seem to have been subject to differing and varying valuations in the past (see below).

12.2.4 Direction of Movement and Technology of Transport

The direction in which vessels circulated is almost impossible to assess with any confidence, since only one site within this network of contacts was sampled (Knossos) and the exact location of almost all other sites is unknown. However, it is possible to make some tentative suggestions regarding broader patterns of circulation. The distribution of known and possible EN sites consistently suggests a focus along the northern coast of Crete, from at least as far east as the Mirabello Bay and possibly extending west from Knossos towards Chania (see Appendix I). If this picture is correct it would seem to imply that some movement between settlements, certainly any that required a large distance to be covered, was predominantly east-west and maritime based. In their modelling of the maritime colonisation of Crete, Broodbank and Strasser suggest that "hide-boats or logboats... [were] the most likely form of transport... given the constraints of an early Neolithic tool kit" (Broodbank & Strasser 1991:241), while elsewhere the use of simple reed boats has been proposed (Cherry 1985:21). In each of these cases it is likely that such vessels were employed in short-range maritime movement, that is movement which hugged coastlines and hopped to visible nearby islands, and which in any one day could only cover a relatively short distance (cf. Cherry 1985:21-2; Broodbank & Strasser 1991:241). Thus, the likely presence at Knossos of a few vessels originating in southern Greece and south-west Anatolia suggests that this east-west axis of maritime movement ultimately extended further west and north via the island of Cythera to the Greek mainland

¹⁵⁸ If one considers the range of vessels represented by the possible Cretan imports identified in sequences around the southern Aegean, one inevitably finds that all of these are decorated in some way (slashed cordons, incised/pointillé, barbotine). However, this pattern results from the impossibility of recognising undecorated vessels in these sequences on the basis of style alone and cannot therefore be used to argue for the exchange of only decorated vessels.

and east and north via the islands of Kasos, Karpathos and Rhodes to Anatolia (see below for further discussion).

12.3 The Circulation of Other Goods?

The ways in which exchange systems of the Neolithic Aegean have been variously approached, have recently been subject to careful reappraisal (see Perlès 1992:117-9). Perlès identifies three different perspectives and methodologies, which are characterised here as follows:

- (1) *Socially Simplistic*: although tools, raw materials, ornaments and prestige goods are considered to have some value in social relations, little or no attention is paid to possible differences in production, quantities in circulation, use value, regional distribution. Such an approach tends to produce “only one form of Neolithic exchange, one socioeconomic basis for the circulation of goods, one distribution network” (Perlès 1992:117).
- (2) *Joining the Dots*: socio-economic forms of production and technical function of the goods are ignored in favour of a simple analysis of their distribution at a regional level. No distinction is made between different productive and consumptive forms of an object, such as obsidian cores, debitage, blades and scrapers. Instead these are all subsumed into a single artefact category. Such an approach ignores the extent to which different stages in the life of an object (production, distribution, consumption) all inform upon each other (see Chapters 3-5).
- (3) *Single Artefact Biographies*: largely in response to criticism of approaches (1) and (2) some studies have considered the production and distribution of a single category of raw material or finished item (e.g. obsidian). However how these raw materials or finished goods interact with other related goods or materials is ignored.

Clearly an understanding of Neolithic exchange systems is predicated upon diachronic study of all commodities in circulation and, most crucially, how different objects or commodities were articulated in practice. Unfortunately, however, study of the latter is currently inhibited by the lack of contextual information regarding the relationship between different types of object or commodity, whether in acts of production, consumption or exchange (see Chapter 9). This restricts study of the circulation of ceramics and other goods to the comparison of individual summaries (see below), which give useful details of the circulation of specific categories of material in comparison to ceramics, but which, it must be stressed, do not provide a means of entering into the different contextual relationships, which must have existed between ceramics and other materials.

12.3.1 Chipped Stone

Obsidian is the clearest example of a resource which must be procured from a long distance. It has been argued that the main source for the obsidian at Knossos was Melos (Cann & Renfrew 1964). However this was based on a small sample (n=5) and in a separate larger sample, analysed at Bradford University by Dr. A. Aspinall, two pieces from ENI and one from ENII proved to be from the island of Yiali, off the south-west Anatolian coast (Cann & Renfrew 1964:239; Evans 1994:5 n.10). The unexpected discovery of the presence of Yiali obsidian raises the possibility that more might exist in the assemblage than originally thought. Obsidian was by far and away the main form of chipped stone in use in Aceramic and EN Knossos and was occasionally retouched (Evans 1964:142, 146, 150, 155, 157). Obsidian is most common at Knossos in ENI levels and amongst these there are peaks in numbers in strata IX, VIII and later in stratum V (mostly small flakes) (Evans 1964:233). In addition small quantities of chert are found throughout the deposit, which were occasionally retouched.

Another form of chipped stone are the schist 'pot lids', which occur from stratum VII (Evans 1964:231). In many cases these are in fact too small to have served as lids, at least for ceramic vessels, but could have served as pot stands (see Chapter 10). The nearest sources of schist occur at some distance to Knossos and

unless the raw materials were procured directly by the community at Knossos, these items are likely to be non-local products. The nearest schist sources are on the north flanks of Ida, on the western side of the Herakleion Basin and possibly around Iouktas (see Appendix III).

12.3.2 *Ground Stone*

Stone axes occur from the Aceramic onwards, while stone 'maces' occur from stratum VI (Evans 1964:229-31). These have been classified on the basis of their raw material (see Warren 1968) and it has been generally assumed that all have a Cretan raw material source, although this has never been examined analytically. A striking feature of the axes and maces in ENI levels at Knossos is that scarcely any are made from limestone, the most suitable local rock to Knossos: there is a single limestone mace from stratum VI and an axe from stratum IV (Warren 1968:240-1). Thus it would seem that during Aceramic-ENI exotic materials from non-local sources, such as 'greenstone', chlorite and serpentinite of various colours, were deliberately sought, all seemingly favoured more for their appearance than their performance characteristics (Warren 1968:239-40; Evans 1968:270). The nearest sources of serpentinite and chlorite lie in the foothills of mount Ida around Gonies (Warren 1968:239 n.2). Figures 12.5-6 depict variation in raw material sources per stratum.

The axes from Knossos are currently being subject to a detailed re-study by Dr. T Strasser. Preliminary results from this study indicate that three pieces¹⁵⁹, previously considered to be haematite are now identified as emery (T. Strasser pers. comm.). Since Aegean sources of emery are confined to the Cyclades and coastal Anatolia (Izmir), this important discovery indicates the exploitation of off-island stone sources from the Aceramic and compliments the evidence for the use of obsidian from the islands of Melos and Yiali. Evans states that stone querns and mortars, known from the very earliest phase of ENI, are generally made from "volcanic rocks, grits and sometimes limestones" (Evans 1964:231). Currently there is no known source for such volcanic rocks on the island and certainly if

¹⁵⁹ i.e. one from stratum X (Aceramic), one from stratum IX (ENIa) and one from stratum IV (ENII) (T. Strasser pers. comm.)

such volcanic mortars were found in Bronze Age strata an off-island provenance would be immediately presumed. It is also perhaps worth mentioning in this context the unpublished marble bowl from an Aceramic level in sounding X (Evans 1970b) as well as the two marble figurines from stratum VIII (Evans 1964:237-8). Two pieces of marble from Neolithic contexts at Knossos, thought to resemble figurine marble, were analysed by S.E. Ellis of the Department of Mineralogy (British Museum): although one was identified as a granular limestone unlike any known Cycladic marbles, the other proved to be an onyx-marble, the sources of which are uncommon (Ucko 1968:321 n.1). Unfortunately neither stone could be linked to a specific source.

12.3.3 Shells and Other Ornaments

Numerous marine molluscs occur throughout the EN deposit at Knossos (Evans 1964:238). By far the majority were collected worn and empty from the beach and thus were not a food resource (Reese 1987). This suggests another function: some appear to have been used as burnishing tools, others have been pierced, presumably to be worn (Shackleton 1968:264-6). Although explicable in terms of direct procurement, their presence could also be accounted for by their circulation as exchange items, perhaps in the form of ornaments. In addition to this probable use of shells there are variety of bone, clay and stone beads and pendants, all of which seem to have been used as forms of body ornament (Evans 1964:237).

12.3.4 Colouring Materials

Lumps of red and yellow ochre are known from stratum X, stratum V and stratum IV, while a small piece of malachite and two pieces of azurite come from stratum IX (Evans 1964:238).

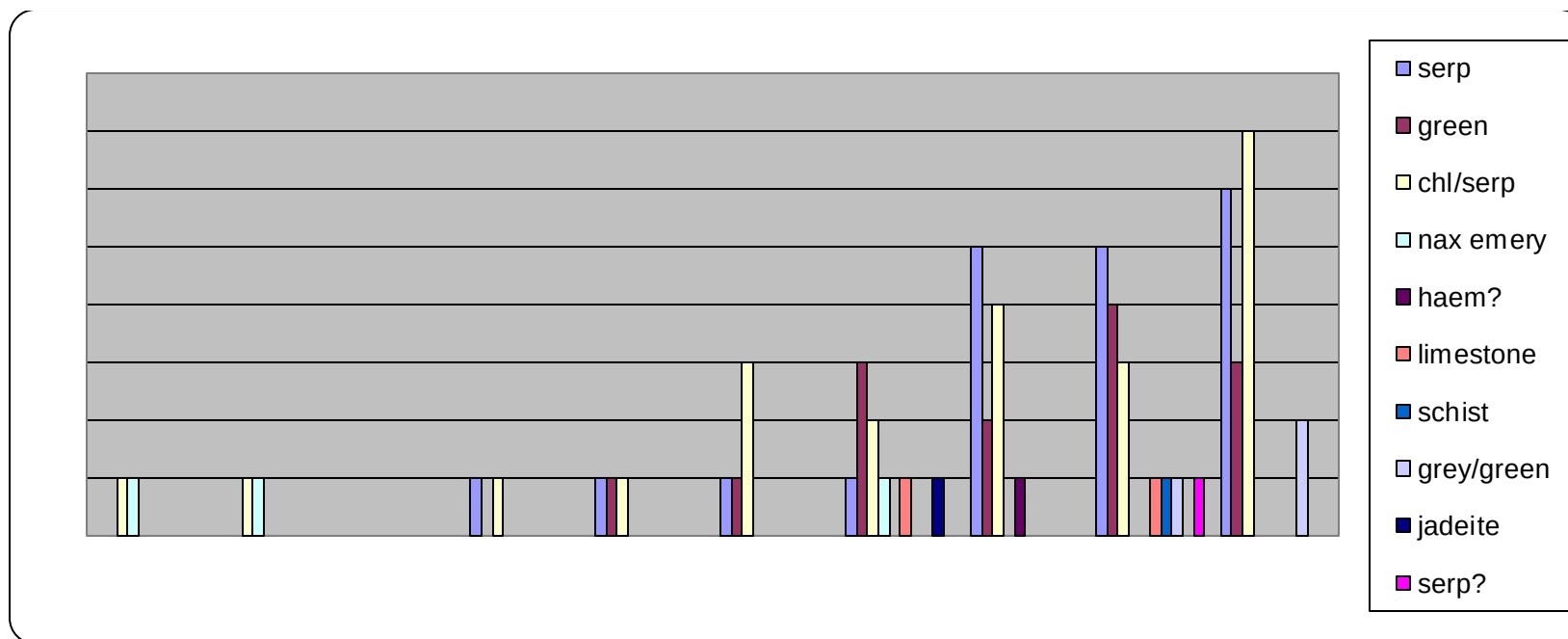


Figure 12.5 Variation in Raw Material Sources of Stone Axes Per Stratum

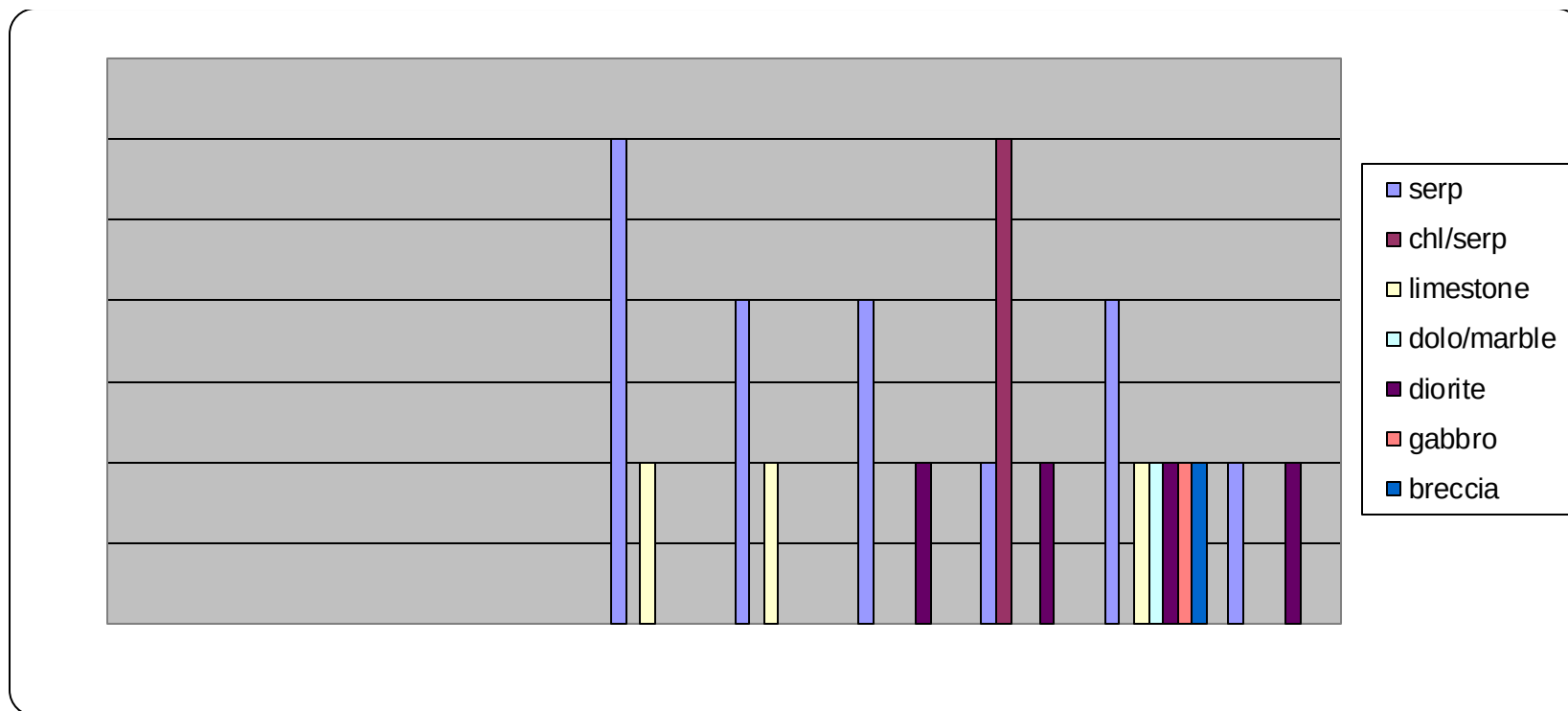


Figure 12.6 Variation in Raw Material Sources of Stone Maces Per Stratum

12.3.5 Conclusions

In advance of further study it is perhaps dangerous to speculate on the possible circulation of these various items. Nevertheless, the demonstration of the early circulation of ceramics between Knossos and sites unknown only emphasises the likelihood that other goods were also exchanged. Discriminating archaeologically between hypotheses of exchange and those of direct procurement is notoriously difficult, however if non-local items are present in small quantities and if these items represent a variety of sources, many of which lie at some distance, then hypotheses of exchange provide the most economical explanation (Perlès 1992:116-7). This explanation is reinforced when one takes into account the complex knowledge required to find, extract, transport and produce these various items. Such context-specific knowledge is not likely to have been available to all communities equally over time and space. Indirect support for this is also provided by ethnographic studies, which suggest that direct procurement is rare (Perlès 1992:116).

In this way exchange can be the only likely explanation for the presence at Knossos of the majority of the items discussed above. Melian or Yiali obsidian and axes of emery have raw material sources which lie off Crete and at some considerable distance. This may also be true for the volcanic stone mortars. Other more common types of stone artefact are likely to have a provenance on Crete, but cannot be immediately local (<5-8km) to Knossos (e.g. greenstone, serpentinite and chlorite axes; schist 'pot lids'). Indeed during ENI it is not clear if any axes or maces were made from materials local to Knossos.

There are several parallels here with patterns of circulation suggested above for ceramics:

- (1) Rare presence of items with a source from off the island (e.g. obsidian, emery tools, volcanic mortars).
- (2) More frequent presence of items whose source is probably closer but not local to Knossos (greenstone, serpentinite, chlorite axes, schist 'pot lids'). It is very tempting to compare the consistent presence at Knossos of fabrics dominated

variously by 'greenstone' (Fabric 6), serpentinite (Fabric 10), chlorite (Fabric 13) and phyllite (e.g. Fabric 8), with the frequent presence of items made in these materials. Although further speculation is impossible in advance of further analysis, it remains at least possible that the production of axes, 'potlids' and ceramic vessels alike took place in communities located near the sources of these various raw materials.

(3) Most of these goods are consistent with an origin within the Herakleion basin, however the presence of emery, Melian obsidian and Yiali obsidian suggests a pattern of circulation, which ultimately complements that suggested above for ceramics. If the limits of maritime technology made large journeys over large stretches of open sea unlikely or infrequent, then the most likely way for these exotic items to reach Knossos from the Cyclades was for them to travel either westwards to the southern Peloponnese, then via Cythera to west Crete and then east along the north coast to Knossos, or alternatively eastwards and southwards via Yiali, Rhodes, Kasos and Karpathos to east Crete and then west along the north coast.

(4) However, unlike ceramics, which exhibit a different pattern of circulation in ENIc/II, stone axes and maces show no change. Most examples are still from sources not immediately local to Knossos, although there are now a few examples which could now be local. Indeed the diversity of sources represented seems to reach a peak in ENII (n=7).

There is therefore nothing in these data to suggest that ceramic vessels during ENIa-b circulated in significantly different ways to other goods. However that is not to say that the actual ways in which the circulation of ceramic vessels was articulated need necessarily have been the same as other goods. Indeed the data are currently insufficient to allow any exploration of how the circulation of ceramics articulated with the circulation of other goods (see also below). Rather, this comparison simply shows that during ENIa-b there are no obvious differences in the way ceramics, ground stone tools, chipped stone or body ornaments

circulated. The first clear indications of any divergent patterns come in ENIc/II, where an apparent decline in the presence of non-local ceramic vessels is not matched by a similar decline in ground stone tools.

12.4 A Reassessment of Current Models for Neolithic Exchange

12.4.1 Different Artefact Trajectories? Different Mechanisms of Exchange?

This apparent basic similarity in the patterns of early circulation of ceramic vessels, stone axes and obsidian stands in contradiction to the conclusions reached by a recent detailed study of exchange in the Neolithic Aegean (see Perlès 1992), which compared the production, circulation and consumption of three different artefact types, namely ground/chipped stone, fineware ceramics and ornaments/rare goods (seals, vases, figurines) (see 1992:table 3). This study concluded that these different artefact types were produced, valued and consumed in fixed and very different ways. Regarding exchange it was argued that each artefact type circulated within one of three different forms of exchange, namely utilitarian, social and prestige (Perlès 1992; Demoule & Perlès 1993:384).

Certainly there do seem to be clear differences in the ways in which these different artefact types were produced (cf. obsidian with ceramics), part of which can be seen to be a function of the differential spatial distribution of raw material sources for each artefact type: some sources are ubiquitous (e.g. ceramics), others more discrete (e.g. stone axes) with some confined to single sources (e.g. Melian obsidian, Aeginetan andesite, Ionian honey-flint). Increasing spatial discreteness inevitably means that not all communities will have equal access to particular raw material sources. This suggests that certain communities are likely to focus or specialise in the exploitation of those sources, which are not ubiquitous. Thus, for example, Perlès notes that Greek EN-MN sites generally exploited local resources of chipped stone on a small-scale using a 'mediocre' and probably local production technology, but at the same time had access to 'high quality' honey-flint and jasper blades which were never produced locally (1992:128). These quality implements were most likely manufactured by specific communities specialising in their production and then circulated through exchange. The production of obsidian implements, which such communities also had access to, in many respects

represents a case apart since there is evidence to suggest that it was not simply blades that were being exchanged, but rather that specialised production took place locally at each site and may have been in the hands of itinerant specialists (Perlès 1992:128).

The general situation with chipped stone and other rare artefacts is contrasted with that of ceramic vessels, which Perlès argues were "simple" in their requirements on knowledge and skill and "always a primarily local production"; moreover "non-local ceramics were very rare in the Early and Middle Neolithic" since production was located in villages which were geographically evenly distributed (1992:128, 133; Demoule & Perlès 1993:383). This characterisation of early Greek ceramic production and consumption has been subject to a detailed critique by Vitelli (1993b), who disagrees with Perlès' characterisation in many areas: ceramic technology cannot be dismissed as simple or unskilled and as lacking stylistic investment or even social importance nor can the consumption of vessels be considered to be high.

Particularly problematic is Perlès' characterisation of the quantities of various artefact types in circulation. She argues that chipped and ground stone circulated in large quantities, while ceramics and 'rare goods' circulated in low quantities. However, as noted by Vitelli, there seems to be a contradiction between Perlès' assumption that large quantities of chipped stone were in circulation and statements elsewhere to the effect that the quantity of obsidian at one site in any one phase was small enough to represent the output of a single day's output by a specialist (Vitelli 1993b:24; Perlès 1992:136). Circulation in large quantities is also difficult to accept for stone axes. Perlès quotes the total number of stone axes at Franchthi as evidence for this and contrasts the rarer incidence of andesite millstones (10-30% of grindstones in the Argolid) (1992:141). However this produces a false contrast since no meaningful comparison is possible between the total quantities of a general artefact type and the specific output of a single source/production location within a general artefact type. Furthermore it is difficult to see how the 128 axes at Franchthi, deposited during a period of more than 2500 years - i.e. c.1 axe every 20 years - correspond to large quantities in circulation! Likewise concerning shell bead manufacture at Franchthi Perlès

optimistically concludes from production waste that output was high. However more recent detailed study has shown that output was very low and the evidence from other sites suggests that the quantity of shell bead necklaces in circulation was low (Miller 1996). Stone vases also seem to have circulated in very small quantities (Perlès 1992:142) and at least one community (Nea Makri) may have been specialising in their production (Phelps 1975:114). Thus if one breaks down the quantities of specific artefact in circulation within each general artefact type (i.e. particular types of stone axe, mortar, chipped stone), the differences between these different categories dissolve.

When compared to the evidence from Knossos for the same period, Perlès' assessment of the low circulation of Greek EN-MN ceramics (1992:145) also seems problematic. As Figure 12.1 demonstrates, during ENIa-b (Greek EN-MN) local fabrics (1a-i, 2a-e) account for less than half of the ceramics consumed at Knossos. It has also been argued (see Chapters 6-7) that a small number of vessels originated in areas at least 250km from Knossos, which far exceeds the maximum noted by Perlès of 70km (1992:146). Thus although Perlès (1992:143) contrasts the high level of pottery consumption with the low level for 'rare goods', these data from Knossos show that within the broad category of pottery there are vessels which are as rare and thus consumed in equal quantities as 'rare goods'. In addition at Knossos it is not simply finely finished vessels which seem to travel. Rather both coarse (burnished) and fine (polished, incised) vessels circulate to such an extent as to suggest that the ubiquity of sources and production locations did not act to constrain circulation in the way that Perlès suggests they might have done. This latter point reveals something important, namely that the extent to which ceramic vessels circulated during ENIa-b contradicts the simple economic argument from necessity and availability and suggests rather that this pattern is significantly social in origin: ceramic vessels circulated widely despite the fact that functionally-equivalent locally-made versions were available (see below).

Difficulties are also encountered when one considers Perlès' identification of three different contexts in which chipped/ground stone, ceramics and 'rare goods' were exchanged and consumed, namely utilitarian, social and prestige (see Perlès 1992:143-4, 148-9, 152-3; see discussion in Chapter 3). Thus axes and

chipped stone are considered to be 'utilitarian', that is they are items which are purely functional and have a low stylistic input. These are contrasted with 'rare goods' and pottery which are non-utilitarian, that is not purely functional and therefore social. 'Rare goods' are considered to be in a special category of prestige items. Pottery qualifies as non-utilitarian because during Greek EN-MN it is not a tool for cooking, is finely finished and fragile (Perlès 1992:143-4). The validity of these distinctions is open to serious question and is actually very difficult to justify. In Chapter 3 it was argued that *all* action is social action, that *all* material culture is profoundly social and that *all* functional categories are effectively social constructs. In reality it is impossible or even ridiculous to assume that the circulation and consumption of stone axes was in any way less social or less prestigious than the circulation and consumption of ceramic vessels or other rarer items. Thus this distinction drawn by Perlès is false and confusing. Nor does it even make sense when applied to the available data: although Perlès notes the 'handsome' exotic stone axes from the 'communal' building at EN Nea Nikomedeia as exceptions to her distinction (1992:143), there are many others. For example almost all the stone axes from Aceramic-ENIb Knossos are significant for the exotic nature of their raw materials, a feature which cannot be simply explained in purely economic or functional terms. As a result the distinction drawn (Perlès 1992:144) between exogenous utilitarian products, exogenous non-utilitarian and local non-utilitarian dissolves. In this way the three different exchange systems (utilitarian, social, prestige) or categories of circulation and consumption, which Perlès 'identifies' (1992:153), appear to be a modern imposition and may have little or no relevance to any past scenario.

And so if one incorporates these criticisms and substitutes a characterisation of ceramic production, circulation and consumption based on data from Knossos for the one preferred by Perlès, then ceramic vessels exhibit a much closer similarity to other artefact types (see Figure 12.7).

	Ground/Chipped Stone	Ceramic Vessels	Ornaments /Rare Goods
origin of artefacts	mostly non-local, some local	local and non-local	mostly non-local

quantities consumed	medium to low according to category	medium to very low according to fabric	very low
use context	social/ritual	social/ritual	social/ritual
quantities in circulation	medium to low according to category	medium to very low depending on distance from source	very low
maximal distances	350km	c.250km+?	unknown, but long
fall-off patterns	'reciprocal'	'reciprocal'	unknown
Inter-/intra-site distribution	present in all sites & households	present in all sites & households	present in some sites & some households

Figure 12.7 Comparison of the Consumption and Circulation of the Main Artefact Types during Greek EN-MN (a modification¹⁶⁰ of Perlès 1992 (tables 2-3) substituting ceramic data from Knossos)

Indeed, if one sets aside the basic differences in the distribution of constituent raw materials and in the various production sequences¹⁶¹, there seem to be no significant differences in circulation and consumption for ceramics, ground/chipped stone or ornaments/rare goods. It is important to be clear that (*contra* Perlès 1992:149) the recognition of these basic similarities in the circulation and consumption of these three artefact types is neither 'socially simplistic' (see above) nor a reductive attempt to create a single form of exchange, a single socio-economic basis for the circulation of goods or a single distribution network. Rather, this recognition of similarities simply represents a more faithful characterisation of the data currently available. It remains possible that if the resolution of our data was better, it might prove possible to see subtle differences

¹⁶⁰ This table uses Perlès' assessments for each category, apart from ceramics and where she refers specifically to obsidian. Figure 12.7 ignores the data for the circulation of obsidian since this does appear on current evidence to be a special case. Figure 12.7 also ignores evidence for differences in production and raw material location. For the use-context of chipped/ground stone the broader definition social is preferred to 'utilitarian' since it is impossible to justify the distinction of utility as having any relevance to how such artefacts were perceived in the past (see Chapter 3). Also the fall-off pattern for rare goods is considered 'unknown', rather than the vague 'prestige goods', since, as Perlès herself indicates (1992:tables 2-3), the distances over which such vessels circulated is unknown.

¹⁶¹ In the conclusions to Chapter 11 it was suggested that even these differences may not have been as significant as has previously been claimed (e.g. Perlès 1992; Perlès & Vitelli 1999).

in the circulation, valuation and social classification of different objects, however what must be stressed is that at present there is nothing in the available data and certainly nothing in Perlès' analysis to demonstrate the existence of such differences. Certainly the general nature of the criteria in Figure 12.7 and the wide variation exhibited by each artefact type within each criterion do not preclude a very real variety in the potential trajectories along which individual objects, whether stone axes, ceramic vessels or 'rare goods', could travel.

And so, if one sets aside obsidian, one cannot, at least not for Crete, argue that different artefact types, with differentially distributed raw material sources and different production sequences, *necessarily* circulated in different ways prior to the Greek LN or Cretan ENIc (see below). Furthermore, at present the three mechanisms which Perlès has described have no basis in the available data. Recognition of this, however, need not engender further expressions of our ignorance of the 'socio-economic basis' for the networks in which objects circulate (cf. Perlès 1992:116), but rather provides the basis for a more subtle and contextually sensitive characterisation of the circulation of ceramic vessels during the Neolithic. In the following section, as a preliminary to later discussion, several mechanisms, which have previously featured in analyses of Neolithic exchange, will be discussed in connection with the data from Knossos.

12.4.2 Identifying and Understanding Modes of Neolithic Exchange: Down-the-Line versus Middleman Exchange?

In an early article on the circulation of raw materials in the Neolithic Aegean and their correlation with modes of exchange, Renfrew argued that all early movement could most easily be accounted for by a model of reciprocal 'down-the-line' exchange, where artefacts travel over distance by passing from hand to hand and from community to community, without the assistance of full-time specialist 'middlemen' traders (Renfrew 1973:185). This interpretation was considered to be the best means of explaining patterns of distribution which indicated a rapid fall-off in frequency with distance from source.

More recently, Perlès has argued that the specific fall-off curve of frequency versus distance from source for the Melian obsidian found at EN-MN

sites in Greece is not so rapid and may indicate the existence of middleman traders (1992:146, 151). She identifies a very gradual fall-off rate over a very wide area which includes sites in northern and southern Greece together with a very sudden drop-off outside this zone, which is held to correspond to an expected drop-off "beyond the traders' zone of action" (Perlès 1992:146). It is unfortunate, however, that this assessment is based on 'impressions' and could not be quantified or demonstrated in absolute terms. Furthermore, elsewhere Perlès argues that obsidian blades are "never really plentiful... and particularly not at sites outside the direct procurement area", a statement which would suggest that the quantities of obsidian at sites are too low to construct a meaningful fall-off curve. These considerations inevitably take something away from the conclusions reached.

The middleman hypothesis can also be questioned in more general terms on the grounds of the usual relationship between producers, middlemen and consumers. The role which middlemen play in socio-economic systems has recently come under closer scrutiny and it is now recognised that middlemen play an important role in translating the external demands of consumers back to local producers with the end result being a reorganisation of that production gearing it more to the external market (see Kopytoff 1986:88-9; Appadurai 1986:33, 42ff). As noted by Nicklin, "the appearance of middlemen tend to signal the extension and growth of modern market economies" (Nicklin 1971:12). Thus with the presence of middlemen one is likely to see changes in the organisation of production and increases in output; i.e. one would expect to find 'production for exchange' (see Chapter 4). However, in situations where there are no specialist middlemen, local producers are unlikely to have knowledge of external markets and are unlikely to re-organise their production accordingly; i.e. production is 'for use' or 'livelihood'.

As demonstrated in Chapter 11, ENIa-b ceramic production on Crete does not appear to have been oriented towards high output or to have been re-organised towards production for exchange or to satisfy the needs of distant consumers. Rather as a 'production for use' ceramic production seems to have been sparing of labour demands and not motivated by considerations of economic efficiency (seasonal, low output; see Chapter 11, also Chapter 4). This even seems to have

been the case elsewhere in the Aegean for the production of valuables perhaps by communities specialising in their manufacture: at EN Franchthi shell-bead manufacture was labour-intensive and the output very low, showing no signs of having been organised primarily for exchange (see Chapter 11). Thus, although one could argue that such products of community specialisation should be considered 'commodities by destination' (Appadurai 1986:16), in the sense that they exceeded the immediate consumption requirements within their location of manufacture and would most likely be exchanged, one cannot characterise this as production for exchange in the conventional sense.

In this way the singular lack of any impact of external demand on local production in the earlier Neolithic of Crete and the Aegean, that is the absence of 'production for exchange', constitutes a strong argument against the existence of middlemen traders in any conventional sense. It therefore seems unlikely that earlier Neolithic exchange, at least on Crete, was ever in the hands of full-time specialists and more likely that it was based on forms of reciprocity, as Renfrew originally suggested (see below).

A more fundamental problem with these approaches (Renfrew 1973; Perlès 1992) is that both assume that different artefact distribution patterns will always correlate with specific modes of exchange. This assumption has been the basis for most reconstructions of past exchange systems over the last two decades, however it is now clear that "a number of quite different agencies might have been responsible for the same types of patterning" (see discussion in Bradley & Edmonds 1993:5-11). Highly similar fall-off curves can be generated by a variety of different processes, interactions and contexts. A further problem with such approaches is that they often assume that the supposed identification of a mode of exchange from spatial distribution of artefacts is all the explanation required for that exchange system. Thus the majority have tended to emphasise the frequency or the scale of consumption and circulation, rather than the character and context of artefact use and deposition (Bradley & Edmonds 1993:11). As emphasised in Chapter 4, the use of typological models to identify past forms of social organisation is always to some extent reductive and ahistorical since it assumes that it is worthwhile and useful to generalise about past behaviours, in this case

viewing the circulation of artefacts as somehow pre-destined by the mode within which they were circulating. As argued in Chapters 3-4, a more sensitive approach is to be preferred, which views the circulation of objects in terms of the different social contexts through which they pass and the different social relationships and values such objects help to create (Bradley & Edmonds 1993:11-12).

12.4.3 Exogamy?

The application by Halstead of the DMP model to early farming communities in Greece, represents a significant advance in our understanding of those factors which might encourage the creation and maintenance, through reciprocal exchanges, of social relationships within and between communities (see Chapter 4). Early Greek farming communities were relatively small and in all but the largest examples cannot have been demographically self-sufficient. Likewise later Neolithic island communities must have relied on networks of social contacts to ensure their viability (Cherry 1985:24). For example Knossos from its Aceramic beginnings to the end of ENIa seems never to have exceeded 0.5ha in size with a population of well below 100 (see Appendix II). Thus exogamy must have been one factor which promoted exchanges between communities. However, as Halstead has noted for northern Greece (1999:78-9), the size of the interaction zones, as suggested by ceramic stylistic similarities between settlements, are far larger than would be necessary for simple demographic viability. This statement also seems to hold true for ENIa-b Knossos: ceramic vessels highly similar or nearly identical to ones produced in the immediate locale of Knossos were being made at a number of locations around the Herakleion Basin and as far away as the Bay of Mirabello (c.75km). If however, instead of zones of stylistic similarity, one considers only those fabrics, which occur most frequently at Knossos in this phase (Fabrics 1a-i, 2a-e, 5a, 6, 8), then a much smaller zone of intense interaction is suggested. Although speculative, one could tentatively suggest that Fabrics 5a, 6 and 8 might correspond to between one and three other settlements with which Knossos was most frequently exchanging. If so and if these settlements were of a similar size as Knossos then this would suggest a maximum breeding population of c.250 at

the end of ENIa and c.1200 by the end of ENIb (see Appendix II). Halstead has suggested a figure of around 500 as a stable, viable breeding population (1999:79). Thus, if there is any validity in this admittedly very speculative reconstruction then it would suggest that this zone of intense local interaction between a relatively small number of settlements could relate more closely to the scale of interaction expected between local intermarrying populations.

12.4.4 Risk-Management?

Halstead has also suggested that the need to off-set the risk of individual household failure constitutes another factor encouraging the maintenance of links beyond the household and perhaps beyond the community: By maintaining such links individual households could call upon outside assistance at times of subsistence failure or during periods of labour shortage (see Chapter 4). In this way households are likely to compete with each other to establish links with stronger households outside the community. Certainly the need to manage risk may be embedded within a number of motives behind the cultivation of wider social ties, however it is hard to see it as a primary motivating force. Sahlins' powerful characterisation of small-scale pre-modern societies as non-economising and essentially optimistic (even over-optimistic) about their abilities to provide for their own subsistence (see Chapter 4) suggests that risk-management, although a seemingly obvious necessity, need not have been at the very forefront of their decision-making.

12.4.5 Conclusions: Social Fields and Special Journeys?

The ceramic data from Knossos strongly suggest that the majority of exchanges can be accounted for in terms of interaction between a number of communities within a relatively small radius around Knossos, probably within the Herakleion basin. This area is defined here as a *social field* (see Welsch & Terrell 1998:50-4). Thus most ceramic vessels appear to have been produced, exchanged and consumed within this immediate area. During ENIa-b the level of interaction between communities within this field was high, with vessels made outside the immediate area of Knossos (>5km) accounting for around half the ceramic

assemblage. During ENIc-II, the level of interaction beyond the immediate area of Knossos dropped considerably to c.15%.

The rare presence of vessels originally produced at some greater distance from Knossos and the existence of very large style zones can be explained in two ways:

(1) *Overlapping Social Fields*: the social field described above surrounds Knossos, however each community within Knossos' field will have their own social field which may include other communities not so well represented at Knossos. Social fields therefore overlap spatially and together create an interlocking web of contacts, which in extent will always transcend those of any individual community within it. In this way vessels from distant sources may travel in different directions from community to community, from field to field, until their deposition sometimes at a great distance from their place of origin. This mechanism requires that one assumes that ceramic vessels circulated (and re-circulated) consistently as commodities and were not subject to inalienability (Chapter 3; see below).

In this way analyses of 'Down-the-Line' exchange only work because social boundaries blur and overlap. Unfortunately, the impression one usually gains from such analyses is not that objects could have unpredictable biographies, but rather that the circulation of particular categories of artefact was unidirectional and predictable with objects moving steadily away from their source becoming less and less frequent in site assemblages as they move. That this is not the best characterisation of how ceramic vessels actually may have circulated is indicated by the frequency data from Knossos, which strongly suggest that once ceramic vessels move outside the social field surrounding their place of manufacture, they do not move in groups, which steadily decline in size as they move further away, but rather in such small quantities (<1/1000sherds) as to suggest their movement as individual vessels. At this point there is no frequency curve, but rather a steady base-line of frequency for all rare vessels (cf. Figure 12.2). Once outside their initial social fields the ultimate deposition point of such vessels actually seems to be *unpredictable* and could range from the next community to communities in

other regions of the island or even beyond. Nor need the circulation of such vessels be in any way unidirectional, rather it is safer to admit the possibility that such circulation involved movement in all directions.

(2) *Special Journeys*: although the model of overlapping social fields theoretically could account for the rare presence of ceramic vessels originating at some considerable distance from Knossos, there are good reasons to think that in addition to frequent interaction probably over relatively short distances, there must also have been rarer occasions when single journeys were made over considerably larger distances.

The existence of such journeys is above all implied by the presence at Knossos of ceramic vessels and other goods, which must have an origin off the island. Thus the presence from the Aceramic of obsidian from Melos and Yiali and stone tools of emery and from ENIa ceramic vessels with likely origins in southern Greece and south-west Anatolia/east Aegean, indicates that longer journeys were made beyond Crete. Even if one assumes the minimal¹⁶² view, that such journeys took place between communities located at the far east and west ends of Crete and communities on the very tips of Greece or Anatolia, this nevertheless requires long journeys crossing island chains (i.e. Cythera, Kasos, Karpathos), which at present during Aceramic-ENIb (c.7000-5100BC) appear to have been uninhabited (Broodbank 1999:31-4). Such journeys were probably not frequent, but nevertheless were regularly made to judge by the presence of off-island material throughout the EN deposit (ceramic vessels, obsidian, emery). Furthermore, once the existence of such special journeys has been established, then it becomes quite possible, if not likely, that such journeys were also made

¹⁶² In support of minimal penetration of regions beyond Crete it is perhaps worth noting that likely off-island vessels are represented by a very small number of fabrics, several of which improbably, considering their very distant origin, recur (e.g. Fabrics 24, 26, 28, 32). This may suggest that contacts with regions off-island were not extensive and even restricted to specific areas within those regions. The recurrence of some fabrics over the course of EN may indicate that these contacts were maintained over a long period of time. Halstead has argued (1989:75) that distant partnerships are inherently stable because of their inevitable redundancy at some times. However it is equally possible that knowledge of specific maritime routes off Crete to distant regions, passed on from generation to generation, led successive generations of travellers to the same distant locations.

within Crete between different communities in different social fields or even in different regions.

The possibility of such special longer journeys having taken place during ENIa-b can be approached from another direction. The principal problem with assuming that all non-local items at Knossos are explicable in terms of a sequence of exchanges within overlapping social fields is the general association noted in ethnographic studies between gift-giving and the 'inalienability' of the gift given (see Chapter 3; Thomas 1991:14-22). Although the exact nature of the exchange relationships, which lie behind the ENIa-b circulation of ceramic vessels, remains obscure, if, as seems likely, these exchanges generally served to create, reproduce and manipulate social relations (e.g. marriage rights, settling disputes etc.) between individuals and groups, who were already socially close, then it is highly probable that they frequently equated to some form of gift exchange. If so, then the 'gift' of a ceramic vessel is likely on many occasions to have rendered it inalienable: the on-going significance of the gift lies in the way it always contains an association with the original producer/owner and thus continues to testify to the continued existence of the social relationship between giver and receiver, which its original exchange rendered in material form. If forms of 'gift exchange' were the principal forms of local exchange during the earlier Neolithic then the degree to which objects re-circulated after initial exchange from their production locale may have been quite restricted. However, in those exchanges where there was greater social distance between the two parties, such as those conducted outside the immediate social field, where giver and receiver are unlikely to be close kin, it is possible that exchanged objects did not have the same connotations and associations and may therefore have had a less restricted commodity candidacy.

Within forms of exchange which rendered the object inalienable and in the absence of third parties (i.e. middlemen traders), for whom such vessels might have been exchange commodities more than gifts, it is hard to see how vessels could have passed at a local level through many hands prior to their arrival at Knossos. Also questionable is the extent to which ceramic vessels could have passed through many hands and remained unbroken or undiverted. Finally, as

noted above once vessels travel beyond the immediate social field surrounding their location of manufacture, there is not so much as a declining frequency curve, but a frequency base-line, which suggests that vessels did not move from community to community in groups which decreased in size as distance from source increased (e.g. 'Down-the-line' exchange), but as *single* vessels.

All of these features combined therefore favour the existence of special longer journeys of acquisition. One might also note in passing that the regular occurrence of special longer journeys between settlements in different regions of Crete might also be the best way to explain the continued maintenance of large zones of stylistic similarity during this period (ENIa-b). These special journeys would have taken individuals far from their home communities and must have required considerable skill, have entailed high risks and have taken considerable amounts of time. Clearly therefore such journeys required considerable effort, knowledge and skill and as such must have been a source of prestige (cf. Helms 1993).

12.5 Luxury/Ordinary Goods, Diversion and the Differential Creation of Value

And so it may be suggested that two basic types of movement contributed to the circulation of ceramic vessels and other goods between communities during ENIa-b. Firstly and primarily intensive interaction at a local scale, and secondly more distant special journeys beyond the local environment. A broad parallel for the co-existence of these two types of movement is provided by the kula system, where grander (high prestige) inter-island exchange is contrasted with more intimate regular and problematic intra-island exchanges (Appadurai 1986:20). In the kula system such longer distance exchanges represent deliberate efforts to transcend the more humble flow of things. In other words, such long journeys serve to divert objects from their usual paths (Appadurai 1986:28-9), i.e. local circulation in intensive local interactions, and thereby serve to create special value in the object and special prestige on the traveller. If this comparison has any meaning it would seem to suggest the possibility that one of the motivations behind such special journeys during ENIa-b, was the strategic diversion of objects

from their usual patterns of circulation in order to create special value and thereby social prestige.

In Chapter 3 it was argued that value is not a fixed attribute of each object, but rather that is created and recreated through acts of exchange. Thus objects may gain or lose value depending on their context and specifically on how they are perceived. Here it is perhaps worth noting again the distinction drawn by Appadurai between how early complex and less complex societies differentially create distinctions between luxury and ordinary goods. In early complex societies the links between luxury and ordinary goods mostly involve the production process, with luxury goods usually having more complex production sequences. However in less complex societies the connection between luxury and other goods involves "not the ripples of a complex set of production milieux and forms but critically, the domains of exchange and consumption" (Appadurai 1986:39; see Chapter 3). Likewise Sahlins has argued that since producers in less complex societies always retain some sort of control over their economic means, social competition tends to be played out in the arenas of consumption and exchange (Sahlins 1974:94; see Chapter 4).

Several converging lines of archaeological evidence suggest that during ENIa-b ceramic vessels and other objects did not have fixed values based on the rarity of their raw materials and/or the complexity of their production sequences (*contra* Perlès 1992; see discussion above), but rather were subject to changing estimations of value constructed through acts of exchange and consumption.

(1) *No clear correlation between distance from source and 'quality' of vessel*: thus, although many of the non-local vessels in the ENI assemblage at Knossos are well-formed finely polished open bowls of various types and would thus qualify broadly as 'fineware', the presence also of coarsely burnished open and closed vessels, some of them from very distant sources (see above) makes it clear that it was not simply the most finely-produced vessels which circulated. The circulation of coarsely finished vessels makes sense if such vessels had gained in value through exchange, travelling far from their source precisely because their social value had transcended their original use-value.

(2) *Redundancy of form and function*: all non-local vessels at Knossos have direct formal and functional equivalents amongst vessels produced locally. This redundancy in form and function is only emphasised further by the very strong similarity in form and finish exhibited between vessels produced locally (<5km) to Knossos (Fabrics 1a-i, 2a-e), vessels produced nearby (Fabrics 5a, 6, 8) and vessels produced, either at the opposite end (c.75km) of the island (Fabric 12) or perhaps at the edge of the Herakleion Basin (Fabric 10). This conclusion directly contradicts Perlès' claim that during the Neolithic the degree of stylistic marking/variation corresponds to the scale of exchange: high stylistic variety, high level of exchange (Perlès 1992:140). Such similarities or redundancies in form emphasise how the circulation of vessels cannot be explained either in simple economic terms through their special functional capabilities or in their obvious distinctive characteristics. Regarding this latter point it should be stressed that on many occasions it is impossible to discern provenance simply by looking at vessel form or finish. This invisibility of origin suggests that knowledge of a vessel origins could only be transferred between owners through oral transmission. This invisibility may even suggest that origins were not as important as other associations in a vessel's life history, such as individuals or events. Certainly such invisibility allows the narrator/owner of such vessels room for a degree of manipulation of fact and fiction in the creation and recreation of individual vessel biographies.

(3) *Drilled mend-holes*¹⁶³: during macroscopic study the incidence of mend-holes per fabric and form was recorded, the results of which are presented in Figures 12.8 and 12.9. Out of the total number of mend holes recorded for ENIa-b, almost 75% were in non-local fabrics. The high frequency with which mend holes correlate with non-local fabrics is much greater than the rate at which these fabrics occur (cf. c.75% of mend-holes, only c.50% of assemblage; see Figure 12.1). However, during ENIc-II the frequency with which mend-holes occur in non-local

¹⁶³ Drilled mend-holes have been noted as a feature of a number of other Neolithic ceramic assemblages, such as EN-MN Franchthi (cf. Vitelli 1993a:40 n.1, 150, 211 n.11) and LN-MC Ayio Gala and Emporio (Hood 1981:20).

fabrics falls to less than 20% with now over 80% of mend holes being in local Fabrics 1a-i, 2a-e. Here the frequency of mend-holes seems to relate closely to the frequency in which fabrics occur (cf. c.80% of mend-holes in local Fabrics 1a-i, 2a-e, local Fabrics 1a-i, 2a-e comprise c.85% of the assemblage; see Figure 12.1).

It seems likely that the occurrence of mend holes should direct us towards those vessels for which greater effort has been taken to ensure their curation (see Plate 56). Moreover it seems reasonable to suppose that this extra effort in some way provides an index of relative value. One noticeable feature of mend holes is that with perhaps only one or two exceptions in the whole EN sequence they are found on fine polished bowls/jars. This would seem to illustrate a general if unsurprising point, that fine polished vessels were more highly valued than ones which were more coarsely burnished. Also worth stressing is the especially high frequency with which mend-holes occur in non-local fabrics at Knossos during ENIa-b. This would seem to suggest that during this period greater efforts were taken to curate vessels in these fabrics, than in local Fabrics 1a-i, 2a-e and that this greater effort might correspond in some way to the greater value attached to these more exotic vessels.

Phase	Context	Fabric	Ware	Comments
ENIa	VIII	5a	fine	curved open bowl; near rim
ENIa	VIII	5a	fine	curved open bowl; near rim
ENIa	VIII	1/2	fine	open bowl; body
ENIa	VIII	6	fine	near rim
ENIa	VIII	6	fine	body
ENIa	VIII	1/2	fine	open jar; near rim
ENIa	VIII	6	fine	near rim
ENIa	VIII	10	fine	body
ENIa	VIII	10	fine	body
ENIa	VIII	10	fine	body
ENIb	ENIb	8	fine	collared jar near rim
ENIb	ENIb	8	fine	collared jar body
ENIb	VII	1/2	fine	near rim
ENIb	VII	1/2	fine	near rim
ENIb	VII	10	fine	body
ENIb	VII	6	fine	near rim
ENIb	VII	10	fine	near rim
ENIb	VII	6	fine	near rim
ENIb	VI	5a	fine	curved open bowl; near rim
ENIb	VI	5a	fine	curved open bowl; near rim
ENIb	VI	1/2	fine	thin-walled body
ENIb	VI	1/2	fine	near rim

ENIb	VI	5a	fine	thin-walled body
ENIb	VI	5a	fine	vertical carinated bowl; near rim
ENIb	VI	5a	fine	vertical carinated bowl; near rim
ENIb	VI	5a	fine	vertical carinated bowl; near rim
ENIb	VI	8	fine	bowl with offset rim; near rim
ENIb	VI	8	fine	body
ENIb	VI	6	?	body
ENIb	VI	6	?	body
ENIb	VI	1/2	?	body
ENIb	VI	1/2	fine	bowl with offset rim
ENIb	VI	1/2	fine	body

Figure 12.8 Incidence of Drilled Mend Holes Per Fabric, Form and Finish (ENIa-b)

Phase	Context	Fabric	Ware	Comments
ENIc	V	5a	coarse	thick-walled body
ENIc	V	1/2	fine	curved open bowl; near rim
ENIc	V	1b	?	curved open bowl; near rim
ENIc	V	1b	?	curved open bowl; near rim
ENIc	V	1b	?	curved open bowl; near rim
ENIc	V	1d	fine	carinated bowl with offset rim
ENIc	V	1d	fine	carinated bowl with offset rim
ENIc	V	5a	fine	body
ENIc	V	5a	fine	body
ENIc	V	1b	fine	body
ENIc	V	1b	fine	body
ENIc	V	1b	fine	carinated bowl with offset rim
ENIc	V	1b	fine	carinated bowl with offset rim
ENIc	V	1b	fine	flared rim bowl; near rim
ENIc	V	2a/b	fine	deep bowl; near rim
ENIc	V	1b	fine	body
ENIc	V	2a/b	fine	body
ENIc	V	1e	fine	curved bowl with offset rim; near rim
ENII	IV	5a	fine	near rim
ENII	IV	1e	fine	near rim
ENII	IV	1e	fine	near rim
ENII	IV	1e	fine	body
ENII	IV	1d	coarse	body
ENII	IV	1e	fine	body
ENII	IV	1e	fine	body
ENII	IV	1e	fine	body
ENII	IV	1e	fine	body
ENII	IV	1e	fine	curved bowl with offset rim; near rim
ENII	IV	1e	fine	curved bowl with offset rim; near rim
ENII	IV	1e	coarse	body
ENII	IV	1e	coarse	body
ENII	IV	1f	fine	body
ENII	IV	1f	fine	body
ENII	IV	1f	fine	body
ENII	IV	1f	fine	curved bowl with offset rim; near rim
ENII	IV	1f	fine	body
ENII	IV	1f	fine	body
ENII	IV	1f	fine	body
ENII	IV	5a	fine	curved jar with offset rim; near rim
ENII	IV	8	fine	body
ENII	IV	8	coarse	thick-walled body
ENII	IV	34	fine	body

Figure 12.9 Incidence of Drilled Mend Holes Per Fabric, Form and Finish (ENIc-II)

(4) *Similar patterns of circulation for other artefact types:* a final indication that production sequences were probably not responsible for the value attached to artefacts is indirectly provided by the general similarities (*contra* Perlès 1992; see above) which seem to exist between the circulation and consumption of ceramic

vessels and other goods during ENIa-b (see Figure 12.7 and discussion above). These similarities exist despite the different production sequences of these objects and despite the differential distribution of the raw materials required.

When these four converging lines of evidence are combined they strongly suggest that different ceramic vessels were valued in different ways in different places and at different times. They indicate a higher valuation for fine polished vessels than for coarse burnished ones, but also for ENIa-b suggest that fine polished vessels, which had travelled some distance from their source, were more highly valued than their local equivalents. It would also appear, however, that both coarse and fine vessels circulated. In addition the small number of ENIa-b mended vessels in immediately local fabrics (1a-i, 2a-e) also serves to emphasise that such vessels could also have particular social value. When combined these features suggest very strongly that the value of ceramic vessels was not fixed or absolute, but very much contingent, subject to variation and intimately related to the contexts in which these vessels were exchanged and consumed. In other words quantitative and qualitative differences in the consumption or valuation of different goods must have been dependant on context and *not* on the very different requirements necessary for their production (cf. Chapters 3-4). One of the ways in which the value of exotic vessels may have been curated and displayed was through the oral narration of vessel biographies (stories surrounding acquisition, associated individuals, events, places). In this way the life history of an object may have been *essential* and not incidental to its value (cf. Appadurai 1986:23ff.).

And so it should be clear that the distinction between luxury and ordinary goods at ENIa-b Knossos was not hard or fast, but was subject to varying contextual definitions, whether created by exchanges over short distances or by special acts of procurement over longer distances, which served to divert objects from their normal paths of circulation. Thus although all forms of exchange create value, these valuations may vary within and between these different forms. For example, it seems reasonable to argue that special value and special prestige accompanied objects brought back from special longer journeys. Comparative ethnographic, historical and archaeological study well illustrates the political and

ideological symbolism associated with the procurement of valuable resources from distant or outside locales and their role in the negotiation of power, status and identity (see Helms 1993, especially pp.210-7). In this way the exchange and consumption of certain ceramic vessels may have taken place within what have been termed 'tournaments of value' (Appadurai 1986:21ff.; see Chapter 3). Such 'tournaments of value' are not driven by economic necessity but rather by the desire to negotiate status and establish reputation.

Finally although strictly outside the range of this study mention should be made of the implications of this interpretation of circulation in ENIa-b for our understanding of the preceding Aceramic period. The circulation of objects far from their original source noted for ENIa-b suggests the possibility that a similarly high level of circulation might characterise the Aceramic. Certainly the presence of an emery stone axe in stratum X, a marble bowl in sounding X (Evans 1970b) and Melian obsidian would be pointers in this direction. In addition, macroscopic study of the small amount of other chipped stone in stratum X suggests the exploitation of a number of sources (T. Strasser pers. comm.). The consistently small size of the settlement at Knossos during this long phase also indicates the necessity of contacts with other settlements (see Appendix II). Finally, the arrival of ceramic technology and the adoption of several forms which have contemporary parallels in other regions of the Aegean (see Chapters 7, 13; Appendix I) may also constitute an argument in favour of contacts between communities on Crete with those outside the island, which might be analogous to those described above for ENIa-b.

12.6 The Circulation of Goods (ENIa-b): A Stable Universe of Commodities?

Although much of this discussion of exchange and circulation has been about widening the scope of previous approaches to Neolithic exchange, it should not be forgotten that the actual range of material goods in circulation, although apparently numerous, is, in comparison for example with the Aegean Early Bronze Age, relatively small (cf. beads and body ornaments, marble figurines, stone axes, maces, schist 'potlids', mortars, querns, chipped stone (obsidian, chert etc.), colorants, as well as invisible items such as perhaps food, wooden objects,

basketry, people). This range of potential commodities seems to have remained stable, that is it does not appear to have been consistently extended to include other artefact types (see also Section 13.2.4). In Crete during ENIa-b different settlements around the island were producing ceramic vessels with strong similarities in form and finish so that in general the wide circulation of ceramics at this time rarely meant the arrival of new and very different foreign forms. Likewise although stone axes of a variety of non-local sources were consumed at Knossos during this period, the frequency with which three or four main sources recur and the similarity in form between these different sources again suggests stability and an emphasis on continuity.

This limit, both to the range of material categories in circulation and to the amount of variation within each material category, suggests that material categories may have been formalised (see also Chapter 13) with the types of exchangeable objects might have been restricted to a limited set of formal categories. Comparative ethnographic studies of consumption and exchange have noted that in pre-modern small-scale societies there tends to be only very limited room for manoeuvre in the 'tug-of-war' between the economic tendency to commoditisation and the inclination of all societies to restrict commoditisation to a 'stable universe of commodities'; that is to put a limit to the numbers and types of commodities in circulation (Appadurai 1986:17). This restriction of equivalences and exchange to a 'stable universe of commodities' often acts to protect and reproduce status systems (Appadurai 1986:25); in such systems luxury or valuable goods play the role of tokens through which status is conventionally reproduced. In contrast, where the universe of commodities is ever-changing, status systems rely on the strategic control of taste.

And so the circulation of ceramic vessels during ENIa-b may be understood in terms of exchange within a stable universe of commodities. Although individual vessels were potentially subject to a variety of valuations, the majority are likely to have circulated within a relatively small social field surrounding their place of manufacture. Within this zone it is likely that such items may have circulated within a more restricted system of equivalences. Recognition of the stability of this local system in turn allows the significance of the rare

appearance of more exotic items to be more clearly understood. At one level the ground stone tools of emery or ceramic vessels with origins in distant communities, such as the Mirabello Bay in East Crete or regions outside Crete, fit perfectly within existing material categories at Knossos and are thus 'acceptable', however on another level the distance over which they have travelled, the biographies they have acquired and perhaps the extent and difficulty of the special journeys undertaken to acquire them make them rare, exotic, valuable and above all powerful objects. Thus while most exchanges existed within a universe of commodities, whose very stability and acceptability was something which was actively maintained in each act of exchange through adherence to a particular set of social values, the apparent desire to acquire and consume more powerful versions of these socially acceptable material categories suggests the possible existence within communities like ENIa-b Knossos of social competition - within certain limits - by individuals and/or households in pursuit of status and reputation (see Chapter 13).

12.7 Understanding Changes in Circulation During ENIc-ENII

During ENIc and ENII significant changes in the circulation of ceramic vessels are apparent, with a serious increase in the consumption of products from the immediate area of Knossos (<5km) and a concomitant sharp decrease in the presence of non-local items (see above). This decrease in non-local ceramic vessels is not matched by a similar decrease in the presence of non-local ground stone axes and maces. This situation contrasts with the preceding ENIa-b phase and suggests that significant changes in the circulation and exchange of ceramic vessels may have taken place.

12.7.1 Ceramic Regionality?

During approximately the same period (ENIc/ENII = LNI; see Appendix I) the Greek mainland sees the development of greater ceramic regionality (Perlès 1992:139-40). In Thessaly this proliferation in regional styles seems to correspond in some cases to specific production centres specialising in certain ceramic products and it has been argued that at this time there were actually *more* ceramic

vessels in circulation (Perlès 1992:139-40), a scenario which stands in direct contradiction to ENIc/II Knossos, where evidence for changes in production at this time (see Chapters 10-11) suggest that ceramic production took place on a greater scale but in conjunction with an overall decline in the quantities of ceramic vessels in circulation.

At present the Cretan data are simply too sparse to be able to argue seriously for a parallel development of ceramic regionalism on Crete. Not only does Knossos remain the only certain site for this phase, preventing any further comparison, but also the serious decrease in the representation of non-local fabrics at Knossos during this period means that very little can be said about ceramic production elsewhere in the island at this time. However, as far as Knossos is concerned, the decrease in the presence of non-local vessels would seem to suggest that changes in mobility may have taken place during this period.

12.7.2 Evidence for Wider Contacts

Decrease in the circulation of ceramic vessels within the area of Knossos and the implication that patterns of mobility were much less extensive than before seems to contradict the widespread evidence (noted Appendix I) for an increase in wider links between Knossos, the Cyclades and the eastern Aegean, which first appear in ENIc and from ENII are strong. For example one might compare the series of close links which synchronise ENII Knossos with Emporio VIII and to a lesser extent Saliagos (Washburn 1983; see Appendix I). These can be understood within a wider LN context of increased links between different regions bordering the Aegean and new settlements on Aegean islands (see Broodbank 1999). For example Eslick has noted (1980; 1992) that from MC south-west Anatolia changes in orientation away from the east and towards the Aegean. It is no accident that the first signs of increased contacts (c.5300BC) probably coincide with the establishment of many permanent settlements in the Cyclades and other Aegean islands, which seem to have been inter-linked by exchange networks (Broodbank 1999:37). Sampson has noted that from the beginning of the Greek LN common ceramic traits unite the islands, with for example 'White-on-Dark Ware' common to Emporio, Ayio Gala on Chios, Tigani on Samos, Vathy on

Kalymnos, Rhodes, Saliagos (Sampson 1984:239) as well as Naxos and Thera. However in addition to these shared traits it has been argued that there is a degree of regionality. Thus Sampson isolates four regions within the LN Aegean (North-East Aegean, Dodecanese/Samos/SE Aegean, Attic-Kephala-Euboea Culture/Cyclades and North-West Aegean) (1984:245, fig.6).

It has been tentatively suggested (Appendix I) that communities on Crete may have played a more active role in this phase of island colonisation than previously thought. On the basis of a series of shared ceramic features between new communities on islands in the east and south-east Aegean and contemporary communities on Crete, features which have a long history on Crete and are *not* found in other regional sequences (i.e. flared strap, flap and wishbone handles, triangular 'ears' on the rim, plastic cordon decoration, pellet/knob decoration and incised/pointillé decoration), one could argue that at least some of these new communities are likely to have had a Cretan origin or at least a very close relationship with the island.

This evidence for a greater level of movement and activity within the island Aegean during the ENIc/II period on Crete and the likely active role of Cretan groups in this process makes it hard to see how this decline in the presence of non-local vessels at Knossos could be explained in terms of the sudden isolation of Crete or Knossos from the exchange networks of ENIa-b. Rather the evidence for new contacts and new settlements would be likely to promote greater access and more intense circulation leading one to expect to see an *increase* in exchange during this period: one could argue that the ENII peak in the diversity of stone sources represented in stone axes and maces reflects this.

12.7.3 Conclusions

These considerations therefore suggest that the actual and very real decline in the circulation of non-local ceramic vessels at Knossos during ENIc-II was not due to any lack of access to non-local goods or to an inability to make long journeys of acquisition, but instead suggests that these changes were due to more fundamental and significantly social developments. If Knossos can be considered typical, then it would seem that for whatever reasons ENIc/ENII communities on

Crete no longer placed such a value on the acquisition of exotic ceramic vessels. In view of the rapid growth in the size of Knossos at this time and a probable concomitant increase in population, one could argue that this reflects a decrease in the demographic necessity of exogamy: certainly it seems likely that Knossos at this point finally reaches a point at which it is at least theoretically demographically self-sufficient (population c.500; see Appendix II). However, this observation does not explain why these changes should occur at this point and not earlier or later. Nor does simple population growth explain why the incidence of ceramic vessels with more distant sources decreases so dramatically during ENIc/II.

Further explanation of these changes must inevitably remain speculative. If, as argued above, the presence during ENIa-b of relatively large numbers of non-local vessels, sometimes with very distant sources, can be best explained through their acquisition on special long journeys, then the steep decline in ENIc/II might imply a decrease (or even cessation) in the number of special longer journeys being made during this period. A decrease in the incidence of such journeys, which during ENIa-b may have been causally related to the maintenance of large style zones, may have similarly contributed to the emergence of sharper regional differences in ENIc/II. In addition, one could argue that the expansion in the range and variety of ceramic products produced locally during ENIc-II (see Chapters 10-11) might have somehow addressed the drop in variety left by the sharp decrease in the incidence of non-local vessels. It is perhaps significant that all these changes suggest that the probable role and value of exotic ceramic vessels in social competition had changed with new mechanisms serving in the ongoing negotiation of power and identity.

Conclusions

And so to return to the long-held theories of ceramic isolation for Knossos and Crete which preface this Chapter, it is now possible to say with some confidence that non-local vessels comprise a notable proportion of the EN assemblage at Knossos, particularly during ENIa-b, and that the significance/value of these vessels was probably great. The tautology in the

equation of distance and value has been noted in a number of studies of Neolithic exchange (e.g. Féblot-Augustins & Perlès 1991 cited by Gamble 1993:36-7):

"by travelling far an exchange item is automatically transformed from being mundane to being special... But where does this transition in value occur, the passage from local to exotic, and why and how do the distances vary?" (Gamble 1993:36-7).

Clearly Gamble finds this difficult to answer, concluding that the mechanisms and significance of exchange remain obscure until the Neolithic. However if one views value as constructed through acts of exchange and subject to variation (Appadurai 1986; Kopytoff 1986; see Chapter 3) then one can see this dilemma in a new light. Distant objects by virtue of their rarity, their unusual biographies and their intimate association with 'outside' have value and power (Helms 1993). Such objects were acquired through exchanges, which create a social relationship between giver and receiver. Such objects objectify those relationships, but significantly, since they are objects which have a use, their consumption provides their owner with the opportunity and cue for narratives surrounding their acquisition. Such narratives allow the owner/teller to benefit on more than one occasion from prestige associated with the ability to make journeys outside the realm of the familiar (Helms 1993). In this way it is above all through the public consumption of such exotic objects that their owners are able to gain the prestige and status associated with the conduct of longer journeys of acquisition (see Chapter 13).

In this way the importance of exchange was great, particularly within ENIa-b communities, as well as possibly earlier in the Aceramic. On one level the circulation of goods testifies to the existence of close social relationships (kinship? friendship? exogamy?) between the community at Knossos and its immediate neighbours, relationships which may have minimised conflict and contributed to the apparent stability of EN Cretan communities (cf. similar comments of Perlès 1992:121 for Thessaly). However at a different level the acquisition and display ('tournaments of value') of particularly valuable ceramic vessels and other goods may have been one of the few legitimate ways in which individuals and households could negotiate status and power.

This new view of the circulation of goods in Crete during the Aceramic and EN also places previous attempts to understand the initial colonisation of Crete in a new light. Thus Broodbank and Strasser's innovative attempt to model this colonisation now emerges as an over-simplification of what was a much longer process. The settlement of Crete probably took place as an intensification of earlier movement and exploration and was a single, if important phase within a process of circulation of individuals, ideas and objects, which continued well after the first colonisation (before 7000BC) and can be traced in various forms throughout the Cretan EN. Within this much broader perspective, modelling long-distance movement purely in terms of colonisation represents too narrow a view of mobility.

CHAPTER THIRTEEN

THE CONSUMPTION OF CERAMIC VESSELS DURING THE EARLY NEOLITHIC

As with production and circulation, study of the choices, values and strategies which lie behind EN consumption, in the absence of direct observation or oral testimony, must rely instead on study of the material itself. In Chapter 9 the difficulty of isolating temporally and spatially restricted consumption contexts in the EN sequence at Knossos was acknowledged and discussed. Study of consumption was seen to be largely restricted to analysing direct evidence for choice at a broader spatial (communal) and temporal scale (i.e. a single ceramic phase). There is therefore no way of studying the different consumption choices made by individual households or other social groupings within the community. However, these restrictions upon the resolution of our direct data for acts of consumption, do not prevent consumption being approached from another angle. Since material action tends to be habitual or unconscious and since, even at this habitual level, material action reproduces social values, relations and strategies, detailed structured study of the material objects themselves - particularly those, like pottery, with a wide variety of potential uses, forms and finishes - can provide a rich source of information about the very values, relations and strategies which lie at the heart of consumption studies (Chapter 3; Miller 1985:11-12, 67, 191-3). Material acts of production create and recreate material categories, which embody elements of the social order of the world within which they are created (see Chapter 3). Since the gap between producers and consumers in small-scale societies, such as those of Early Neolithic Crete, is unlikely to have been very large, the categories created during production may have had a close relationship to the social classifications in which such vessels were *consumed* (see Chapters 3-4). Furthermore, different material categories may have acted as frames or cues for different forms of activity (Chapter 3).

Therefore, the discussion of EN consumption in this chapter will begin with an analysis of the range of material categories in the Knossos EN ceramic sequence. This will involve careful assessment of the extent to which the material categories recognised during archaeological study have any relevance to social

classifications of the past. This sort of approach largely focuses on the primary or intended function of these categories. This inevitably ignores the extent to which material categories may be employed in a variety of tasks, which they were not initially intended to perform, and this limitation to the analysis is explicitly acknowledged here. In the second half of this chapter discussion of EN ceramic consumption will proceed from the direct analysis of ceramic material, via other forms of archaeological evidence to a more general contextual analysis of the changing ways in which ceramic consumption was bound up within the flow of activities, which constituted social life at Knossos (and probably at other settlements on Crete) during the seventh and sixth millennia BC.

13.1 Identifying Early Neolithic Material Categories

The new typology of forms, presented in Chapter 7, like the previous typologies of Furness and Evans, is based on the selection of specific dimensions of variability as significant, namely rim, shoulder, handle, base, decoration. That this may have also been the means by which ancient material categories were distinguished is suggested by:

- (1) A consistent association between particular form-types and particular finishes: for example incised pointillé decoration during ENIa-b is almost entirely restricted to polished flat-based mugs and plastic cordon decoration is almost entirely confined to large burnished deep or slightly incurved bowls; during ENII incised chevron decoration is almost entirely confined to carinated/curved bowls with offset rim, rim strap handle and concave base in Fabrics 1e-f.
- (2) A consistent association between particular form-types/finishes and particular forms of use-alteration: for example a number of incised pointillé flat-based mugs on their interiors have a white concretion, which is not found on any other vessel; likewise burnt interiors only occur in conjunction with grey burnished round-bottomed vessels.

(3) The detailed comparison conducted in Chapter 7 between the most common vessel forms from Knossos and vessel forms from south-west Anatolia and the Peloponnese revealed many general similarities in form, but importantly noted that the most significant differences consistently occurred amongst a limited group of variables, namely rims, handles, bases and forms of decoration. This would seem to suggest that at least some of the dimensions of variability selected by archaeologists, might well correspond to those employed in the creation and recognition of different EN material categories in the past.

Taken together these points seem to suggest that modern archaeological types may bear some relation to the categories in which ceramic vessels were consumed during the Early Neolithic and that one might go some way to identifying ancient material categories through the isolation of significant associations between form, finish and use-alteration. In the next section some of these associations will be discussed in greater detail.

13.2 Material Categories and Dimensions of Variability: Exploring Associations Between Form, Finish and Function

13.2.1 Surface Finish and Colour

During ENIa-b perhaps the most fundamental pair of associations within any single fabric group is the correspondence between burnishing and large open thick-walled vessels and that between polishing and smaller open thinner-walled vessels with flat bases. Thus rounded bases are almost always burnished and not polished, while most flat bases are polished rather than burnished. There is also a clear association between plastic cordon decoration, large open bowls and burnishing and between incised pointillé decoration, flat-based steep-sided vessels and polishing. It must be stressed that, although these associations hold for the majority of cases, there are overlaps between the two main categories: for example occasionally there are fine thin-walled small bowls which are coarsely finished; more intriguing are the numbers of collared jars with flared strap handles and flat-bases that are polished, since this is the only truly closed shape to be finely finished in this way. In general, however, this basic distinction holds.

In some fabrics (e.g. Fabrics 1a-i, 2a-e, 6) there appears to be a clear distinction in production between burnished vessels which generally lack slip layers and polished vessels which received slip layers (see Chapters 6, 8, 10). This would appear to suggest that a distinction between burnished and polished vessels also existed in the mind of producer. Since more effort seems to have been spent on creating a high quality polished surface, one might infer that polished vessels represented the more valued category of vessel.

The significance of this distinction is obviously difficult to assess with any certainty. During ENIa-b the coarse-fine distinction is visually very obvious and it seems possible that it corresponded to a fairly basic distinction in consumption. In his study of the consumption of categories within a modern Indian village, Miller, although concluding that variation in form did not necessarily equate to variation in function, did note the existence of a clear relationship between finish and function¹⁶⁴: thus painted red pots were all associated with the function of carrying water, while cooking pots were always given a black finish (Miller 1985:162). This was very much a relationship based on convention and was not dictated by any sort of efficiency gains. Miller also noted that this distinction based on finish also had some relationship to distribution: red-painted pottery was associated with a local variation of the *jajmani* system, a formal mode with fixed principles and expectations centred around two festivals; in contrast black pottery was sold on the market system of supply and demand (see Miller 1985:162-3).

This example suggests that basic differences in finish and colour might correspond to basic differences in intended function. Regarding the potential significance of the EN coarse-fine distinction, we might let ourselves be guided by the strong association noted above between round bases and burnishing and between flat-bases and polishing. It has been noted that round bottomed vessels sit better on uneven ground, while flat-based vessels only make sense if used on a flat surface, such as a table (Sherratt 1991)¹⁶⁵. This would suggest that one possible meaning for the coarse-fine distinction, is that it marked a difference

¹⁶⁴ The important relationship between the colour of specific vessels and their function/social significance has been widely noted (cf. Vitelli 1995:61; Kaplan & Levine 1981:876-78; Rice 1987:331-2).

¹⁶⁵ The existence of tables of some sort during EN seems difficult to doubt. In Chapter 7 it was suggested that incised ceramic 'trays' might actually have functioned as models of tables.

between those vessels specifically intended for use on a table (tableware) and those vessels which were not. If the identification of polishing with tableware holds, then the large number of polished collared jars with flared strap handles and flat-bases, would then be explicable in terms of their intended primary function as a type of tableware (see below). In Chapter 12 it was shown that it was almost always polished vessels, which were subject to mending attempts (see Figures 12.9-10). This was interpreted as indicating that polished vessels were consistently more highly valued than more coarsely burnished vessels. This interpretation in conjunction with the greater effort put into producing polished vessels (see Chapter 10) would be entirely consistent with polished vessels being a form of tableware.

The ENIa-b coarse-fine distinction is by no means the only meaningful association between form, finish and function. For example all examples of a type of round-based deep bowl, which to judge by use alteration (see below) had been used as a type of cooking pot, are in a grey or white burnish. The significance of colour here is further supported by the discovery that in some fabrics (e.g. Fabric 4) this colour was deliberately achieved through the application of a calcareous slip on a non-calcareous body (see Chapters 6, 8, 10). The deliberate use of different slips to control the colour of vessels can also be seen in Fabrics 1a and 1d where there are frequent examples of the use of a non-calcareous slip over a calcareous body to ensure that the resulting vessel had a dark surface (red-brown-black) (see Chapter 10). This practice is almost entirely confined to polished vessels and suggests that dark polished vessels were considered particularly appropriate (see below). And so, while the reasons why a grey/white colour should have been important for cooking vessels or why a dark surface should have been sought for polished vessels might remain unclear, the significance of the association of colour and function in these examples seems clear.

During ENIc-ENII, all of the ENIa-b associations between colour, surface finish, form and function continue. However this period also sees an extension to the range of finishes possible within particular fabrics (see Appendix VII). During ENIa-b variation in finish in almost all fabrics consisted of burnished, polished, burnished and plastic decoration or polished with incised decoration. However

during the latter part of ENIb (stratum VI) and above all during ENIc-ENII the range of finishes found in particular fabrics increases. During stratum VI (late ENIb) barbotine decoration appears in Fabrics 1d and 5a, while ripple decoration makes its earliest appearance in Fabrics 8 and 11. During ENIc rippled, dark-on-light painted, red-scribble burnished and brushed decoration appear in Fabrics 1c and 1d. In addition there are new forms of incised decoration and new motifs appearing in Fabrics 1b, 1c, 1d, 1e, and 2a/b. And so, if colour and surface finish during ENIa-b might mark off different material categories, perhaps relating to different types of activity, the extension to the range of surface finishes during late ENIb and ENIc-ENII might indicate an extension to the range of activities or perhaps the types of occasion during which ceramic vessels might be used. This possibility will be subject to further evaluation below.

13.2.2 Simple Rims and Offset Rims

Another basic dimension of variability is that marked by the presence or absence of offset rims. As noted in Chapter 7, vessel-types with offset rims essentially share the same range of basic forms as those with simple rims and, in this way, offset rims serve no greater purpose than to extend the range of form types. The majority of vessels with offset rim are thin-walled and polished, although there are occasional exceptions to this rule. In this way, the addition of an offset rim in most cases creates a separate group of vessels within the category of polished vessels. The possible reasons for this separation remain obscure. Since the range and size of forms with offset rims are essentially the same as those without offset rims, there is no obvious functional difference between these vessels. One might speculate along the lines of the use of these two groups of vessels in different consumption activities, on different occasions or perhaps as containers for different items (liquids and solids?). However, this remains simply speculation and it is as well to remember the *caveat*, noted by Miller in his Dangwara example, that variation in form need not necessarily correspond to any variation in function (Miller 1985:162).

13.2.3 A Recurring Series of Vessel Types: Redundancy of Form?

In each of those fabrics, which are well-represented in the EN sequence at Knossos (i.e. Fabrics 1a-e, 2a-d, 5, 6, 8), there are a range of forms, which consistently recur (see Appendix VII). These form-types are listed in Figure 13.1. In addition to these recurring shapes there are also more unusual shapes, which are shared only amongst some fabrics: e.g. flared cup (Fabrics 1b, 1d, 5a, 10), flat-based mug (Fabrics 1b, 1d, 2a/b, 5a, 23), 'tray' (Fabrics 2a/b, 6).

Simple Rim	Offset Rim
deep bowl	deep bowl
curved bowl	curved bowl
carinated bowl	carinated bowl
shallow bowl	shallow bowl
hole-mouth bowl/jar	incurved jar
's' profile jar	collared jar
flared bowl	

Figure 13.1 Forms Which Consistently Recur in the Most Frequently Occurring EN Fabrics at Knossos.

From a purely functional perspective, it is striking how many of these forms are essentially interchangeable with one another (see Appendix VI). In most cases the dimensions of variability which mark off each type as different need not necessarily affect how that particular type performs. Indeed the range of shapes presented in Figure 13.1 could be replaced with perhaps three forms (shallow open bowl, deep open bowl, collared jar). In this way one might characterise the basic EN shape repertoire as exhibiting redundancy of form (see Chapter 3). This redundancy of form only increases if one takes into account the likely existence of containers in perishable materials (see below). Thus, it is concluded that notions of functional efficiency play little part in the detailed explanation of variation in form (cf. similar comments of Miller 1985:67; cf. Chapter 3).

In view of the distinction made between burnished vessels and polished vessels, it is worth noting that vessels which are only burnished are made in a much more restricted range of shapes, than vessels which are polished. The majority of burnished vessels are deep or incurved bowls or collared jars, although other forms do occur more infrequently in the burnished category. In contrast polished vessels frequently occur in a much wider range of forms: i.e. curved

bowls, shallow bowls, flat-based vessels, curved bowls with offset rim, deep bowls with offset rim, carinated bowls with offset rim, collared jars with flared strap handles. Thus the nexus of formal ceramic variation is in polished vessels. If the identification of polished vessels with table ware (see above) has any substance, then this would seem to indicate that the greatest demand for different vessel forms was in activities closely associated with the consumption of food. This conclusion finds an echo in a statement made by Broodbank (1992:53) to the effect that any identifiable stylistic change in EN ceramics at Knossos was heavily concentrated amongst open shapes (eating, drinking and serving), while closed (storage) vessels show little variation and decoration. Certainly if the connection between polished vessels and tableware is correct, it becomes easier to explain this greater variation, since the consumption of food is very likely to have been, at least on some occasions, a very public arena of consumption (see Sections 4.2-3).

13.2.4 Formal versus Informal Categories of Form

As outlined in Chapter 3, variation in systems of material categories may be characterised as either informal, where the variety of forms or finishes within a single producing group is very high and where typologies are very extensive and difficult to subsume into a simple order, or formal, where the variety of forms or finishes is low and where typologies are simple with low variation and are often remarkably consistent between sites (Miller 1985:199-200). If each distinct ENIa-b fabric were to represent a producing group, then the total range of forms produced by each group can be calculated. Figure 13.1 lists 13 basic recurring forms, which, even if one adds 2 or 3 more unusual form types, still only amounts to around 16 form types. This figure might, for example, be contrasted with the 51 different material categories based on form noted by Miller for just one group of potters in India (1985:39). This might suggest that the range of ENIa-b forms within each fabric was relatively low. In Chapter 7 it was suggested that the variation which can be observed in the range of EN forms can be understood to be very simple to generate through the differential combination of a limited range of basic forming sequences. In this way the ENIa-b range of material categories

may be understood as simple. Finally, as noted above, this simple range of forms and this limited range of finishes are repeated in a large number of fabrics, many of which must correspond to producing groups in different locations outside Knossos (see Chapters 6, 7, 10).

When taken together these various features suggest that the ENIa-b system of material categories should, using Miller's definition, be characterised as formal; that is one where the variety of forms or finishes is low and where typologies are simple and remarkably consistent between sites. Since pottery is not reproduced either by itself or by abstract structures, but by the active intervention of human agency (see Chapter 3), recognition of the high degree of formal order exhibited by ENIa-b material categories carries implications for how such vessels might have been consumed. In Chapter 3 it was argued that one of the ways in which material categories work is as a frame or cue for further action. Thus if categories of vessel acted as frames for action, then in the case of a formal system of material categories, such as that suggested for ENIa-b, it seems likely that the ways in which these vessel categories were consumed may have been equally highly formalised. The production of a similar, simple range of forms at different ENIa-b settlements (see Chapter 10; cf. Plates 32-4, 57-8), therefore, would seem to testify to a widely-shared set of formalised ideas about how ceramic vessels should be consumed.

Here it is worth emphasising how stable ENIa-b material culture was (see also Section 12.6). A crude way of appreciating the rate of ceramic change is through a comparison of the estimated duration of definable ceramic phases, since the ability to separate different strata using ceramics depends entirely on the degree and speed at which ceramics change over time (see Figure 13.2). Even with the new sub-phasing of ENI proposed in Appendix I, individual ceramic phases still remain long in duration (c.600-700 years) until late in the ENI sequence, after which point the observable pace of ceramic change increases to a faster rate (c.200-250 years). Clearly EN ceramics, particularly ENIa-b ceramics, exhibit a very slow rate of change.

Phase	Estimated Duration
Aceramic	c.600 years

ENIa	c.600 years
ENIb	c.700 years
ENIc	c.200 years
ENII/MN	c.400 years
LNI	c.250 years
LNII	c.250 years

Figure 13.2 Estimated Duration of Neolithic Ceramic Phases (Based on Appendix I).

In this way it should be clear that ENIa-b material culture is not in a constant state of flux but rather suggests the reproduction of a 'stable universe' of material categories and social values (see also Chapter 12). Indeed, the very slow rate of change observable in ENIa-b ceramics, suggests that the social context within which material categories were being reproduced was an inherently stable one. In order to bring out the full implications of this, one might contrast this situation with one where ceramic change is necessarily more rapid, such as, for example, where there is a defined social hierarchy and where processes of emulation are taking place¹⁶⁶. Here ceramic change is necessarily more rapid because objects and/or practices may become symbolic of persons or groups within such a hierarchy, perhaps even as markers of status. In such a scenario if an individual or group should wish to raise their status within the hierarchy, they might elect to adopt some of the objects and/or practices associated with the higher status (emulation). In turn if the higher individual or group wishes to maintain the previous contrast, they must either prevent this or promote new objects/practices as symbols to maintain this distinction. Such a dynamic inevitably leads to a more rapid rate of change in material culture.

The contrast between this situation and the scenario described for ENIa-b ceramic consumption could not be stronger and it hints at the absence of a permanent clearly-defined social hierarchy. It also provides further support for the idea that the consumption (and production) of ceramics vessels was highly regulated and subject to formal rules or social values, which actively promoted the maintenance of specific forms and, presumably, the practices which went with

¹⁶⁶ Here one should see especially Miller's discussion of the effects of social hierarchies and attendant processes of emulation on the rate at which ceramics change (1985:185-196).

them. This sort of non-innovation should be understood to be equally as dynamic as any situation where innovations are taking place (see Chapter 3). Furthermore, as argued in Chapter 3, it is just such rules or systems of social values, which render power to symbolic capital. Through socially-generated restrictions on consumption (and exchange) (e.g. taboos), formalised systems of social values act to control and direct symbolic activity towards specific activities and specific material categories and away from others. It should be stressed that although such rules direct activity, they also allow limited room for manoeuvre and negotiation, where individuals and groups can compete for status, even within a society which lacks a defined social hierarchy and which may uphold an ideal of egalitarianism. It was suggested above that the nexus of formal variation in ENIa-b ceramics occurs amongst categories of polished vessel, for which a primary function as tableware was tentatively suggested. If correct this might suggest that the consumption of food in ceramic vessels was one of the few areas where, subject to certain rules, individuals or groups might compete for status (see below).

During ENIc-ENII there is a clear increase in the rate of ceramic change. This period also sees a slight increase in the range of forms produced in each fabric group: for example, while almost all the basic recurring ENIa-b forms continue, there are new forms such as the various types of carinated bowl (carinated, shallow carinated, flared carinated). As noted above, this period also sees an extension in certain fabrics to the range of surface finishes used. In terms of formal or informal categories of form, this would seem to suggest a certain loosening of ENIa-b formal categories to include new forms. The continuation of almost all ENIa-b material categories would seem to suggest that, whatever functions pottery vessels performed during ENIa-b, these functions continued to be fulfilled. However the creation of new categories of finish and the introduction of new forms might also indicate that there was also some sort of extension to the ways in which ceramic vessels and previously been consumed (see below).

13.3 How were EN Ceramic Vessels Consumed? Material Categories in Action

The important role played by early ceramic vessels in the preparation and consumption of food has long been recognised (see Chapter 2; Rice 1999:29-37).

Regarding the Knossos EN sequence in particular several scholars have drawn attention to a primary focus on vessels suitable for the serving and display of food, with other shapes being considered more suitable for storage than cooking (Evans 1964:196; Broodbank 1992:53). Restudy of the EN material with particular attention paid to evidence for use-alteration has allowed the validity of these statements to be re-assessed.

13.3.1 *Cooking*

As emphasised by previous scholars, there is no evidence at EN Knossos for the direct use of ceramic vessels over a fire. Despite careful examination no sherds could be identified with soot marks on their *exterior*. However, it was found that there was always a small number of sherds with clear traces of burning/sooting and even burnt sediment on their *interior* surface, particularly around the interior of the base (cf. Plate 54). Usually this burnt concretion was observed to have penetrated the body of these vessels, leaving a dark stain in the sherd break. Vessels are generally white or grey burnished, although unburnished organic-tempered vessels are also found (Fabric 15), and in every identifiable instance have rounded coil-built bases (see Section 10.2.5). The form of the upper portion of these vessels is less easy to reconstruct with confidence, since these vessels are always highly fragmented (cf. Plate 45). However surviving fragments suggest a hole-mouth jar or deep bowl, probably with strap handles attached around half way down the body (see Appendix VI). The consistently large diameter of these vessels suggests that these were not used for individual food consumption but rather contained food to be shared between a number of individuals. Such vessels were identified in Fabrics 1d, 1e, 1i, 4, 8, 12 and 15. It should be stressed that, with the possible exception of Fabric 15, none of these fabrics represent functionally-specific cooking pot fabrics: rather the same fabrics were used to make the full range of EN shapes (see Section 10.2.5). Since none of these vessels preserve any evidence of burning on their exterior surfaces, yet demonstrate clear evidence for the application of heat to their contents, it seems

likely that they testify to the use of a method of indirect heating, such as the addition of pre-heated stones (pot boilers)¹⁶⁷.

Evidence for indirect forms of cooking can also be found at other early Neolithic Aegean sites. In Aceramic levels at Argissa (Thessaly) Weinberg notes the discovery of "large quantities of river pebbles which had been subjected to repeated heat and are believed to have been heating stones used in cooking" (1970:568). From the same site there is also no evidence for the use of stone cooking vessels nor were there any signs of burning on two thick-walled vessels of unbaked clay (Weinberg 1970:569). Thus these heat-treated pebbles must have been used in some vessel made from a perishable material, such as basket or wood. For EN-MN Franchthi Vitelli notes a similar lack of evidence for sooting/burning on the exterior of vessels (direct heating), but notes that occasionally there are sherds which "preserve sooty deposits, but always on the *interiors* of vessels" (Vitelli 1993a:214, my italics; see also 1993a:213-5). It is only late in MN when the first evidence occurs for the possible direct use of vessels over a fire (Vitelli 1989:24). Vitelli has concluded from this that ceramic vessels were not used for cooking during this period (1989:24-5; 1993a:214-5). However it would be more accurate to say that although ceramic vessels were not used in direct-heat cooking, there is evidence to suggest that certain vessels may have been used for indirect-heat cooking.

It is important to place these ceramic vessels used for indirect-heat cooking within the wider context of EN cooking practices. At Knossos such vessels do not in any way dominate the ceramic assemblage; in fact, although a consistent presence, they are never common. It therefore seems highly unlikely that these vessels accounted for all cooking needs, rather the opposite. Even within the restricted excavated area of EN Knossos, there is abundant evidence in each stratum, in the form of shallow pits filled with ash, bones or even 'greasy' deposits, for the use of small pits for cooking (Evans 1964: 140, 153, 155). Judging by the high frequency with which these occur these are likely to have served as the main means of cooking. This in turn suggests that the grey burnished or organic-

¹⁶⁷ Examples of the use of forms of indirect-heat cooking can be found in the ethnographic literature (see references in Brown 1989:206-7; cf. Sassaman 1995:225).

tempered ceramic vessels used for indirect-heat cooking could only have played a restricted role in cooking and were probably not a regular daily cooking pot. Rather, it seems possible that such vessels might have been associated with the preparation of special foods or might have been used on special occasions.

Halstead has argued that the location of many cooking facilities in EN-MN (Greek) settlements in open spaces between houses suggests the existence of social pressure to share cooked food (1995:16-19; see Chapters 2-3). Although broadly in favour of such an interpretation, Andreou, Fotiadis and Kotsakis note that ash-pits have been found both inside and outside houses (1996:559). This is also the case for EN Knossos, where built structures invariably contain numerous small ash-pits cut into their occupation floors (e.g. Evans 1964:153), which would seem to indicate that some cooking was small-scale and took place indoors. At the same time, however, there is at least one instance of a much larger cooking installation located in an open(?) cobbled area to the north of house C (stratum VII) (Evans 1964:153). Apparently House C maintained both small-scale internal cooking facilities and a larger-scale open-air cooking area. This suggests a more complex scenario than a simple sharing of all cooked food. If cooking took place both indoors as well as in more public arenas there may have been a distinction in food preparation between on the one hand the small-scale, private(?) preparation and perhaps consumption of food indoors and on the other the larger-scale, public(?) preparation and perhaps consumption of food outdoors. If so it may have been that private consumption of food was the normal practice with more communal acts of food consumption being perhaps a more ritualised form of consumption restricted both spatially to areas adjacent to but outside the household and temporally to specific occasions.

During ENII at Knossos there seems to have been a change to the spatial location of external cooking facilities. Evans notes that along with changes in the scale, techniques and design of house building, there seems also to be a tendency to enclose external yards: "remains found in [sounding] AC suggested that some structures might have had small enclosed yards attached" (Evans 1994:14). These ENII changes may find a near contemporary parallel on the Greek mainland in the LN division of previously open village settlements into separate 'courtyard groups'

(Halstead 1995:17). Halstead has interpreted these changes as signifying more restricted sharing between households (1995:17-18).

And so, when the available data for earlier Neolithic cooking practices are collected together they present a surprisingly coherent picture. Before the adoption of pottery all cooking was done without the aid of ceramic containers. Although it seems likely that most cooking, at least at Knossos, was done in fire pits, the discovery of heat-treated stones at Aceramic Argissa strongly suggests that non-ceramic perishable container forms (skins? wood? basketry?) were also used for a form of indirect-heat cooking. When ceramic vessels first appear, it would seem that, far from revolutionising cooking technology, as emphasised in 'adaptionist' approaches to early ceramics (Chapter 2), these new containers actually did very little to change pre-ceramic methods of cooking. Indeed on present evidence it seems unlikely that those ceramic vessels, which were used for a form of cooking (indirect-heat), were ever used on a daily basis. Vitelli reached a similar conclusion regarding pre- and post-ceramic cooking practices at Franchthi and suggested that the failure to use ceramic vessels as cooking pots might signify continuities in both diet and cooking practices between the Mesolithic and Neolithic (Vitelli 1989:25), continuities which may have persisted owing at least partly to the embedded social nature of culinary practices. Clearly, the supposed advantages of ceramic vessels in direct-heat cooking, so obvious to modern researchers, were not so immediately apparent to the earliest users of pottery at Knossos and at other sites in the Aegean.

13.3.2 Storage

In contrast to cooking, the use of ceramic vessels for storage does not leave unequivocal traces. If one considers the suitability of each of the various EN forms for storage, one is forced to conclude that almost all medium to deep bowls and jars of whatever form could have been used in this way if necessary. Of these, perhaps the most likely candidates are some of the jars, since some of the largest (c.15-18cm diameter) schist 'pot-lids' identified by Evans (1964:231) could have served as covers. However any large upturned bowl could have been used as the cover of another. In his study of ceramic consumption in an Indian village, Miller noted that, after a period of use, all ceramic forms were taken out of their primary

functional context and used for storage (Miller 1985:71). This may also have been the case for EN Knossos, with a variety of different vessels having secondary lives as storage vessels.

Unfortunately, there is little direct indication as to what the potential contents of storage vessels might have been. All bowls forms would have been suitable for either liquids or solids, although there is a complete absence of shapes dedicated to the storage and pouring of liquids (no spouts). Perhaps the best adapted for both are the collared jars, since they have collared necks which make pouring more easy, but which also are of a sufficiently wide diameter (e.g. c.20cm) to allow easy access to the contents, whether liquid or solid (see also below on transportation). Perhaps the most likely candidate for storage is agricultural produce, although literally any loose material would have been possible.

The scale at which any agricultural produce could have been stored in ceramic vessels cannot have been very large. Figure 9.8 suggests that during ENIa and ENIb the quantities of ceramic vessels in circulation were relatively low (see Chapter 9). Also worth stressing is the small size of EN vessels, especially in comparison to later Bronze Age dedicated storage vessels. Certainly there is a very real absence of obvious dedicated storage jars (pithoi) at EN Knossos and it may well be that like mainland Greece, Crete did not see the first of such specialised storage jars until late in the Neolithic (Cullen & Keller 1990; Perlès 1992:144). In this way, one is forced to conclude with Vitelli (1989:26-7) and Yiouni (1996b:192) that at EN Knossos, as at EN (Greek) Franchthi and Nea Nikomedeia, ceramic vessels were neither large enough nor numerous enough to be able to satisfy the direct storage requirements for a single independent household for a year. This in turn suggests that we should consider the possible existence of other, perhaps communal, forms of storage during this period at Knossos. Possible evidence for such structure might be the cache of burnt grain in association with a burnt post-hole structure located in an Aceramic level (stratum X) outside the main area of the settlement.

13.3.3 Transportation

Perhaps owing to the general reluctance in studies of Neolithic ceramics to accept the movement of anything more than a few fineware vessels between sites (see discussion in Chapter 2), the possible use of ceramic vessels for transportation has not been seriously discussed. This is unfortunate since there is a need for transport containers at both intra-site and inter-site levels, the most obvious example being the need to convey water from source to place of consumption. In this regard it is worth noting that there are a number of vessel forms are provided with large strap handles, usually large open bowls (deep bowls, curved bowls) or collared jars (see Plates 57-8). Certainly their suitability for transportation might go some way to explaining the regular occurrence at EN Knossos of such vessels, especially collared jars, in fabrics which cannot be immediately local to the site (e.g. Fabrics 5a, 6, 8, 9, 10, 11; see Plates 57-8). In this way the movement of these vessels may indicate that at times the contents of an exchanged vessel may have been the object of that exchange and not the vessel itself.

As with storage above, there is no indication of what the contents of these vessels might have been; liquids or solids are equally likely. The need to transport water could theoretically have been fulfilled by the collared jars. However, a far better candidate for a specific container for liquids is suggested by a number of clay jar stoppers from EN and later strata (e.g. Evans 1964:pl.58.3). The diameter of these clay stoppers is far too narrow (1.5-2.5cm) for even the narrowest ceramic jar and it therefore seems likely that these stoppers were sealing a container in a perishable material, perhaps a lined basket, or more likely a gourd. Whatever the material, such vessels, with their narrow neck aperture, would have been ideal for the transportation and storage of liquids.

13.3.4 Serving/Display

Most EN bowl and jar types allow easy access to the contents of the vessel and thus could have been used directly in the consumption of food and drink. Indeed one is forced to acknowledge that the majority of types comprise a range of essentially interchangeable forms whose specific significance - if actually different for each form type - is effectively lost to us. Certainly the larger deep

bowls, which occur in several fabrics and which are often decorated in plastic decoration, either cordons or lumps/pellets around the area of the rim (sometimes both), with their large diameters make most sense as communal containers for food. In support of this, many of these vessels have wear marks around the base of the interior, which are suggestive of repeated scraping, perhaps by smaller bowls. Some confirmation of this is provided by wear marks on the exterior rims of smaller curved bowls (both with and without offset rims). This suggests a situation where food is shared out of a communal vessel to be consumed in one or more smaller vessels which may or may not have also been shared. Other closed vessels could also have been used as serving containers; the best candidates being the smaller polished collared jars with flared strap handles and flat bases.

Unfortunately, further exploration of how specific bowl forms were consumed is generally limited by the lack of contextual information. The only possible exception to this is a certain category of open shallow open bowl which has a flat base and steep sides (flat-based mug), which make their first appearance during ENIa and continue throughout ENI. These vessels are the most frequently decorated EN form type, although undecorated examples are also known (see Appendix VII). Indeed almost all examples of EN incised/pointillé decoration occurs in this form in Fabrics 1d, 2a/b and 5a. The only other categories of artefact, where incision and/or pointillé is also frequently found, are clay 'shuttles' and above all figurines, more specifically human figurines, since animal figurines appear not to have been decorated. In addition to figurines, a single example of incised/pointillé decoration is found on a unique, but fragmentary ceramic object (Fabric 2a/b), whose significance remains unclear (see Evans 1964:fig.27.23). The usual technique used for figurines is that of

"small punctured holes... either alone or in combination with incised lines running along one or both edges of the lines, covering either the whole or parts of the body. Both techniques occur in all periods..." (Ucko 1968:329-30).

This compares very closely to the use of incised/pointillé decoration on flat-based mugs.

In this way incised/pointillé decoration makes a link between flat-based vessels and human figurines. This link is further reinforced by a unique flat-based mug in Fabric 23 (97/60), which in addition to having an unusual form of incised/pointillé decoration (dots and wavy lines) also has the upper torso of a figurine moulded into and projecting above its rim (see Plate 59). Although this example remains unpublished, Evans illustrates several figurine fragments which could represent other possible examples of this practice (Evans 1964:226, fig.60.6-7). A key to the possible significance of this connection is provided by Ucko's study of the Neolithic figurines from Knossos (Ucko 1968). He concludes that much of the incision and/or pointillé decoration on figurines is used to represent anatomy, clothing or tattooing (see Plate 60): indeed around one quarter of all figurines would seem to have either clothing, tattooing or scarification of some form and in almost every case incisions are used (Ucko 1968:329).

In view of the possibility or even likelihood that tattooing was practised at Knossos during EN, it is worth drawing attention to a number of items from the EN sequence, which have previously attracted little attention in this regard. First and foremost are the bone needles, both perforated and unperforated, which were found in 'considerable numbers' (Evans 1964:236, fig. 61.11, 13, pl.60.1-2). Also worthy of mention are the small quantities of red and yellow ochre (strata X, V and IV), one piece of malachite and two of azurite (stratum IX), all of which were "almost certainly prized for their use as colouring materials" (Evans 1964:238). Finally there is the single example of what, on analogy with EBA Cycladic examples, could be a mixing palette (stratum VIII) (Evans 1964:fig.28.24). This is the only known ceramic example (Fabric 2a/b), however other versions, perhaps in wood, could have existed.

If much of the incised and/or pointillé decoration on human figurines represents tattooing, then it might be reasonable to suppose that the incised/pointillé decoration on flat-based mugs might also bear some relationship to the practice of tattooing. In addition to the connections already noted, there are other suggestions that this might have been so. Study of the application of incised/pointillé decoration strongly suggests that it was applied in a very careful manner, since the pointillé dots are not randomly applied but were deeply

impressed in regular rows, always with a small gap between each one (see Section 10.4.5). Such decoration could have been applied by the same bone needles, mentioned above, which would equally have served as real tattooing needles. Moreover, after incised/pointillé decoration has been applied it would appear that a white or red paste was rubbed into each incision in order to accentuate the effect. This practice would find a neat parallel with application of colouring pigments during tattooing.

Ethnographic parallels for the objectification of values, ideas or even people in ceramic vessels abound. For example in the study of David et al. (1988) among the Mafa and Bulahay of northern Cameroon, the decoration of pottery is understood by analogy to the decoration of the person: pots may be assimilated to persons and represent human and other spirits. A similar sort of relationship may have existed at EN Knossos between flat-based vessels, the human body and the practice of tattooing. How this relationship was articulated in practice is difficult to decipher. Flat-based vessels are usually provided with large handles, perhaps placed at opposite sides of the vessel. All flat-based vessels are small enough to have been picked up by one person. At least one flat-based vessel has incised decoration on its base (see Evans 1964:fig.27.20) - a practice not found in any other forms - and this would seem to suggest that the base was often visible, as would be the case if the vessel was held by its two handles and tipped towards the mouth. In this way, these vessels perhaps make most sense as vessels for the individual consumption of food or drink. That said however, it should be noted that several incised/pointillé decorated flat-based vessels have a white encrustation on their interiors. This does not appear to be a food residue, but rather resembles the white in-filling of the incised/pointillé decoration¹⁶⁸. It therefore remains possible that this white encrustation may have had something to do with the use of these vessels in body decoration.

The very specific set of associations which surround the consumption of flat-based vessels, suggests above all that they should be considered to play a part in ritualised action, which involved both the consumption of food and/or drink and the practice of tattooing. The sort of rituals which spring most readily to mind

¹⁶⁸ This, however, was not tested by analysis.

are those which involve rites of passage of some sort during the human life-cycle. Tattooing might mark a form of personal transition, such as the acquisition of a new identity or status. This transition might also be marked by food consumption. In this way these ceramic vessels along with the body tattoos may have continued to symbolise this set of associations long after the event itself. Finally and in the context of these final conclusions it is worth noting the possible importance of gender in these practices. Ucko notes that "over one third of the female figurines are either tattooed, clothed or cicatrized... while only one twentieth (?) of male figures have any non-anatomical markings" (1968:330). This may indicate that tattooing and therefore the consumption of flat-based vessels might have been intimately associated with moments of transition during the female life-cycle, such as the beginning of menstruation or marriage.

Such an example provides further support for an earlier suggestion, based purely on the observation that the system of EN ceramic material categories is highly formalised, that the EN consumption of ceramic vessels may have been subject to very specific rules with perhaps specific types of vessel having specific meanings, particular sets of practices and associations and perhaps different contexts of use. In the end, however, the general lack of contextual information for specific acts of consumption means that this must remain speculation.

13.4 Diachronic Changes in the Consumption of Ceramic (and Non-Ceramic) Containers (Aceramic-ENII)

13.4.1 Aceramic

It is almost certain that during the Aceramic use was made of non-ceramic containers made from perishable materials (Evans 1968:271). It has already been argued above that during EN there is evidence in the form of clay stoppers to suggest the use of very narrow-necked non-ceramic containers (gourds?). Other evidence for the existence of non-ceramic containers is provided by evidence for interaction between ceramic and non-ceramic forms, such as when pottery mimics the form and/or finish of containers made from other materials (skeuomorphism). Skeuomorphism has been noted as a feature of early ceramics in many areas of world with a variety of other containers, usually of perishable materials, being

mimicked: e.g. birch-bark bags, baskets, soapstone bowls, animal skin bags, gourds, wooden vessels, leather vessels (see Chapter 2).

Perhaps the clearest examples of skeuomorphism occur in fine dark polished bowls, particularly ENIa examples. These bowls contain several features which recall wooden vessels. Particularly striking is the consistent use made of wishbone handles, which seem to function poorly as handles for ceramic vessels. Wishbone handles are long, heavy and with such a narrow point of attachment as to render them highly susceptible to breakage (cf. Plate 32): indeed in almost every case such handles break off at their point of attachment. In wood however such a handle would be both straightforward to carve and would be much less likely to break off. Certainly such a handle would be unlikely to arise purely from a ceramic tradition. Other features of these vessels, such as pierced or unpierced ears mounted on the rim could easily have wooden prototypes. Wishbone handles and pierced ears are invariably found on the simplest bowl forms, namely curved bowls or shallow bowls, which also could easily have wooden prototypes; however even the more complicated shapes, such as curved or carinated vessels with offset rim, could have been rendered in wood. Mention is also worth making of a number of very rare or unique ceramic forms, which might have been more common in wood, such as the ceramic spoons (two examples) and the single ceramic palette (Evans 1964:fig.28.24, fig.57.15-16). The possible connection between some of the finishing techniques used for polished vessels and some of the finishing techniques used for wooden vessels (i.e. carving out, smoothing, polishing, incising) has already been noted in Chapter 10.

Further strong indications in favour of the skeuomorphism of wooden vessels is provided by a consideration of how polished vessels were finished. A significant proportion of the earliest polished ceramic vessels have a horizontal scribble burnish laid over their polished surface, which seems to have been a deliberate attempt to reproduce a polished wood grain finish (see Plate 60). Also apparently deliberate was the creation of a dark as opposed to a buff polished surface. Where non-calcareous clays were used (e.g. Fabric 2a/b, 6, 8) a dark polished surface would be the most likely natural result, however in calcareous Fabric 1a a non-calcareous slip was deliberately used apparently to ensure a dark

surface (see Chapters 8, 10). Certainly all 'wood-grain' polished bowls have a dark surface, whatever their clay chemistry. And so, here the deliberate creation of a dark grained surface makes is perhaps best explained in terms of the skeuomorphism of pre-existing wooden vessels. This 'wood-grain' technique is particularly characteristic of the earliest (ENIa) dark polished vessels, however the use of non-calcareous slips on calcareous bodies to ensure a dark polished surface continues to be a feature of Fabrics 1a, 1b, 1c, 1d, 1e and 1f throughout EN. This suggests an ongoing significance for dark polished surfaces long after the initial interaction between ceramic and wooden vessels in ENIa.

In this way it seems likely that many of the basic forms of polished bowl could have had wooden prototypes. In view of the clear links between ENI ceramic tableware and wooden prototypes it is perhaps probable that prior to the adoption of pottery wooden vessels were primarily used as tableware. And so, if at least some polished ceramic bowl forms had wooden prototypes, then this raises the question of potential prototypes for other EN ceramic forms. Wood would have been a good material out of which to make open forms of tableware: open shapes are easy to carve out and being tableware vessels need not be too large; a wooden container is naturally water-tight and can be smoothed and polished to a shine to accentuate its appearance; wood can also be incised or carved to produce relief decoration. Other forms, however, especially very closed shapes or very large vessels would have posed problems in wood.

Ceramic versions of these very closed or very large forms preserve a series of features which suggest the possibility that such forms might skeuomorph containers in a different material, most likely basketry: these ceramic vessels tend to be round-based globular shapes, sometimes with collared or extended rims and often with strap handles, more rarely with tubular loop handles (vertical or horizontal). Round bases, globular forms, collared or extended rims, strap handles and loop handles are all features found in modern ethnographic examples of basket-making. An origin in basketry might be particularly appropriate for the collared jars and their flared strap handles (thin/flat-profile), which in ceramic are common in a variety of fabrics from the very earliest pottery bearing level (stratum IX) (see Appendix VII). Such a vessel, if produced in basketry, would

have been light and easily carried. Basketry would have also allowed the construction of larger vessels suitable for storage. Finally, as with wood, connections can be drawn between some techniques potentially used in basketry and techniques used the formation of ceramic vessels (e.g. a coil of reeds is twisted together and then a vessel is built from this coil by tying each coil on to the next) (see Chapter 10).

Skeuomorphs of other materials are less easy to isolate with certainty. Stone bowls are actually very rare with only a single unpublished 'worked stone bowl' coming from Aceramic levels (sounding X) (Evans 1970b:7). Indeed in general it would seem that stone bowls may themselves skeuomorph container forms in other materials: for example a stone bowl from an ENIc context (sounding XY) copies a common ceramic form (deep bowl with offset rim) (see Plate 62).

Unfortunately, because wood and basketry are perishable materials, direct evidence for containers in these materials is unlikely to ever be found. However, such containers must have existed during the Aceramic and, in view of the evidence for skeuomorphism in the earliest ceramic containers (ENIa), there is a very real likelihood that many ceramic forms had wooden or basket prototypes. Certainly there cannot have been any difficulty in terms of accessing the raw materials for such materials, since both wood and reeds must have been easy to come by. The existence of such crafts is suggested more indirectly by the use of timber in the construction of buildings and the almost certain existence of some form of sea-craft during EN (see Chapter 12), which must have involved skills in wood-working, basketry and/or sewing. Furthermore the apparent success of ENI maritime movement suggests that these crafts were reasonably well developed.

And so if an understanding of how different ceramic forms skeuomorph vessels made in different non-ceramic materials, is combined with a consideration of the various material properties of wood and basketry, a relatively coherent picture emerges for the consumption of containers during the Aceramic. It seems probable that there existed a range of non-ceramic containers made from wood, basket and perhaps gourd. Moreover, it would seem that these non-ceramic containers in the Aceramic may have potentially comprised a very similar range

of forms to those found in ENIa ceramics and that these Aceramic forms may possibly have performed very similar functions to those ascribed above to EN ceramics.

13.4.2 Early Neolithic Ia-Ib

When ceramic containers first appear in ENIa they manifest themselves in such a range of distinctive forms that it has long been argued that both ceramic technology and the ceramic forms themselves must have been developed elsewhere prior to their introduction/adoption at Knossos (Evans 1964:196; 1968:271; cf. A. Evans 1921:35; see Chapter 2). Past attempts to provide an origin for this technology have generally looked east, pointing to blank areas on the Neolithic map, particularly the islands of the east Aegean or along the Aegean/Anatolian littoral. Unfortunately, however, as knowledge of the Neolithic in these areas increases, it is becoming increasingly unlikely that these areas did provide the origin for the ceramic forms of ENIa Knossos (cf. Appendix IV, Chapter 7). As was outlined in Chapter 7, although some general similarities exist between the basic forms at EN Knossos and contemporary forms on both sides of the Aegean, what is quite clear is that these distant areas also had their own distinctive range of features and moreover lack all of the most distinctive features of Cretan ENIa forms (i.e. offset rims, wishbone handles, strap handles, flared strap handles, pierced triangular ears). Nor do these areas provide parallels for the most distinctive ENIa-b finishes (i.e. incised/pointillé, incised lattice, ripple burnish, barbotine, slashed cordon decoration).

This would seem to suggest that the hypothesis of wholesale and slavish adoption of a 'foreign' technology with a 'previously developed' range of forms, whether from the Greek mainland to the east or Anatolia to the west, is no longer tenable. Rather, in view of the near certainty that non-ceramic forms existed prior to the adoption of pottery, the role played by other containers in the adoption of pottery should be given fuller consideration. Certainly the quite extensive body of evidence in favour of very real links between ceramic and non-ceramic forms makes it hard to deny that at least some of the most distinctive ceramic forms must have had non-ceramic prototypes (e.g. eared bowls, bowls with wishbone handles,

strap handled bowls/jars). In this regard it is worth drawing attention to the fact that it is those very features, which so distinguish ENIa forms from LN Anatolian or EN Greek forms, (i.e. wishbone handles, strap handles, flared strap handles, pierced triangular ears) that present the clearest evidence for skeuomorphism.

If correct this would suggest a very different context for the adoption of pottery. In view of the striking similarities in the date of the first arrival of pottery containers in Greece, coastal Anatolia and Crete (see Chapter 2; Appendices I, IV) it remains likely that trans-Aegean diffusion at least of the basic idea of ceramic technology played a part in the adoption of ceramic technology. This could have taken place along existing extensive social networks, which must have existed during the Aceramic (see Chapter 12). However, what the data from Knossos suggest is that existing local non-ceramic container forms most likely had a significant influence on the forms which the first ceramic vessels took. Where this first combination of adoption and adaptation first took place on Crete is immaterial. What seems to be more important is that there was great interest in these new containers and in the new technology and that both spread rapidly through Crete, probably along existing social networks. This is perhaps the best way of explaining the presence in the earliest pottery bearing stratum (stratum IX) of a wider diversity of fabrics than any other EN level, with several of these fabrics demonstrably having come from some considerable distance (e.g. Fabric 12).

Consideration of the scale at which ceramic vessels were consumed also sheds light on the earliest phase of ceramic-use (see Figures 9.7-9; Sections 9.3-5). Although the figures presented in Chapter 9 represent a very crude estimate, they do give some indication of important differences in the scale at which ceramics were consumed during different phases of EN. For ENIa they suggest a very limited use of ceramic vessels. Regarding this low figure it is worth emphasising that the figure of c.25 vessels represents a maximum estimate, an even lower figure could be possible (see Section 9.5). Since the basic range of recurring ENIa form types was identified as numbering between 13-16 forms (see Figure 13.1), it is difficult to see how different social groups within the Knossos community could have control or own a full range of ceramic forms. This may indicate that during ENIa (and possibly ENIb) there was some sort of communal

sharing of ceramic vessels between social groups, perhaps even that there was no direct ownership of vessels by individual households. Vessels could, for instance, have been kept in some sort of communal storehouse on analogy with the communal building at EN Nea Nikomedeia.

What these low figures for ENIa also emphasise, is that although the earliest ceramic vessels most likely comprised a range of forms and functions comparable to earlier Aceramic containers, they could not have entirely replaced the use of these non-ceramic vessels. Instead the low level of consumption of ceramic vessels during ENIa and to a lesser extent during ENIb testifies not only to the ongoing use of non-ceramic container forms alongside ceramic vessels, but also to a continued reliance primarily on non-ceramic containers long after the adoption of ceramic technology. The low frequency of indirect-heat ceramic cooking pots and the general unsuitability of ceramic vessels for storage on any sort of large scale (small number and small size of vessels) also suggest that both these tasks, although making use of ceramic vessels, were primarily accomplished using other means.

And so, contrary to views of early ceramics, which view the adoption of ceramic vessels in terms of potential improvements in adaptation or economic efficiency (see Section 2.1.2-3, 2.1.5), the data presented in this and other chapters strongly suggest that the adoption of ceramic containers revolutionised neither the processing/cooking of food nor the range of available storage containers nor perhaps even the serving/display of food. Instead there are strong indications that pre-ceramic forms of container consumption continued very much as they had done prior to the adoption of pottery. Moreover, what seems likely is that when ceramic technology first appeared, instead of becoming the independent evolutionary revolutionising force of 'adaptionist' hypotheses, it was required to submit to the very specific needs and values of individual Aceramic/ENIa Cretan communities. Analysis of the process of adoption very much suggests that the first ceramic containers, in both form and finish, were inspired by non-ceramic forms. In this way they did not create new categories of container or consumption, but instead had to fit into existing non-ceramic material categories.

The absence of any evidence to suggest that the earliest ceramics to revolutionise and dominate the consumption of containers re-focuses attention on the reasons for the adoption of ceramic technology and ceramic containers. A general feature of more recent studies of early ceramics around the world has been an emphasis on the likelihood that the earliest pottery had a particularly high social value (see Chapter 2). For EN (Greek) Franchthi Vitelli has argued that ceramic vessels were probably valued, possibly because "their scarcity, novelty, and perhaps function might well have made them precious" (Vitelli 1993a:39). This sort of interpretation makes particular sense in the context of EN Knossos. The wide range of forms and functions manifest in even the earliest pottery combined with the very low levels of actual ceramic consumption and the continued primary reliance on non-ceramic containers, make most sense if there was a hierarchy of value for containers in different materials, with ceramic vessels occupying the uppermost register. ENIa-b ceramic vessels would, therefore, have constituted more valuable versions of containers which also continued to be produced and consumed in other materials. In this way the consumption of ceramic vessels instead of non-ceramic vessels, might have rendered a habitual action in some way special. This in turn opens up the possibility that particular strategic use could have been made of ceramic vessels during occasions of social competition, such as communal feasting. Certainly the low level of ceramic consumption would be best explained if the consumption of ceramic vessels was valued, periodic and strategic, with particular efforts taken to maintain or extend the life of individual vessels (cf. mend-holes).

A possible further context for the use of ceramic vessels is suggested by two spatially discrete series of pit deposits, one in sounding AC dug into stratum VIII towards the end of ENIa and sometime prior to the construction of House C (stratum VII) and another dug into the top of the Aceramic deposit in sounding X, probably during ENIa (see Appendix I for details of date and sequence of construction). Both are characterised by the excavation of a large pit into the debris of an earlier occupation level, followed by the excavation of two or more smaller pits in the base of this larger pit. These smaller pits seem to have been filled soon after excavation and usually contain animal bone, ash, potsherds and

less frequently figurines and/or complete ceramic vessels. The larger pits, however, appear to have been left open for some time after the sealing of the smaller pits. These pits may possibly represent some sort of ritual activity perhaps to be connected with some of the ceremonial aspects of house abandonment, such as the clearing/cleaning of occupation floors and the possible 'votive pottery pits' in the top of the destruction levels of houses, which may have been closure/foundation deposits (Evans 1968:268; 1964:48; 1994:7, 14). Certainly the deposition of figurines and complete ceramic vessels within closed temporally and spatially restricted deposits marks them out as unusual, especially if one considers that during ENIa ceramic vessels do not appear to have been consumed in large quantities. If these were ritual events then the excavation of a series of large and small pits may hint at the actions of a quite a large group of people; in addition the initial excavation of a larger pit would have provided an arena, within which ritual action centred around the smaller pits could be observed by a large group of people. However, whatever their significance, such occasions seem to have provided opportunities for the ceremonial consumption and disposal of ceramic vessels.

13.4.3 Early Neolithic Ic-II

As suggested by Figure 9.8, ENIc and ENII see a considerable increase in the scale at which ceramic vessels were consumed. Even when some attempt is made to account for increases in population (see Figure 9.9), this still represents a significant increase from ENIb by a factor of between four and nine. This period (ENIc-ENII) also sees an increase in the range of finishes and forms produced within individual fabrics, which in turn would seem to indicate a possible increase in the number of different ceramic material categories (see above). Such a rise in the overall consumption of ceramic containers suggests a concomitant sharp decline in the reliance on non-ceramic containers. Thus it is perhaps during this period that ceramic containers first begin to dominate or even replace non-ceramic container forms.

At the same time as this increase in the scale of consumption, there is also a clear increase in the rate of ceramic change (see Figure 13.2). This, in conjunction with the other changes described above, suggests that the previously

stable process, whereby ENIa-b material categories were maintained, underwent change, as a result of which the system of material categories became less formalised and/or the overall range of activities, in which ceramic vessels were used, was extended to include activities or occasions where previously non-ceramic vessels had been used. If so then it would seem that ceramic consumption changed from being periodic to frequent. Thus while the ways in which ceramic vessels were consumed during ENIa-b were probably maintained (i.e. special occasions of food consumption), ENIc-ENII seems to see the use of ceramic vessels on a more frequent basis.

Conclusions

Throughout this chapter an attempt has been made to view EN ceramic vessels as firmly embedded within EN social life and social action. Analysis of EN material categories has suggested that the consumption of ceramic vessels was formalised and subject to rules. In view of Bourdieu's idea that social stability is closely related to the success with which that society reproduces its constitutive values (see Chapter 3), the consistent reproduction of the same basic system of material categories, presumably representing a system of social values, would seem to testify to a high degree of social stability during this period. This social stability is likely to have been a direct result of the formalised nature of consumption (as well as production and exchange). Consistent reproduction of the same formal material categories may be understood as a very conscious attempt to link the present with the past, by recreating elements of that past in the present. This may even amount to the collapsing of the barriers between past and present, where time is conceptualised as cyclical (Chapter 3). Social life during the Neolithic therefore emerges as something which was governed to a large extent by powerful social values which were most likely manifest in taboos, sayings and stories, whose validity must have been considered beyond contention (*doxa*). These values were passed on to each succeeding generation and were given practical expression in the every day acts of individuals and groups. The very fact, however, that such rules depended for their continued validity and existence on

the actions of individuals underlines the possibility that at some point these specific rules or values could be contested. In general this emphasis on continuity between past and present would seem to be a feature of many Neolithic societies (e.g. Stevanovic 1997:334).

Careful consideration of the adoption of pottery found that this emphasis on continuity between past and present most likely had a strong influence on the adoption of ceramic containers. It was argued that the pre-existing system of non-ceramic material categories had a profound influence on the form and function of the earliest ceramic vessels. Rather than revolutionising this pre-existing system, ceramic vessels were forced to conform to it. In this way this system of pre-existing material categories may be characterised as formalised and as profoundly resistant to change. The earliest ceramic vessels appear to have been absorbed within it, probably as the occupants of a new, higher register of value. Their consumption during ENIa-b was most likely periodic and strategic. In this way a specific and strategic use of ceramic vessels has the potential to direct our attention towards those values, activities and occasions which were most important to the EN community at Knossos.

It has been argued that during the EN ceramic vessels were used primarily in the context of commensality, either as serving vessels or as special cooking vessels. Most vessels would also have been suitable for storage, however large-scale storage most likely took place in non-ceramic containers. Some vessels were also suggested as suitable for transportation (e.g. collared jars with flared strap handles). These could have also played a part in the context of commensality, either as serving vessels or indeed as the containers for gifts to be exchanged between different groups of people, originating either within the Knossos community or from outside. A more specific set of associations was seen to be represented by incised/pointillé decorated flat-based vessels. These vessels may have played a role in specifically ritualised activity involving the consumption of food and perhaps other substances along with body modification (tattooing). Such ceremonies may also have been specifically gendered (female).

In almost all of these instances, the consumption of ceramic vessels seems to involve groups of people coming together, exchanging and consuming ceramic

vessels, food and drink. In at least one instance, such occasions were also accompanied by the ceremonial disposal of ceramic vessels (e.g. Pits A and B, stratum VIII; see discussion above). People are likely to gather, give and receive for a variety of specific reasons: strong possibilities are occasions, such as marriage (see Appendix II for the early demographic inviability of Knossos) or death, which constitute significant stages in the human life cycle; other possibilities could include key stages in the agricultural calendar, such as harvesting, or perhaps at other stages in an unknown ritual cycle. In his study of ceramic consumption in a modern Indian village, Miller explicitly contrasts ritual and non-ritual consumption of ceramic vessels: in the former, usually life cycle and annual ceremonies, the selection of particular vessel types is fixed and selected vessels are employed in a prescribed manner, while in the latter the selection and use of vessels is much more flexible and open to differential interpretation (Miller 1985:124-132, 163). In the context of EN-MN (Greek) Franchthi, Vitelli has suggested that the consumption of ceramic vessels may have played a role in ceremonies and rituals which served to dissipate and regulate social conflicts (see Vitelli 1993a:213-9). If the consumption of ceramic vessels at Knossos during ENIa-b was similarly and specifically associated with special perhaps ritualised occasions, then this may go some way to explaining why the ENIa-b system of material categories appears to have been so formalised. If ceramic vessels operate as frames or cues for action, then the very formalised set of ENIa-b material categories would have provided knowledgeable consumers with specific information about how such vessels should be consumed. In this way during ENIa-b the periodic, public, consumption of ceramic vessels according to prescribed rules might be contrasted perhaps with the daily, private consumption of non-ceramic containers, which may have been more flexible and open to interpretation.

Study of the changing patterns of ceramic consumption raises the possibility that different social groupings are manifested in the consumption of ceramic vessels during different periods. For example during ENIa the likelihood that ceramic vessels were shared between households might suggest that some vessels might have been owned by the group and were possibly used specifically

during those special occasions when collective acts of consumption took place. In contrast the increase in the level of ceramic consumption during ENIb may mark a change in the availability of ceramic vessels to individual households, with perhaps individual household 'owning' a full range of ceramic vessels. However, these still do not appear to have been numerous enough to suggest frequent (private?) use of ceramic vessels. Rather ceramic vessels may have continued to be used on specific occasions, perhaps on the more public occasions of food preparation and consumption, which might have taken place in areas adjacent to the household, such as the cobbled yard with large cooking installation to the north of House C (stratum VII). In this way ENIb ceramic consumption could have been directly linked to occasions of inter-household co-operation, competition and commensality. This form of ceramic consumption may have continued into ENIc-ENII, however this period may also see the beginnings of regular private consumption of ceramic vessels by individual households (new categories of ceramic vessel, increase in ceramic consumption). This may reflect a more prominent socio-economic role for the individual household group (cf. Chapter 11).

And so during the EN acts of commensality may have acted at several levels and at different scales. Within the household the collective consumption of food may have served to reproduce roles and status according to the internal hierarchy of the household group, while at a group level commensality may have acted to reproduce the values and practices which structured and stabilised EN communal life. Even during ENIa, when the consumption of ceramic vessels may reflect special forms of commensality at a larger group level, intra-household commensality may have taken place on a more regular (daily?) basis using non-ceramic vessels.

Public acts of consumption should not, however, be seen as simple recreations of an idealised egalitarianist social order. Even during ENIa, when ceramic consumption is suggestive of collective acts of sharing and may reflect an ideology of equality and group ownership, it is probable that people more frequently associated in smaller groups based on the household. The potential conflict between the interests of the household and the interests of the community

may have been one of the ongoing dynamics in EN society, with different social mechanisms acting at different times to resolve potential disputes. Public occasions, although probably ritualised and formalised to some degree, nevertheless will have provided opportunities for individuals and groups to compete for and display status. In addition such occasions would have provided the opportunity for a potentially wide range of private transactions. In Chapter 12 the differential creation of value in ceramic vessels during ENIa-b was seen to be closely related to acts of exchange, distance from source and perhaps deliberate acts of long-distance acquisition. Particularly valuable or powerful vessels could therefore be used in a structured way to create or display status. Public occasions, such as communal feasting, would have provided the occasions and opportunity for what might be termed social 'tournaments of value', where individuals and groups might compete to display status. This could have involved both story-telling and actual consumption of ceramic vessels (see Chapter 12). In this way the consumption of ceramic vessels on such occasions may have served both to reproduce a set of social values and social categories, which lay at the very heart of EN society, but at the same time allowed individuals and groups limited manoeuvre, within those formalised systems of values and categories, for the strategic employment of material culture in the ongoing negotiation of status, affiliation and identity. Such societies would be best characterised as egalitarianist, rather than egalitarian, since in reality they were marked by forms of informal social hierarchy, which manifest themselves in overlapping networks of alliances, commitments or debts of honour.

CHAPTER FOURTEEN

CONCLUSIONS

A central theme in this thesis has been the characterisation and interpretation of ceramic variation. At a basic level this centrality is only to be expected: one cannot investigate ceramic production, exchange or consumption without first committing oneself to the detailed characterisation of variation in fabric, form and finish. However, within the context of studies of Neolithic ceramics in the Aegean, the issue of ceramic variation has a very specific relevance. In a review of current approaches to early ceramics and early ceramic technology in the Aegean (Section 2.3), it was noted that there exists a critical divide between detailed analyses of individual site assemblages and more general syntheses of Neolithic production, consumption and exchange. While the former have emphasised the local production of ceramics and a minimalist view of ceramic exchange, the latter have stressed the important role of ceramic vessels in exchange and have implied that certain ceramic vessels moved widely if perhaps in small quantities. At present, therefore, awareness amongst some scholars that ceramic vessels should play a role in exchange is matched by an apparent inability in detailed ceramic analyses to recognise non-local ceramic vessels.

It has been argued that this conflict arose initially at least partly because of problems of methodology. Earlier studies of Neolithic ceramics in the Aegean were generally based on the observation of variation in form and finish and had the primary goal of constructing relative regional ceramic chronologies. Such studies tended to prioritise the recognition of similarities between different site assemblages over the characterisation of any local differences, thus creating a picture of stylistic homogeneity. In their conclusions regarding technology, they tended to infer a simple relationship between stylistic homogeneity and technological homogeneity (i.e. total local production; e.g. Furness 1953), although none of these went as far as to test this interpretation further. Such a picture of total local production also accorded well with then current ideas regarding the Neolithic economy, which emphasised subsistence self-sufficiency over exchange (e.g.

Childe 1981). However, more recent studies *have* subjected Neolithic ceramic assemblages to detailed technological study (e.g. Vitelli 1993a; Yiouni 1995, 1996a) resulting in the identification in each case of considerable diversity in fabric. Such studies have emphasised that observation of form and finish alone may not be the best method to investigate ceramic variation.

Despite this identification of fabric diversity, however, the old idea of technological homogeneity, at least in dedicated ceramic studies, has not been subject to critique. Instead most studies continue to emphasise total or near total local production. The failure to engage with the issue of technological homogeneity is surprising and demands further consideration. The reasons for this cannot simply be methodological: for example, Vitelli's *macroscopic* study of the EN-MN ceramics from Franchthi (1993a) represents a model approach; it is only perhaps in the failure to integrate the results of this macroscopic study with the series of analyses conducted (petrographic, chemical) that this study could be said to be methodologically weak (see Section 5.6.3). One cannot therefore simply ascribe the continued emphasis on total or near total local production to an inability to characterise a Neolithic assemblage in the level of detail necessary to allow the identification of non-local ceramics. Indeed, the very possibility of re-interpreting Vitelli's original ascriptions of provenance using her original data (see Section 11.1 on 'Andesite Ware'), demonstrates that the problem in more recent studies is not so much the ability to characterise non-local material as the will to recognise it.

It has been argued that the eagerness, with which recent technological studies of ceramics have explained all forms of ceramic variation (i.e. fabric, form, finish) purely in terms of local production, may actually reflect the continued influence of the old self-sufficiency model for the Neolithic economy (see Section 2.3.1). In more general studies of the Neolithic economy there has been a subtle shift in emphasis from a focus on production, mainly of subsistence, purely for local consumption to an awareness of the important role played by exchange (see Section 2.3.1). This shift in emphasis is largely responsible for some of the more positive statements regarding ceramic exchange to be found in more general syntheses. In contrast recent technological studies of ceramics have continued either implicitly or explicitly to stress the self-sufficiency model (e.g. Vitelli 1993a:208). This model

continues to act as a conceptual barrier preventing further exploration of the significance of ceramic variation in all its forms. As a result in their interpretations of provenance the onus of proof is always left to the person wishing to identify non-local products (see Section 11.1).

ENI-II Ceramic Technology at Knossos

In many respects the Early Neolithic ceramic sequence at Knossos represents an ideal opportunity to explore the critical issue of ceramic variation in Neolithic assemblages. First discovered early in the twentieth century (A. Evans 1900-1901), Neolithic ceramics at Knossos have had what might be termed a ‘classic’ history of interpretation: early study combined form and finish with observations of stratigraphy to construct a relative ceramic chronology (Mackenzie 1903), which has since been refined by later more detailed analyses (Furness 1953; Evans 1964). Such studies emphasised stylistic and technological homogeneity, although no dedicated technological study had previously ever been conducted. Based on this interpretation of ceramic production as almost entirely local, a dominant view has developed which sees EN Knossos as essentially isolated not only from the Aegean, but also from other settlements on Crete (see Section 12.1).

This characterisation of ceramic production and exchange, however, can no longer be sustained. Combined macroscopic and microscopic (petrology, SEM) study of fabric, form, finish and firing has demonstrated the presence at EN Knossos of considerable degree of ceramic variation (see Chapter 10). Consideration of fabric reflects a wide variety of approaches to paste preparation involving the use of single or multiple clay sources (clay mixing) of a variety of types as well as a wide range of tempers (limestone, metamorphic, igneous, altered igneous, grog, sand, organic) (see Chapter 6; Appendix V). Perhaps more significantly this diversity in fabric *cannot* be explained purely in terms of local production within the immediate area (<5km) of Knossos. While the most frequently occurring fabrics are also those that are most compatible with a local provenance (marls, limestone; i.e. Fabrics 1a-i, 2a-e), there are many other fabrics, which occur less frequently, whose nearest possible sources lie within north-central Crete but beyond the immediate area

(>5km) of Knossos (e.g. Fabrics 5a, 6, 8, 9, 10, 11). In addition a small group of very rare fabrics have a mineralogy that would suggest that their origins lie at some considerable distance from Knossos (e.g. Fabric 12, Mirabello Bay; Fabrics 31 and 35, probably off-island). Detailed comparative study of form and finish also suggested the possibility of an off-island provenance for rare Fabrics 24, 25 and 28, whose mineralogy is not distinctive of a specific origin.

Perhaps the most striking feature of the majority of the fabrics identified is that they present very similar features of form and finish, even in cases where production locales are widely separated. For example, vessels produced in the Mirabello Bay area of east Crete (Fabric 12) are indistinguishable in form and finish from those produced in the immediate area of Knossos (e.g. Fabrics 1a-i). When the relationship between variation in fabric, form, finish and frequency was considered in depth, it emerged that c.97.5-99.9% of the EN assemblage at Knossos could be characterised in terms of a relatively limited range of recurrent features of form and finish (see Sections 7.5-6, especially 7.6.1-2; Appendix VI). Although subtle differences can sometimes be noted between different fabrics (see Appendix VII), in general it is their similarities that are most striking. Wherever information existed for these fabrics which might indicate provenance (mineralogy, frequency), it either suggested a Cretan provenance (e.g. Fabric 12) or at least a compatibility with an origin on the island. In contrast, the remaining small group of rare or unique fabrics either share little or no parallels in form or finish with this main group or have a mineralogy that is inconsistent with an origin on Crete (see above).

The recurrent range of features of form and finish, characteristic of the main group of fabrics, was subject to detailed comparison with published assemblages from neighbouring Aegean regions. This comparison resulted in the identification of a more restricted range of features of form and finish, which lack any close parallels outside Crete and are thus considered to define Cretan Neolithic ceramic production. These distinctive features break down into three main dimensions of variability, namely rims, handles and decoration, and comprise offset rims, wishbone handles, strap handles, pierced triangular ears, incised/pointillé, incised lattice, dribble painting, ripple burnish, barbotine, incised cordon/rope decoration.

The general similarities in form and finish shared amongst most fabrics helps to explain why previous macroscopic studies of EN ceramics at Knossos have always chosen to emphasise homogeneity in form and finish. However, as microscopic analysis of fabric has shown, considerable variety may exist at a lower level. A similarly concealed diversity is suggested by the microscopic examination (petrology, SEM) of vessel surfaces (see Section 6.6; Chapter 8). This revealed that the apparently narrow range of EN surface treatments (burnished, polished, incised) could be achieved in a variety of ways. In general this study noted that surface compaction as a result of burnishing or polishing was a feature found in most fabrics. However, in some fabrics (e.g. Fabrics 5a, 12) high quality polished surfaces were produced by burnishing or polishing the smoothed vessel surface. Other fabrics (e.g. Fabric 8) testify to the application of a slip (non calcareous or calcareous) prior to polishing. Some of these slips derive from clays different in composition from the body. In the case of some calcareous fabrics (e.g. Fabrics 1a-i, 19), a non-calcareous slip has been used, apparently in order to ensure a dark (red-dark brown) polished surface on vessels, which would normally fire buff to grey.

In contrast to the subtle differences in techniques of finishing between fabrics, study of forming and firing methods suggested that vessels produced in different fabrics were generally formed and fired in the same way. However, this conclusion may to a large extent reflect an inability to characterise these stages in production at the same resolution as finishing. Vessels were mostly coil-built, probably in stages, although flat-based vessels probably began as pinch-pots that were then built up with coils. Study of firing (petrography, SEM) suggested that in most fabrics vessels were fired to a variety of temperatures, which vary from below c.750°C to beyond 1000°C (see Chapter 8). No clear patterning emerged when this variability was broken down by fabric; rather individual fabrics tend to be characterised by a range in firing temperature and firing atmosphere. In this way it was concluded that SEM-based study of firing temperature, although of proven worth in studies of Bronze Age ceramics (e.g. Kilikoglou 1994), does not represent a productive means of characterising differences in firing behaviour in Neolithic ceramics. In the majority of examples studied no inferences could be made regarding firing environment, however in a small number of cases consideration of secondary

calcite alteration and/or non-homogeneity in firing both led to the conclusion that firing was likely to have been fast with contact between vessel and fuel. This would indicate firing in an open environment, such as a bonfire or pit.

In general most fabrics that are represented throughout the ENI-II sequence at Knossos exhibit no obvious evidence for changes in technology. In this way and to a very great extent ENI-II ceramic technology is characterised by stability and continuity. However, during ENIc-ENII a series of parallel technological changes take place in the local fabrics (i.e. Fabrics 1a-i, 2a-e). These comprise changes in paste preparation (more finely crushed limestone temper), forming (new method of coil joining and strap-handle attachment), finishing (introduction of new finishing methods) and possibly firing.

The Organisation of Ceramic Production (ENI-II)

In general, previous attempts to characterise the organisation of earlier Neolithic ceramic production may be criticised for the overly simplistic way in which they have chose to interpret most or all ceramic variation purely in terms of local production. For example, in her study of ceramic production at EN-MN Franchthi, Vitelli applied a very specific interpretation to ceramic variation: the five main fabrics identified were interpreted as reflecting production by five different producing groups, which probably correspond to five individual female specialists working in different households. This reconstruction relies entirely on the local production of the five different fabrics, an interpretation which has been shown to be open to doubt (see Section 11.1). It is argued that the data from Knossos are particularly instructive in this light. Although the EN ceramic assemblage from Knossos exhibits a degree of variation that is comparable to that found at EN-MN Franchthi, at Knossos macroscopic and microscopic study indicate that a large proportion of this variation cannot be correlated with local production and thus cannot not be used to demonstrate a one-to-one relationship between different fabrics and different locally producing households.

At a more fundamental level, it has been argued that the unquestioned pursuit of specialisation in the earlier Neolithic Aegean is itself open to challenge.

If we seek to identify specialisation wherever we find production, then one has to question the value of the identification. Previous studies have generally not sought to understand the concept of specialisation nor how it might properly relate to the relationship between producers and consumers under the DMP. Often there appears to be confusion between the consumption by non-producers of items produced *for livelihood* and the consumption by non-producers of products produced specifically *for exchange* (see Section 4.2.2 for the definition of these terms); only in the latter case need specialisation be implied. In Chapters 4-5 it was argued that the detail available from the integration of various categories of ceramic data (macroscopic and microscopic) provides the opportunity to move beyond typologies of production and to explore the subtleties and potential uniqueness of the way ceramic production was organised during the earlier Neolithic.

During ENIa ceramic vessels seem to occur in small quantities and from the perspective of production this was taken to suggest that production was seasonal and output low. Consideration of the sequence of production and particularly the effort taken to create thin-walled smooth dark polished vessels suggests that ENIa ceramic production was labour intensive, inefficient and might therefore be characterised as ‘production for livelihood’. Through a combination of arguments it was suggested that production was not in the hands of high-status individual specialists (*contra* Vitelli), but was instead most likely to be an activity which was communally-shared and non-specialised.

The stability and continuity shown by most fabrics during ENI-II would seem to suggest that there was an effective mechanism, which ensured the transfer of the knowledge and techniques of ceramic production to the next generation. This mechanism was argued to be the community itself with ceramic technology forming part of the communal reservoir of knowledge with the communal nature of ceramic production acting as an effective check on innovation. However, it was also argued that the absence of innovation may also be understood in a more active sense. Communally-shared acts of ceramic production may have deliberately chosen to emphasise continuity: by recreating past material actions and categories producers effectively situated themselves in a timeless state between past, present and future,

where the community of the present joins communities of the past. Such actions reinforce group cohesion and promote a particular authorised view of group identity and cosmology. If vessels were in some sense communally produced, then they may have in some way belonged to the community. If ceramic vessels were distributed after production, then this distribution could have been according to status within the community. Within the context of collective acts of production the desire to privilege specific individuals as specialists seems to be out of place and perhaps even anachronistic. Indeed it remains possible that within communities of the earlier Neolithic, such as ENIa-b Knossos, individuality was suppressed in favour of corporate solidarity, as would be expected in an egalitarian society.

Although clays and temper suited to the requirements of EN ceramic production enjoy a wide distribution, the distribution of the raw materials for other products does not seem to have been so ubiquitous. Inevitably this means that the production of such products is necessarily more restricted. Production using resources, which are spatially restricted, characterises the production of a range of objects, such as chipped stone (obsidian, chert, schist), ground stone axes, maces, mortars and beads/necklaces.

The spatial restriction to the production of such objects has been taken to indicate that the production, distribution and consumption of these products took place within a different sphere of exchange (e.g. Perlès 1992). For example in their own comparison of the production of different types of artefact Perles and Vitelli concluded that "procurement, production, distribution and consumption did (and do) not vary independently, but together form a coherent system within each category of product" (Perles & Vitelli 1999:96; cf. Toren 1986). However in Chapter 12 it was argued that such differences in the production, circulation and consumption of different types of object were actually impossible to identify in the available data. Rather, at present it would seem that different objects produced in different locales circulated in similar ways. For example, the spatially-restricted production of shell beads at EN Franchthi is characterised by the same high labour input, low efficiency and low output as found in ENIa ceramic production. As Perlès has said, the production of shell beads at Franchthi does not resemble an "export workshop" (Perles 1992:130) and thus could not be viewed as indicating

any form of economic intensification nor could it be characterised as 'production for exchange'. Instead, as has more recently been suggested, the enormous labour investment involved in making one necklace could indicate that production of bead necklaces was "a collective undertaking by some portion of the Franchthi community" (Perlès & Vitelli 1999:104-5).

Thus, although spatially-restricted forms of EN production at first seem to suggest a form of specialisation, such as community specialisation, particularly because not all consuming communities participated in the production of such products, when an example of spatially-restricted production is considered in more detail there seems to be no evidence for any difference in organisation or output. Since the difference between these two forms of production is not in their organisation so much as the source of their raw materials there seems little reason to try to enforce an analytical distinction between them. The difference should be as unimportant to us as it seems to have been in the past. Differences in raw material location are not after all good grounds for an identification of specialisation in any sort of definition.

I would argue that attempts to view the spatially-restricted production of objects as special or different (e.g. Perlès 1992:151-2) do so largely because they misconstrue the relationship between producers and consumers and the role played by exchange. The exchange of ceramic vessels, although significant in proportion to the total numbers of vessels in circulation, nevertheless seems to have operated on a small-scale, particularly in comparison to later periods. In this way exchange was more symbolic than economic since it served primarily to maintain social relationships and as a means of acquiring social status. Exchange at this scale is all about quality rather than quantity. It is inevitable that certain communities, which by virtue of geographical location or initiative have access to a specific raw material, will produce which other communities do not. However the scale of their production seems to have matched that of exchange: that is high expenditure of effort and small scale. Since there is no evidence to suggest that spatially-restricted production ever sought to maximise output, that is production for exchange, such acts of production cannot be characterised as specialised. What seems to be more important, for example in the case of shell bead production is not the production of many bead

necklaces of great exchange value, but the collective nature of production itself: through such shared activities communities maintained their social values, ideologies, world-views.

Changes in the local production of ceramics at Knossos during ENIc-II, were tentatively interpreted as indicating changes in the organisation of production. In addition to the technological changes noted above, this period also appears to see a significant increase in the scale of ceramic consumption and by implication ceramic production. Such an increase in intensity provides a context within which to understand some of the technological changes, such as the introduction of more efficient (time, labour) techniques of forming and finishing. Similar near contemporary changes are apparent in shell bead production at LN Franchthi, which now becomes more intensive, more efficient with a higher output (see Miller 1996). The period of ENIc-II also sees qualitative and quantitative changes in architecture as well as the first appearance of symbolic representations of built structures (house models). These were interpreted as signalling the emergence of the household as a distinct architectural and symbolic entity and a concomitant weakening in any communal ideology that may have existed. It is considered possible that at least some ceramic production may have moved from being a public (communal) to a private activity.

The Adoption of Ceramic Containers and Ceramic Technology

Contrary to theories which emphasise the revolutionising potential of the earliest ceramic containers (see Sections 2.1.2-3), the adoption at Knossos of ceramic technology and ceramic vessels does not seem to have been accompanied by obvious social, economic or material changes. During the Aceramic it is almost certain that use was made of non-ceramic containers made from perishable materials (Evans 1968:271). Moreover, study of the form and finish of the earliest ceramic vessels from Knossos (stratum IX, ENIa), would suggest that these vessels skeuomorph in form, finish and possibly function earlier non-ceramic containers made of wood and perhaps basketry.

This suggests a very different context to the initial adoption of ceramic technology and ceramic containers. It was argued that the principle reason why the earliest pottery at Knossos manifests a 'developed' range of forms, is not because it was developed elsewhere (*contra* Evans 1964:196; 1968:271; A. Evans 1921:35), but because existing Aceramic non-ceramic material categories exercised a strong influence over the form taken by the first ceramic containers and the functions to which they were put. For example, although there is evidence to suggest that ceramic vessels were infrequently used for cooking, the technique used was indirect-heating, a technique of cooking which does not exploit the full potential of ceramic containers and which may be a continuation of pre-ceramic cooking practices. Moreover study of raw materials suggests that the functional optimisation of cooking pots was not a prime consideration in the selection of raw materials. In this far way from being revolutionising, ceramic vessels seem to have been forced to conform to this pre-existing system of material categories and material practices. Once more the emphasis would seem to be on continuity rather than change.

It would seem, therefore, that the only significant material change between the Aceramic and ENIa periods was the arrival of ceramic technology itself. ENIa deposits at Knossos are characterised by a greater diversity of fabric than any subsequent phases. It can be demonstrated that the majority of these cannot be immediately local to Knossos (<5km). In some cases, such as Fabric 12 (Mirabello Bay), it is clear that their origins lay at some considerable distance from Knossos. It

would seem therefore that ceramic vessels circulated between settlements with the greatest intensity during the period when ceramic technology was first adopted. This could reflect a special interest in the products of what was then a new technology. This would also seem to testify to the existence of widespread links between settlements and through which the idea and techniques of ceramic production may have spread very quickly. This hypothesis is also supported by study of the ways in which vessels from different production locations were produced. Not only are forms and finishes remarkably similar - so similar in fact as to render the products of different production locations at times indistinguishable - but also the basic paste technology (coarse tempered fabric) and the forming methods used. This sharing of basic features of ceramic technology between production locations might suggest that ceramic technology was openly and freely exchanged between communities.

This would suggest a model for the adoption of ceramics, which envisages rapid diffusion of the idea of ceramic technology, probably along existing networks of contacts between communities in conjunction with a process of local adaptation where the new technology was used to produce container forms, which to a large extent reflected pre-existing material categories. The absence of any early attempt to intensify either the production of ceramic vessels or the exploitation of natural resources means that this scenario does not accord with that suggested by the resource intensification/competitive feasting model (see Section 2.1.5). However this need not mean that the adoption of ceramic vessels was without elements of social competition or social strategy.

The Circulation of Ceramic Vessels (ENI-II)

In many cases the exploitation of different raw material sources testifies to the existence of different production locations located outside Knossos (see Chapters 10-11). In view of the close link posited by comparative ethnographic studies between the resident location of groups of potters and the location of the raw materials that they use, this would seem to indicate the existence of different EN settlements located within and beyond Crete. This conclusion is particularly important because it indicates that Knossos, far from existing in isolation as is

currently believed, was most likely interacting with different settlements. Such settlements would appear to comprise an essentially hidden prehistoric landscape, which over a century of exploration and survey has consistently failed to detect.

A study of the types of non-local vessels present at Knossos did not identify clear patterns. Indeed contrary to previous views of ceramic exchange during this period, a wide variety of vessels circulated, coarse (burnished) and fine (polished, painted), open and closed. Through a variety of arguments it was suggested that ceramic vessels were subject to changing estimations of value, which were very much context-specific. Consideration of frequency and provenance suggested that vessels from more distant areas of Crete, such as the Mirabello Bay, or perhaps even the Herakleion Basin are as rare at Knossos as those vessels, which are likely to have come from off the island. If correct, this would suggest that ceramic vessels circulated most intensely and were most likely to be consumed and discarded at sites close to their location of production. Furthermore, on the rare occasions when a vessel was exchanged beyond this zone or social field, distance from source was no longer a factor and such vessels could potentially circulate over great distances.

It was suggested that this pattern of intense local circulation could conform to an exogamy model. During ENIa-b when non-local products comprise a significant proportion of the ceramic assemblage, the community at Knossos was small (see Appendix II) and must therefore have formed part of a larger breeding population. However during ENIc-II when the proportion of non-local fabrics drops considerably the population of Knossos is estimated as being considerably larger, well within the minimum estimated figure for demographic viability (see Section 12.4.3).

Consideration of the movement of vessels over longer distances suggests that at least some of this may be best explained in terms of special journeys of acquisition. The existence of such journeys is demonstrated by the presence of items with an off-island provenance (e.g. ceramic vessels, obsidian and emery): in the very least the acquisition of these items required the crossing of long stretches of sea linked by islands which at present do not appear to have been occupied at this time. Moreover, there is no obvious reason why such journeys

could not also have been made between settlements in different parts of Crete. The existence of longer journeys of acquisition during ENIa-b would also help to explain the continued maintenance of large zones of stylistic similarity.

These special journeys would have taken individuals far from their home communities and must have required considerable skill, have entailed high risks and have taken considerable amounts of time. This raises the question of the motivation for such journeys. During ENIa and ENIb at least half of the vessels consumed at Knossos are of non-local origin. This cannot be explained in terms of local scarcity: local Knossian ceramic production could quite easily have produced the low quantities of ceramic vessels required for consumption. Nor can this be explained as answering a functional deficiency: comparison of different vessel forms in different fabrics suggests that there was instead a high redundancy of form. This emphasis on non-local vessels would seem therefore to have had another motivation.

Distant objects by virtue of their rarity, their unusual biographies and their intimate association with the 'outside' may be understood as having special value and power (Helms 1993). Support for a higher valuation accorded to non-local vessels was provided by a study of mend-holes, which proved to be a particular feature of non-local vessels during ENIa-b. Distant objects acquired through exchange create a social relationship between giver and receiver. Such objects objectify those relationships, but significantly, since they are objects that have a use, their consumption provides their owner with the opportunity and cue for narratives surrounding their acquisition. Such narratives allow the owner/teller to benefit on more than one occasion from prestige associated with the ability to make journeys outside the realm of the familiar. In this way it is above all through the public consumption of such exotic objects that their owners are able to gain the prestige and status associated with the conduct of longer journeys of acquisition and the possession of exotic objects.

It has been argued that the material world of the Neolithic represented a formalised or 'stable universe of commodities'; that is the range of potential commodities was limited and does not appear to have been consistently extended to include other artefact types. The pursuit of more powerful versions of existing

legitimate formalised material categories, such as the acquisition of non-local ceramic vessels, might therefore be seen as a way of competing for status, without jeopardising the system itself by introducing new commodity forms. In this way the restriction of equivalences and exchange to a 'stable universe of commodities' often acts to protect and reproduce status systems (Appadurai 1986:25) with more valuable versions of legitimate material categories acting as tokens through which status is conventionally reproduced. In this way the acquisition of non-local ceramic vessels at Knossos would seem to indicate how individuals and groups competed for status within certain social rules, since by possessing these objects individuals and groups are able to take control of existing registers of value and create new ones. In this way although the ENIa-b community at Knossos might be egalitarian in its values, in reality it may have been characterised by unstable and impermanent social hierarchies.

It is striking that despite the obvious importance of exchange, this did not lead to any restructuring of ENIa-b production in favour of the production of greater surpluses specifically for exchange (i.e. production for exchange). One of the principle reasons why this did not take place is likely to be that the reasons for the importance of ceramic vessels in exchange were qualitative and not quantitative. Non-local vessels have a higher value not because of what they are intrinsically, but what people believe they are. These vessels acquire value because of their specific associations with people, places and journeys. It is these associations that are brought out during the narration of vessel biographies. In this way value could only be acquired the hard way, through real participation in these events: one cannot mass-produce pot biographies, they can only be acquired through time and circumstance. It is interesting in this light to note that significant increases in local ceramic output only take place in ENIc-II at the same time as the role played by ceramic vessels in non-local exchanges seems to have been diminished

The Consumption of Ceramic Vessels (ENI-II)

Consideration of the functions to which early ceramics were put suggested a wide range of tasks. There is good evidence to suggest that some types of vessel

were used as cooking pots. Such vessels, however are relatively infrequent, suggesting that the majority of cooking was accomplished using other means. Storage also constitutes a likely function, however the absence of a large dedicated storage jar as well as the generally small quantities of vessels in circulation would seem to suggest that this was not a primary function of ceramic vessels. Evidence for the movement of ceramic vessels between settlements also raises the possibility that ceramic vessels served for the transportation of other commodities.

However, by far the majority of ceramic forms are suitable for the serving and display of food. Consideration of the creation of material categories suggested that surface finish might mark an important division between tableware (polished flat-based) and other vessels (burnished, round-based). The range of forms within each fabric, although still exhibiting some degree of redundancy, seems to have been relatively small (c.16 shapes) and at least during ENIa-b can be shown to have been shared between different production locations. These features characterise this system of material categories as formalised (see Chapter 13). It was suggested that this system of formalised material categories may reflect formalised ideas about how ceramic vessels should be consumed. A possible example of the formalised consumption of a particular category of vessel is provided by flat-based mugs. It was suggested that these vessels demonstrate an association with human figurines, especially female figurines, and incised/pointillé decoration and by inference the human body and the practice of tattooing. These associations may suggest that the production and consumption of these vessels was bound up with the practice of tattooing and possibly even explicitly gendered.

The low frequency with which ceramic vessels seem to occur during ENIa would appear to indicate that everyday container needs continued to be served by non-ceramic containers. The estimated quantity of ceramic vessels in circulation during ENIa would seem to be too few to allow individual groups within the community to 'own' a complete range of forms and therefore vessels may have been shared between different groups or even in some sense communally 'owned'. Since it was argued that in many cases ceramic vessels copy the forms and possibly the functions of non-ceramic vessels, it seems possible that non-ceramic and ceramic vessels could be used interchangeably. It was suggested that the principal difference

between vessels in different media was probably value, with the earliest ceramic vessels occupying a new, higher register of value.

If daily container needs were largely fulfilled by non-ceramic containers, then the consumption of high-value ceramic containers is likely to have been reserved for special occasions. The deployment of ceramic vessels on these occasions is likely to have had high strategic potential. Since most ceramic forms would be suitable for the display and/or consumption of food, it was suggested that these special occasions are likely to have involved commensality. Likely occasions for communal feasting are key stages in the human life cycle (birth, coming of age, marriage, death) or in the agricultural calendar (sowing, harvesting). Arguably, however, the most important feature of such occasions of communal feasting is not so much the way they might cement communal solidarity and help define and reinforce communal identity, important though these things are, but rather the opportunities these occasions provided for the negotiation of personal and group status.

During ENIc-II there appears to have been a significant increase in vessel consumption. To some extent this increase might related to the greater availability of ceramics at this time. However it also suggests that changes had taken place in how ceramic vessels were consumed. During ENIb ceramic consumption is unlikely to have encompassed all tasks for which containers were required: the estimated quantities of ceramic vessels in circulation still appear to be too low to demonstrate the replacement of non-ceramic containers and thus ceramic vessels may still have only been used on certain occasions. This type of special use may have continued into ENIc-ENII. However this period also sees the production of new vessel finishes, which in turn may denote new categories of ceramic vessel. This creation of new vessel categories, finished using new more time-efficient surface treatments (e.g. scribble burnish, white slip) may mark out a new series of ceramic vessels which could challenge and perhaps even replace non-ceramic container forms in more daily activities. In this way the ENIc-II period may see the beginnings of more regular private consumption of ceramic vessels by individual groups within the community.

Final Comments: A Model for Production, Circulation and Consumption in the Earlier Neolithic

Although speculative, this characterisation of production, circulation and consumption may be used to produce a model to explain the relationship between acts of production, consumption and exchange during the earlier Neolithic period at Knossos (ENIa-b). Acts of production appear to be inherently stable in the way they consistently reproduce a specific set of social values and formalised social categories. They represent the universe as it is ideally conceived: that is one of shared activities, shared values, shared identity and shared cosmology. That said, however, it is important to remember that if the products of communal acts of production were distributed, their distribution is likely to have reflected differences in status and thus reflect the universe as it is actually manifest: that is one where individuals and groups compete for status and influence.

Acts of ceramic consumption, specifically acts of communal feasting, can also appear to be stable since at one level they can be viewed as legitimating the authority of the community over that of the household or individual through the reproduction of formalised communal values and categories. However at another such occasions can be seen as providing the opportunity for personal advancement through participation in what might be termed 'tournaments of value', where the process by which value is constructed in people is intertwined with the manipulation, display, exchange and ownership of high-value objects.

Exchange also seems to have taken place within a formalised and limited set of material categories. Its importance during ENIa-b, however, was great: on one level the circulation of goods testifies to the existence of close social relationships (kinship? friendship? exogamy?) between the community at Knossos and its immediate neighbours, relationships which may have minimised conflict and contributed to the apparent stability of EN Cretan communities. However at a different level the acquisition and display of particularly valuable ceramic vessels and other goods may have been one of the few legitimate ways in which different individuals and/or social groups within the community could negotiate status and compete for power. Therefore consideration of how acts of production,

consumption and exchange articulate with each other would seem to suggest the existence during ENIa-b of a material and social system of values and categories that was extremely successful at reproducing itself, largely because it allowed individuals and groups only limited room to compete for status and prestige. This competition never threatened to overthrow the system precisely because the system defined the rules of engagement.

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APPENDIX I.

EARLY NEOLITHIC CHRONOLOGY: TOWARDS AN INTEGRATED NEOLITHIC CHRONOLOGY FOR THE SOUTHERN AEGEAN.

"Before the reconstruction of a detailed chronological framework for Mainland Greece, the Aegean and West Anatolia, it is not safe to look for close affinities between these regions" (Manteli 1993a: 159).

One could be forgiven for thinking, after a century of investigation, that there could be little to add to the issue of the chronology of Neolithic Knossos: one would expect a sequence that was both well-defined at the site and well-integrated with the chronologies of other contemporary sites in neighbouring areas of Crete, as well as on the southern Greek mainland, in the island Aegean and in western and south-western Anatolia. Regarding definition, there can be little doubt that the work of Furness and above all the excavations and studies of J. Evans have transformed the earlier and more impressionistic observations of Mackenzie and Evans into a well-defined stratigraphic and relative ceramic sequence (see Chapter 7); a sequence which, to this day, remains the basis for much of Cretan Neolithic chronology. Moreover restudy of ceramic material during the course of this doctoral research has tended to confirm the validity of this sequence and the only changes suggested below are in the form of new subdivisions within existing chronological phases. Indeed the greater temporal resolution provided by the new sub-phasing of ENI proposed here has in all cases served only to confirm the stratigraphical divisions first proposed by J. Evans, a confirmation of the excellence of this and other earlier work. It is perhaps only in terms of absolute radiocarbon dates that the Knossos sequence could be said to be lacking (see below), and even then it must be recognised that it is still one of only a handful of sequences in the southern Aegean that have radiocarbon dates.

However, regarding the integration of the Knossos sequence with those of other sites, there can be little doubt that there is much that remains to be done. Currently there exists no EN sequence from elsewhere on Crete that could be considered comparable to that of Knossos. EN material has been noted in studies of Neolithic material from Katsambas, Gerani Cave, Lera Cave, Ayios Ioannis Cave, Pelekita and Magasa¹⁶⁹.

¹⁶⁹ Alexiou 1956, 1957; Tzedhakis 1973; Guest-Papamanoli & Lambraki 1980; Davaras 1979, 1982; Dawkins 1905.

However none of these sites in any way constitute a continuous sequence, with which one might further clarify the sequence at Knossos, nor are any of them fully published (see Appendix III). Instead these sites rely on the Knossos sequence for their dating. Thus for EN Crete Knossos stands isolated, an ongoing problem which has given rise to some rather fanciful theories (see Section 12.1).

Attempts towards a closer integration of the Knossos sequence with those of other sites in the southern Aegean have similarly met with little success. Based on little more than intuition and possible Anatolian comparanda for Cretan Neolithic figurines and maceheads, Sir Arthur Evans argued for the existence of an "Anatolo-Cretan Neolithic" quite different from that of the Greek mainland (A. Evans 1928; cf. also Pendlebury 1939:42); while on even less evidence than this, Mackenzie sought a Libyo-Egyptian origin (Mackenzie 1903:162-4). Childe (1937:32) praised Evans' prescience in describing Crete as an 'offshoot' of the Anatolian Neolithic and pointed to new evidence available that seemed to provide further parallels. However much of this early speculation suffers from the problem of synchronicity. Many of the parallels drawn by Childe, A. Evans and Mackenzie are now, through improvements in our understanding of regional sequences and above all radiocarbon dating, known to be millennia apart.

Largely as a result of this, relatively few stylistic parallels are noted in more recent studies, the majority of which, as both Furness and Evans openly admit (Furness 1953:108; Evans 1968:273; 1970a: 383-3), are much later in date than EN Knossos and come from regions at some considerable distance. Despite this spatial and temporal remoteness the presence of certain distinct features of the Knossos EN sequence (trumpet lugs, flap and wishbone handles, triangular 'ears' on the rim, plastic cordon decoration, pellet/knob decoration, pointillé, internally-thickened rims) among Late Neolithic East Aegean and Late Chalcolithic Western Anatolian sequences (e.g. Troad), encouraged Evans to suggest that the general character of the EN sequence "links it definitely to the East Aegean and coastal Western Anatolian tradition" (Evans 1968:273-4). Pointing to the links between the material from the Ayio Gala cave and Hacilar I, which pushes back presence in this area as far back as the Early Chalcolithic (c.5500-5300BC), Evans argued that further evidence of still earlier occupation of Western Anatolia, contemporary with the Cretan Early Neolithic must surely await discovery (Evans 1970a:383). In this prediction, Evans has been proved correct: there

is now evidence for widespread LN (6450-5800BC) occupation along the Aegean coast of Anatolia (see Appendix IV and below).

In his summary Evans considered the parallels he noted to be 'very tenuous' and concluded that Neolithic Knossos was an 'isolated community'. Since then Knossos has remained isolated or even absent from studies of Greek chronology (e.g. Weinberg 1965:301, 1970:608-618, where it is treated as an isolated case), as well as from studies of south-west Anatolian chronology (e.g. Eslick 1992) and the southern Aegean Neolithic (Sampson 1984:248). In the case of the latter, Crete is included in a comparative chronological table, however the synchronisms are based purely on what appear to be uncalibrated radiocarbon dates, which result in a dating of strata VII-II which is far too low (Sampson 1984:248; see below). In a similar way Gallis' incorporation of Crete in his chronological table (Gallis 1996) seems to have been accomplished on the basis of comparing absolute dates for the Knossos sequence to those for Greece, rather than through direct material connections between the sequences and as a result the Knossos sequence floats free from that of other regions. Furthermore some of the dates adopted for different strata at Knossos seem to have been determined more by the need to produce neat correlations: for example radiocarbon dates which put the beginnings of settlement at or before 7000BC have been ignored in favour of a date of 6800BC, which conveniently brings the Knossos Aceramic in line with that of Greece.

None of these 'tenuous' parallels provide a means of integrating different sequences with that of EN Knossos. The connections drawn by Arthur Evans, Mackenzie and Childe are for the most part very free and of limited worth, while those of Furness and Evans are vague and cautiously expressed, such as to preclude further speculation. In all of these examples, connections are sought for chronological purposes and in order to relate the 'culture' at Knossos back to its 'origins'. In none of these studies, however, is there ever any explicit consideration as to what a connection might mean or how it might have come about. Close stylistic similarities may arise out of a variety of circumstances; for example, an actual exchange of ceramics between sites, the existence of a broad regional style zone, separate chronologically parallel superficially similar style zones, separate chronologically different superficially similar style zones etc. The failure to discriminate between these different possibilities also hinders

detailed integration. Rather one is left with the impression that the most one could say is that the EN pottery from Knossos has an Eastern (Anatolia) rather than a Western (Greece) flavour. In the detailed discussion of comparative material in Chapter 7, an attempt was made to indicate the nature of the link and to discriminate between situations where the connection supports the identification of imports either at Knossos or in other Aegean sequences and where the link merely indicates a general similarity in form or finish. The chronological significance of some of the conclusions drawn in Chapter 7 will be presented below.

Wider integration has also been hindered by the presence of only a small number of radiocarbon dates available for Early Neolithic strata at Knossos, many of which have large standard deviations. As a result the absolute dates for the Knossos sequence remain somewhat provisional and thus comparison with the absolute dates for chronologies from the Greece and Anatolia always carries with it a proviso. In this context, it is hoped that the new series of radiocarbon samples taken during new excavations conducted by the Greek Archaeological Service (N. Efstratiou pers. comm.) will in the future provide much-needed detail and clarification and will thus allow a more confident comparison with other neighbouring chronologies. In the following discussion, the Knossos EN chronology will be discussed in terms of its stratigraphy and its relative ceramic chronology and a new sub-phasing of ENI will be proposed. This will be followed by a detailed discussion of a series of comparanda from both EN Knossos and from sites in the southern Aegean, none of which have been previously noted, which suggest the possibility of integrating the various regional sequences. It is hoped that discussion of these links will serve as an important first step in the closer integration of the EN Cretan sequence with those of its neighbours. Finally, this information will be combined with the radiocarbon dates from Knossos and from other sites to produce a chronological table relating the Knossos Neolithic sequence with site sequences in Greece, the Aegean and Anatolia (see Figure I.6).

The Aceramic and Early Neolithic Sequence at Knossos

The Aceramic and EN sequence for Knossos (and thus Crete) is conventionally defined on the basis of the sequence of deposits from sounding AC (strata X-IV) in the Central Court (see Figure I.1)

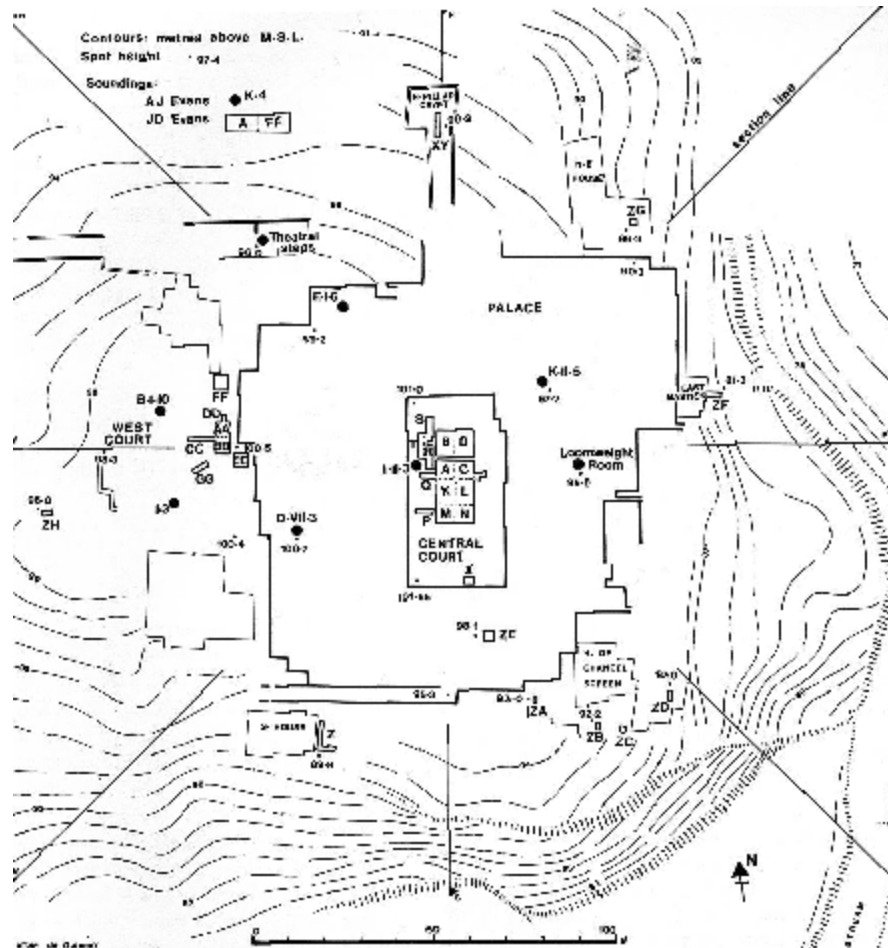


Figure I.1. Plan of the Palace Area Showing the Location of the Soundings (after Evans 1994:fig.1).

This sequence has the virtue of being the longest uninterrupted Ac/EN sequence at Knossos and has been well defined and well published (Evans 1964:140-192; 1994:2-5). Evans divided up this stratigraphic sequence into ten strata which he was able to assign to the different ceramic phases already defined by Furness. Previously the Furness ceramic sequence had been less clearly defined on the basis of the arbitrary layers of A. Evans and Mackenzie (e.g. first metre, second metre etc.). The stratigraphic position of EN material from other soundings

subsequently excavated by Evans in 1960, 1969 and 1970 was established through comparison with sounding AC. These soundings largely complement the sequence in AC, although some have produced additional information: for example sounding XY and sounding AABB have produced deeper deposits for ENII, corresponding to a series of building horizons which are absent from stratum IV (Evans 1964:166-8; Evans 1994:11-14). However, none of these soundings (Evans 1994:10), with the possible exception of sounding X (see below), have produced ceramic material as early as that of strata IX-VIII.

As a result of this, restudy of EN ceramic material for this thesis was largely confined to sounding AC. Additional information was provided by restudy of selected deposits from soundings AABB, X and XY. In the following discussion observations of changes in ceramic form and finish as well as other material changes are combined with stratigraphic information in order to produce a new subdivision of the long ENI phase. These observations will also serve as a check on Evans' stratigraphic divisions¹⁷⁰. Previous studies of relative ceramic chronology for Neolithic Knossos have ignored technological change, confining their observations to form and finish. However, as noted in Chapter 7, form and finish do not seem to be the best indices of variation in the EN sequence. Rather, as has been argued, the combination of observations of changes in form and finish with fabric allows change to be viewed in much greater detail and has thus made a significant contribution to the new sub-phasing of ENI proposed here.

Aceramic (Ac)

Sounding AC, Stratum X (Evans 1964:140-2; 1994:2-5):

This was a thin (c. 20-40cm) deposit, which contained the remains of fires, numerous pits, several infant burials and evidence, in the form of post-holes, for a timber structure possibly to be associated with a large deposit of burnt grain. It should be stressed, however, that no remains of any substantial mudbrick or stone structures were identified. Two sherds were found embedded in the surface of this deposit and it is possible that a further three can also be assigned to the surface of stratum X (see below on stratum IX).

¹⁷⁰ For more details of the EN sequence in sounding AC see Evans' detailed description (1964:140 - 192).

Following the excavation and publication of sounding AC (Evans 1964), doubts were raised regarding the transition from stratum X to stratum IX (see Weinberg 1965:301). Pointing to the parallels exhibited between ENI ceramics and west Anatolian LC pottery and to the large gap in radiocarbon dates between stratum X and IX, Weinberg argued that there was a long gap between the cessation of stratum X and the beginning of stratum IX and that stratum IX represents the resettling of the site by a later ceramic-using people¹⁷¹. Evans in turn quite rightly pointed to the absence of evidence for any stratigraphical break and to the many example of cultural continuity between the two strata (cf. axes, obsidian, stone studs, stone circlets, bone chisels bone points) (Evans 1968:275; 1970a: 381). If at that time he had been aware of sounding X (excavated 1970) Evans could also have pointed to the continuity in mudbrick building methods between Aceramic and earliest ENI and to the presence of pottery within but on the surface of the Aceramic deposits in soundings AC and X, which suggests that pottery first appeared just before the stratigraphical break which Weinberg argued marked the abandonment of the site.

The only remaining evidence of difference between stratum X and IX are:

1. Confinement of bone spatulae to stratum X (Evans 1964:236; 1968:274; 1970a:381-2). Evans notes the similarity between these three examples and examples from Hacilar VI, however these are not synchronous (Mellaart 1970b:175, fig. cxx.f-h).
2. Differential animal kill-off pattern in stratum X (Evans 1968:275; Jarman & Jarman 1968:256-62), identified by Winder (1986; 1991:46) as a real indication of difference between Aceramic and ENI in the nature of the 'extractive relationship'.
3. Absence of pottery from below the surface of the Aceramic deposit.

It should be stressed that although these seem to be real differences between Aceramic and ENI, they do not in themselves constitute arguments in favour of discontinuity.

Sounding X (South Ramp) Levels 24-19, 17ii (Evans 1971:101-2; Evans 1994:2-4):

¹⁷¹ See Chapter 2 for a discussion of Weinberg's theories of the origins of Neolithic pottery in Greece.

This was a thick¹⁷² (c.2.m) deposit, which contained traces of walls, making up four different building levels. Walls were composed of a mixture of stone (often in the form of querns), bricks or 'bricky material' and clay. This construction technique is closely comparable with that found in stratum IX, sounding AC (see below). However, since no pottery could with any certainty be assigned to the Aceramic deposit (see below) and since none was actually found during digging, it seems more likely that most of this deposit is contemporary with stratum X in sounding AC or is perhaps even earlier (Evans 1971:102).

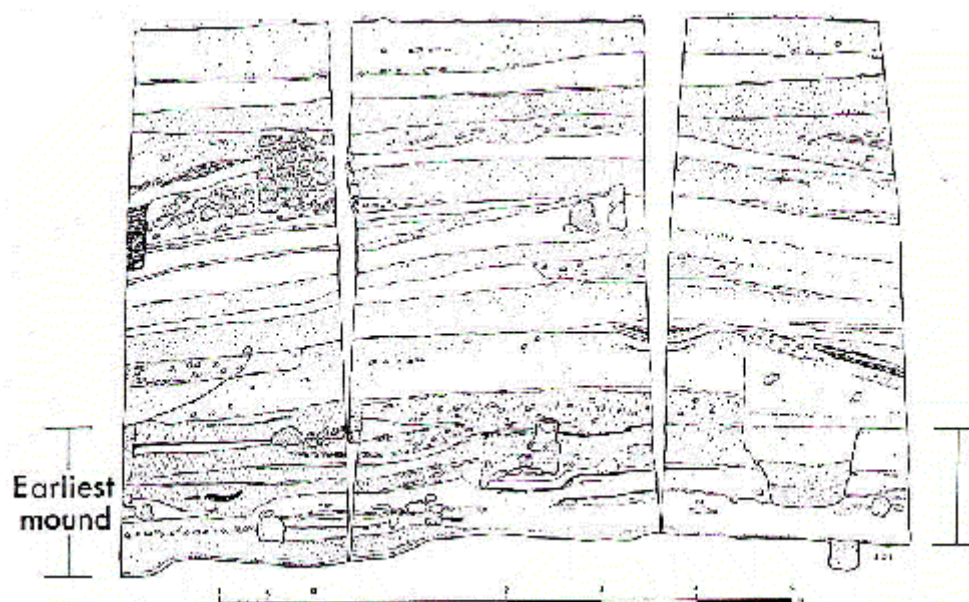


Figure 1.2 Section of Sounding X (after Evans 1971:101 fig.3)

The only possible ceramic material from these lowest levels comes in the form of a rather dubious group of sherds found during water-sieving of material from a single large context (level 24). Since these were all small and at least one was Minoan, Evans rejected them as contamination. This interpretation was challenged by Winder, who used their presence to undermine the identification of the lower strata as aceramic (Winder 1991:39-40). However restudy of this material confirms Evans' original interpretation: indeed many of them are in finer fabrics such as Fabrics 1e and 2c, which first appear in ENIc/ENII, no sherd is larger than c.1.5cm, with the largest being Minoan

¹⁷² One might compare also the c.1.2m of Aceramic deposit discovered in sounding ZE sealed by later Minoan material (Evans 1971:98).

in date. Winder's other arguments against the aceramic nature of this deposit amount to very little. Firstly he argues that the presence of two baked clay figurines in these levels prevents them being truly aceramic. In this however he seems confused as to the meaning of aceramic, which is used to denote the absence of fired ceramic containers not the absence of baked clay (cf. also the presence of baked mudbrick). Indeed baked clay figurines are actually a feature of several sites of the Anatolian Aceramic Neolithic, such as Çayönü and Suberde (Joukowsky 1996:81-3, 88). Regarding his second point, it is difficult to imagine how the *general* absence of pottery from the actual internal habitation floors of Early Neolithic I houses, could explain the *complete* absence of pottery from anywhere in the lower levels of sounding X or the nearby sounding ZE.

After weathering of the section, Evans noted a distinct interface between ENI levels and the tumble of white kouskouras mortar and mudbrick which sealed the Aceramic deposit, which suggested to him that the "surface was exposed for a time before debris began to accumulate once more above it" (Evans 1971:102)¹⁷³. This interface between the uppermost layer of Aceramic and ENI levels can clearly be seen in the published section from sounding X (see Figure I.2). This uppermost Aceramic layer was a soft dark/grey deposit, which contained v. coarse clay fragments. as well as "true red mud brick" (Evans 1970b:4; see fig. I.1). Evans states (1971:102) that the earliest pottery found in X came from the top 15cm of this final Aceramic layer. Unfortunately however, as Evans acknowledges in his excavation notes, absolute certainty is not possible because the uppermost Aceramic deposit (level 17ii in the southern half of the sounding) was not immediately recognised as being distinct from some ENI fill layers at the same level to the North (level 17 and 17i) (Evans 1970b:4). Thus this earliest material was accidentally mixed with the ENI fill material from level 17 (see below). Nevertheless, as Evans himself argued (Evans 1971:102), the absence of pottery from below the surface of the Aceramic deposit is quite clear: the only other sherds found during actual excavation being accidentally dug from the ENIb fill of pits A and B (see below), which had been dug into the Aceramic deposit (Evans 1970b:5-6). The presence of pottery within the immediate surface of the Aceramic deposit finds a parallel in sounding AC, where at least two sherds were found embedded in the surface

¹⁷³ Soil samples were taken to investigate this surface further, but unfortunately no results have yet been published.

of stratum X (see below). It thus seems possible that the top 15cm or so of the Aceramic mound in sounding X are contemporary with the transition from stratum X to stratum IX in sounding AC and thus date to the very beginning of ENIa.

Early Neolithic Ia (ENIa)

1. Sounding AC, Strata IX-VIII (Evans 1964:144-50; 1994:6-8):

Stratum IX was a deposit of variable thickness (c.0.3-1.0m), mostly of mudbrick debris, containing the earliest traces of a mudbrick and stone structure to be found in this area of the site (House E). House E was rectilinear, constructed in mudbrick and stone, and exhibited a long and complex history of occupation. Small finds were rare and pottery occurred in a low density. When examined the pottery proved to be very broken: nothing ever mended up into anything larger than a big sherd, which would seem to suggest that the deposit was very mixed and had probably been trodden down. The absence of anything like a complete vessel suggests the possibility that broken vessels were originally dumped elsewhere, presumably with other debris, and only later came to be deposited as stratum IX. One scenario, which possibly contributed to this, might be the periodic cleaning out of internal habitation floors, which were invariably found clean when excavated (Evans 1994:7, 14).

All pottery assigned to stratum IX seems to have come either from below the walls or below the lowest of several 'stamped down' floors of House E or else from outside; none of these floors themselves (levels 23-24) produced any pottery (Evans 1960b:1). Only one context, AC25b, consisted purely of material which came from below House E and which was thus definitely earlier than its construction. The excavation of AC25b also encountered burials d and e, which were later assigned to stratum X (see Evans 1964:fig.7). This would seem to suggest the possibility that the three sherds from AC25b could equally have come from the top of the Aceramic deposit. When examined the three sherds from AC25b proved to be in the same two fabrics (Fabrics 2a/b, 8) and from comparable shapes (large diameter burnished deep bowls) as the two sherds from AC26, which came from the surface of stratum X (see above). Thus there may have been a surface sprinkle of pottery in the area of sounding

AC prior to the construction of House E and thus prior to stratum IX proper (cf. also pottery on and just below the surface of the Aceramic deposit in sounding X).

Stratum VIII, like stratum IX, varied in thickness (c.0.2-0.9m) and mostly consisted of collapsed mudbrick mixed with habitation debris. In the western half of AC there were the scant remains of a mudbrick and stone structure (House D), with which two clay structures (ovens?) were associated. In the eastern part of the trench two deep pits (A and B) were excavated. From the excavation notebooks it is clear that Pits A and B actually first appeared below the east wall of House C (stratum VII) as a single pit filled with small stones and loose earth (C27¹⁷⁴) (Evans 1959:39). From the published section it would seem that this fill corresponds to stratum VII (Evans 1964:fig.4). Only at a lower level did this single pit become two pits (A and B). From the published section of pit A and from the excavation notebook, it would appear that below the stratum VII fill there were a series of thin sterile layers alternating with stone (Evans 1959:39; 1964:fig. 4), which seem to indicate that Pit A was exposed as a shallow depression below the surface of stratum VIII for some period of time prior to the deposition of the stratum VII fill. Below these sterile layers was the main fill of pit A, which contained ash, earth, two stone figurines, sherds and a bowl (see Evans 1964:fig. 4, fig.63.15, 16, fig.39.4); it is clear from the notebook that the figurines and whole vessels definitely came from these lower two pits and not from the upper fill layer (Evans 1959:39).

This detailed study of the sequence in which these pits were dug and filled supports Evans' inclusion of them in stratum VIII despite the fact that they were dug into this stratum (1964:149-50). It would appear that sometime after the deposition of stratum VIII but before stratum VII a large pit was dug into the deposit, at the bottom of which two pits (A and B) were dug. These pits were filled with an unusual deposit consisting of ash, bone, sherds as well as figurines and several whole vessels (C26). However it would appear that the main pit was not filled but remained open for some time before the deposition of what was probably a levelling fill prior to the construction of House C (stratum VII). This sequence of smaller pits dug within a larger pit, which following the filling of the lower pits remained open, strongly recalls the sequence of

¹⁷⁴ Some or all of the material from C27, assigned by Evans to stratum VII, may also belong to Pits A and/or B. Alternatively C27 may purely be the stratum VII upper fill of the first large pit, since the label for C27 says 'Pits' and 'light brown earth/reddish with stones'.

construction and fills reconstructed for the 'Great Pit' dug into the top of the Aceramic deposit in sounding X (see below). Furthermore both of these pit and fill sequences appear to date to some time in ENIa (see below)

From the excavation notebook for trenches A and C (Evans 1960a:18; 1960b:1) it would appear that part of House E (stratum IX) was dug as AC23 and AC22 (stratum VIII), however in the south and east sides of the published section it can be clearly seen that stratum VIII containing House D seals House E and stratum IX (Evans 1964:fig.4). The existence of a join between contexts AC22 (VIII) and AC24a (IX) as well as a near-join (two non-joining pieces of the same bowl) between AC23 (VIII) and AC24a (IX) provide some confirmation that some mixing of deposits occurred during the excavation of strata VIII and IX. However, despite this small amount of mixing, ceramic deposits in stratum VIII preserve quite a different character from those in stratum IX. Indeed despite being comparable to stratum IX in overall volume, stratum VIII produced considerably more pottery with an entirely different state of preservation. Sherds are frequently large and often profiles or even semi-complete vessels can be mended up. Thus the material in stratum VIII appears to be much less mixed and much less broken than stratum IX. This would seem to confirm that the two strata are stratigraphically distinct, thus supporting Evans' division of strata. This division is also confirmed by a number of joins between the different excavated contexts within stratum VIII¹⁷⁵.

The presence of a number of completed profiles and even near complete vessels within a relatively small deposit from a small area of excavated space, is unusual for EN Knossos and would seem to indicate that these layers accumulated in situ and were not brought from elsewhere. For example, many fragments of a single unique and semi-complete vessel in a blueschist fabric (Fabric 35) all appear to have come from the western half of the sounding and it seems possible that they were deposited in close proximity to each other. The frequency with which joins are found between different contexts excavated within stratum VIII would be further confirmation of the overall homogeneity of the deposit. The presence of thin layers of ash and charcoal within this deposit and a series of pits (Evans 1960a:15-17) may be a sign that it did not accumulate in a single event, but rather in stages. Taken together these suggest that following its

¹⁷⁵ Cross-joins between contexts within stratum VIII: two joins between AC23 and AC22, one between AC23 and AC22 pit d, one between AC22 and AC22 pit d and one between AC22 and C25a.

abandonment, the area of House D (VIII) was used as a dump for broken pots and household refuse with reoccupation only occurring in the next stratum with the construction of House C (stratum VII).

Defining ENIa: Ceramic Form, Finish and Fabric in Strata IX-VIII

Early Neolithic Ia (ENIa) was first defined by Jarman and Jarman on the basis of the presence of mudbrick architecture with ENI pottery. The transition between ENIa and ENIb was placed at the stratigraphical point at which mudbrick structures cease (end of stratum VIII) and pisé and stone structures begin (beginning of stratum VII) (Jarman & Jarman 1968:241). Since this definition was not supported by evidence for ceramic change between strata IX-VIII and the rest of the ENI deposit¹⁷⁶, it could not serve for deposits, which lacked evidence for structures, and thus has not been subsequently used.

Restudy of the ENI ceramic material from sounding AC has cast doubt on Evans' claim of homogeneity and a new subdivision of ENI will be proposed here. Examination of ceramics from strata IX and VIII indicated the absence of quite a number of features, which are characteristic of later strata, and the presence of a small number of positively diagnostic features, which are absent from later strata. Thus the definition of ENIa largely relies on the *absence* of features characteristic of ENIb (strata VII-VI) and ENIc (stratum V). As a result it remains open to criticism on account of small sample size. In order to offset this only the absence of features in fabrics, which are well represented in all ENI strata, were considered as possible defining criteria (i.e. Fabrics 1a-i, 2a-e, 5a, 6, 8). It should be stressed that the features, which are lacking in these fabrics in strata IX-VIII, are common in these same fabrics in strata VII-VI. It should also be noted that the general absence of positive defining features of ENIa is largely a function of the lack of other large ENIa deposits, with which the incidence of other features unique to strata IX-VIII might be clarified.

In this way ENIa is characterised by the *absence* of¹⁷⁷:

Funnel-necked jars: these first occur during ENIb.

¹⁷⁶ Rather Evans emphasised the homogeneity of the ENI strata from beginning to end (Evans 1964:194).

¹⁷⁷ See Chapter 7 for more details.

Large strap handles joining the rim: these first occur in stratum VII and are found in Fabrics 2b and 5a. These should be associated with the appearance of flat-based mugs with handles joining the rim (see below).

ENIb-style Incised/Pointillé flat-based mugs: these first occur in quantity in stratum VII and are frequently decorated in incised/pointillé. These are known in Fabrics 2a/b and 5a.

- a single certain example in Fabric 5a is known from stratum VIII, however this is unlike all ENIb examples: it is undecorated, has a flared profile and has a unusual double pierced lug on the rim. No later parallels are known for either the unusual shape or the double rim lug. Unpierced double lumps on the rim of bowls in Fabric 5a are an ENIa feature (see below).

- in addition a sherd in Fabric 2a/b with incised/pointillé decoration may be from a flat-based mug. Although similar to later examples of this form of decoration this example has a row of dots incised into the rim, a feature not found in numerous later ENIb examples. This form of pointillé decoration may prove to be a positive defining feature of ENIa.

Thus it seems most likely that although flat-based mugs may have an origin in stratum VIII, it is only in stratum VII that they gain the form and finish which characterise ENIb.

Flared Cups/Steep-Sided Bases: these are known from stratum VII-V. They are most commonly found in Fabric 1d, but are also known in Fabrics 1b and 10. It is likely that steep-sided small diameter bases comprise the lower part of the profile and if so this would indicate that flared cups also appear in Fabric 5a in strata VII-VI.

Internally-Thickened Rims on Shallow Bowls: these first appear in stratum V.

Slashed Plastic Cordons/'Rope' Decoration: Although plastic cordon decoration is known from the very earliest levels, it is only after strata IX-VIII that the practice begins

of scoring or notching the plastic cordons, either with a tool or the fingernail. This practice is only found on plastic cordons in Fabrics 2a/b and 10 from stratum VII.

Incised Lattice/Incised Ladder: only found in Fabrics 2a/b and 5a from stratum VII-VI.

Barbotine Ware: This finish first appears in stratum VI and continues into ENII. It is confined to vessels in Fabrics 1d, 1e and 5a.

Painted Wares: isolated examples of painted sherds occurring in unique fabrics are known from strata VII-VI. In addition dark-on-light painted sherds are a rare and very short-lived feature of Fabrics 1d and 1e in strata V-IV.

Fabric 1d: This fabric is entirely absent from ENIa. The only example from an ENIa context is finished in a manner characteristic of ENIc and is probably intrusive.

A number of features are rare in ENIa but common in ENIb:

Incised Pointillé Decoration: only found on a handful of sherds in strata IX-VIII

Rim Pellets: these occur on a single example of a 's' profiled bowl in Fabric 6, however it is possible that this example is intrusive from stratum VII, where this form of decoration is common (see below).

ENIa can also be defined by the positive presence of:

Miniature Flared Rim Lugs in Fabric 1a: these resemble tiny flared strap handles which are found on the rim of several examples of curved or carinated bowls with offset rims in strata IX-VIII. There is one example from stratum IX and two from pits A and B (stratum VIII), one of which is complete (Evans 1964:fig.39.2). This sort of miniature handle is not found in Fabric 1a on the numerous examples of these forms in later strata.

Double Rim Lumps: there are only found on fine polished bowls in Fabric 5a in stratum VIII.

Punched Decoration: this is found just below the rim of two examples in Fabrics 8 and 9 in stratum VIII and in a V-shape on the carinated body of a straight-sided hole-mouth jar in Fabric 8.

'Wood Effect' Burnishing: a striking feature of ENIa polished vessels is the creation of a horizontal 'graining' effect, which resembles wood. This is common in strata IX-VIII in Fabrics 1a, 2a/b, 6 and 8, becoming much less common in stratum VII. It is absent from stratum VI onwards.

Triple Pellets in a Triangular Arrangement (Fabric 1a): examples of this form of decoration are confined to carinated jars with offset rim in Fabric 1a in stratum VIII.

The following are more common in ENIa, than later strata:

Straight-sided Hole-Mouth Jars: these are most common in Fabrics 8 and 9 and occur in strata IX-VIII. straight-sided hole-mouth jars become less common in ENIb and are very rare in ENIc. In general ENIa can be distinguished from ENIb by a higher frequency of incurved bowls/hole-mouth jars.

Defining ENIa: Other Material Changes

In addition to the transition from mudbrick to pisé, a number of other non-ceramic features are here proposed as being diagnostic of ENIa:

Stone circlets: these are known from strata X to VIII, but are not known from later deposits (Evans 1970a:381 fig.1.9; see examples in Evans 1964:fig. 59.1-4). Since other types of stone body ornaments continue throughout the deposit, the absence of stone circlets from levels above stratum VIII may be significant.

Unusual mortar type/pivot: Evans refers to a special type of mortar, which was confined to the 'lower strata', with all but one example coming from stratum IX. Instead of one large depression, this type had two small cup-shaped depressions in the upper surface,

prompting Evans to speculate that they may have functioned as pivot stones (Evans 1964:231; fig. 53, 4-5). This type may prove ultimately to be diagnostic of Aceramic or ENIa, however the rather uneven recovery of mortars (concentrated in lower and upper Neolithic levels) necessitates caution.

Absence of Maceheads: these distinctive objects first appear in stratum VI and after then remain a feature of all remaining Neolithic strata up to and including stratum I (Evans 1964:229-231; Warren 1968:240-1).

The absence of Fabric 1d in strata IX and VIII is one of the strongest defining features of ENIa. This fabric is very common in strata VII-VI and is the single most common fabric in stratum V. The single sherd of Fabric 1d in stratum VIII is considered intrusive both on the grounds of finish (buff lightly burnished), which place it in stratum V or later, and because the same context (C25a) also produced a dark rippled sherd in Fabric 1e which also cannot date earlier than stratum V.

These examples raise the wider issue of contamination. In this it is important to distinguish between contamination, where two deposits of different date have been irretrievably mixed, and the occasional intrusive sherd, which acts merely as background noise. Restudy of ceramic material revealed no examples of the former, while examples of the latter, where individual sherds drop out of the section, are inevitable in an excavation, especially when soundings get as deep as sounding AC (c.7m). Sherds may also migrate between levels through the activity of worms or larger burrowing mammals: for example the excavation notebook for trench A mentions the presence of a 'rabbit hole' in levels later assigned to stratum VIII (Evans 1960a:16-18).

Fortunately, the most common types of ENIc and ENII shape, decoration and fabric are extremely distinctive and are easily separated from earlier material: for example three small sherds of Fabric 1e (no earlier than stratum V) were found in stratum IX, one of which was buff and unburnished suggesting a MN date; one context in stratum VIII (AC22), produced a single example (see sample 97/55) of Fabric 1b (stratum V or later) and 5 small sherds in Fabric 1e, two of which were ripple burnished (stratum V or later). Unfortunately, however, owing to the greater similarity between

ENIa and ENIb ceramics, no intrusive sherds earlier than stratum V could with any certainty be identified in ENIa deposits.

2. Sounding X, Level 18 (Evans 1970b:1-11; 1971:101-2):

At some point after the abandonment of this area of the settlement at the end of the Aceramic or perhaps at the transition to ENIa, a series of pits were dug into the top of the Aceramic deposit. These pits unfortunately cut away much of the Aceramic deposit in the process complicating the stratigraphy of the earliest pottery-bearing levels (see above). Careful examination of transcripts of the excavation notebook for sounding X (Evans 1970b:1-11) reveals the sequence in which these pits were cut and filled. Examination of ceramic material from these contexts allowed dates to be tentatively applied to this stratigraphical sequence (cf. similar sequence of pits and fills of a similar date in sounding AC above).

The earliest cutting into the Aceramic deposit (through Aceramic layers 17ii, 19, 22) consists of what must have been a very large irregular shaped pit, termed the 'Great Pit' (Evans 1970b). Only the SE corner of this was excavated within sounding X, but this alone was at least 2.0m x 1.0m. Within sounding X, this pit began as a shallow cutting to the E but dipped down to the NW until it became very deep (c.1.0m) in NW corner with steep vertical sides. At the bottom of this large pit, a series of at least three smaller pits were cut; two of these (A and B) lay within sounding X, while a third (C) lay partially obscured to the NE (Evans 1970b:7-8). Pits A and B were of approximately the same diameter (c.1.0m), the deeper being pit A (c.0.9m). Pit A produced obsidian and one sherd, while pit B produced bone, obsidian, flint and a little more pottery. These pits were filled up to the level of the bottom of the 'Great Pit' (see Figure I.2; Evans 1971:fig.3). The contents of these lower pits along with the layer that sealed them make up level 18. Although similar in appearance to level 17ii (see below), level 18 was considered to be distinct (Evans 1970b:6).

Careful examination of the pottery from level 18 failed to identify any diagnostic ENIb features, although in view of the small sample size (c.50 sherds) this could not be taken as indicative of an ENIa date on its own. However, the low overall sherd density, the absence of Fabric 1d and the presence in relatively large proportions of Fabrics 5a (6 sherds), 6 (16 sherds), 14 (2 sherds), 28 (7 sherds) and 29 (1 sherd) in

relation to Fabrics 1a and 2a/b (13 sherds) compare well with stratum IX (sounding AC). Thus, although it is impossible to be certain, these positive features combined with the absence of any material diagnostic of ENIb or later, make an ENIa date for these lower pits possible or even likely (see below for date of material in 'Great Pit' and above Aceramic deposit).

Early Neolithic Ib (ENIb)

1. Sounding AC, Strata VII-VI (Evans 1964:150-7; 1994:8):

The change in building methods from mudbrick and stone to pisé and *kouskouras* gave stratum VII and those that followed a distinctive composition that allowed them to be easily distinguished from strata IX-VIII. The collapse of the pisé structures results in the formation of thick bands of yellowish clay alternated with darker levels, which represent habitation debris (Evans 1964:151). Stratum VII varied in thickness (c.0.4-<1.0m) and contained the remains of at least two rooms of house (House C) along with part of a cobbled area with a possible cooking installation. Several hearths and ashy pits were excavated within the two rooms. Two different floor surfaces were excavated in House C testifying to at least two phases. In addition, the excavation notebook seems to suggest that within stratum VII some areas of paving in the western half of AC are stratigraphically later than House C (Evans 1960a:13) .

Restudy of material from the lowest deposits in stratum VII, i.e. below the two floors of House C, suggests that there may have been some mixing with material from stratum VIII. Context A21 in the western half of stratum VII produced three small fragments belonging to a distinctive and unique vessel in a blueschist fabric (Fabric 35), the rest of which came from the western half of stratum VIII¹⁷⁸. In addition a join was made between A21 and A21x (stratum VIII). These would seem to indicate that context A21 of stratum VII also contains some material from stratum VIII. In other contexts in stratum VII the transition to stratum VIII seems clear: for example the excavation notebook for trench A mentions a 'floor level' below A21a (stratum VI), i.e. the upper surface of AC22 (stratum VIII), which is described as "trodden down - not new earth strata" and which had a whole pot on it and a shallow hearth with ash (Evans 1960a:15).

The transition from stratum VII to VI was very clear and occurred across the whole area of AC: the alternating light yellow clay and *kouskouras* with dark streaks of stratum VII changes to a deposit of loose brown earth and ash (stratum VI), which resembles habitation refuse. Stratum VI was a thick deposit (c.0.5-1.2m) which produced no recognisable architectural remains, except for a few patches of pebble

¹⁷⁸ NB the majority of the numerous fragments of this vessel can be definitely assigned to stratum VIII in trench A, i.e. in the western half of sounding AC.

paving, two shallow burnt circular hollows and a smoothed clay 'platform'; in addition some short lines of large stones may or may not represent parts of destroyed walls (Evans 1964:155). Tumbled stone in the south-east was considered likely to have come from a collapsed building to the south and the presence of this building was held to account for the great amount of habitation debris in this stratum (Evans 1964:155).

Defining ENIb: Ceramic Form, Finish and Fabric in Strata VII-VI

ENIb is defined by the presence of a series of features in strata VII-IV, which are absent from strata IX-VIII:

Forms:

Flared Cups/Steep-Sided Small Diameter Bases: these first appear in stratum VII in Fabric 1d and are found in stratum VI in Fabrics 5a and Fabric 10 and from stratum V in Fabric 1b. Examples in Fabric 1d have pierced internal lugs; the example in Fabric 10 has fine plastic cordon decoration and a less flared rim. All have relatively small diameter. In many instances it is difficult to tell whether these functioned as cups or upturned as stands; however the presence of internal pierced lugs, sometimes projecting above the level of the rim suggests they should be oriented as tall cups. Steep-sided small diameter bases also first occur during ENIb and it seems likely that these comprise the bases of flared cups.

Funnel-necked jars: examples are known from stratum VII and stratum V and are found in Fabrics 1d, 2a/b and 5a.

Large Strap Handles joining the rim: these first appear in stratum VII and are found in Fabrics 2b, 5a and 5c. These vessels appear to be large versions of flat-based mugs (see below).

Vertical-Sided Flat-Based Mugs with or without offset rim: variations of this type first appear in quantity in stratum VII: two examples from stratum VIII differ significantly in form and finish from later ENIb examples in Fabrics 2a/b and 5a. A single example in a unique fabric, which may be related to Fabric 2a/b, comes from an ENIb context in

sounding AABB: it is decorated in an unusual combination of incised/pointillé and has the upper part of a figurine projecting from the rim. Examples in Fabrics 2a/b and 5a are so similar in form and finish as to be at times indistinguishable and can only be separated on fabric. The majority of examples are decorated in incised/pointillé triangles, with other linear motifs being rare. Examples of this type vary in size, but all have some sort of handle that joins at the rim. It seems likely that the large rim straps noted above come from very large versions of this form. In support of this one might note that both larger and smaller versions are confined to the same two fabrics (Fabrics 2a/b and 5a).

Pedestalled stands: these first appear in Fabric 2a/b in stratum VI (cf. example in Fabric 2a/b from sounding X below).

Concave Bases: these first appear in stratum VI and are found in most fabrics.

Finishes:

Slashed Plastic Cords/'Rope' Decoration: although plastic cordon decoration occurs from stratum IX, the practice of incising plastic cordon decoration begins in stratum VII in Fabrics 2a/b and 10. In Fabric 2a/b this practice is restricted to large diameter burnished vessels, while in Fabric 10 it is restricted to fine dark polished vessels and resembles a 'rope' pattern.

Plastic Cordon Decoration of fine polished vessels: in ENIa plastic cordon decoration is confined to large burnished vessels in Fabrics 1a, 2a/b, 6 and 8. This practice continues in ENIb, but is also found from stratum VII on two fine polished curved bowls with offset rims (Fabrics 2a/b and 5a).

Barbotine Decoration: this distinctive form of decoration first appears in stratum VI and is confined to Fabrics 1d and 5a. It continues through ENIc in Fabrics 1d and 5a and then into ENII in Fabrics 1e and 5a.

Rippled Decoration: the first examples of this form of decoration can now be tied to stratum VI. This contradicts the consensus view of previous studies of ceramic change, which placed the first examples of this finish in ENII (e.g. Evans 1964:fig.46). The possibility that the examples in stratum VI are intrusive was rejected on the following grounds:

(i) Study of deposits from stratum V has established that rippled decoration is already present in convincing quantities at this stage (i.e. pre-ENII).

(ii) Comparison of the stratum VI, stratum V and stratum IV rippled sherds indicates that by far the majority are in Fabric 1d or 1e, with rare examples occurring in Fabrics 5a, 12, 6, 8 and 10. The four examples from stratum VI are in Fabrics 8 and 10: if they were intrusive one would expect them to be in Fabric 1d or 1e, which are much more frequent¹⁷⁹.

(iii) Study of material from sounding X confirms the presence of rippled sherds in Fabric 8 with other ENIb diagnostic material (see below).

Scored Decoration: distinctive form of decoration which first occurs in stratum VI in Fabrics 2a/b and 5a (cf. also below on sounding X).

Painted Decoration: strata VII and VI produced two painted sherds, both in very rare or unique fabrics (Fabrics 32 and 34). In addition stratum VI (C24) produced a single example of dark-on-light painted decoration in Fabric 1d/e. This form of decoration in this fabric is more common in stratum V and is one of the defining characteristics of ENIc. Unless the single example is intrusive, its presence in the lower levels of stratum VI suggests that this form of decoration in Fabric 1d/e first appeared during the course of stratum VI (see below).

Applied Pellets Immediately Below Rim: This form of decoration, where rounded pellets of clay have been applied to the area below the rim, is to be distinguished from the practice of forming lumps below the rim, whose edges are smoothed into the vessel surface. The latter are well known in ENIa in Fabrics 2a/b, 6 and 8 and continue into ENIb. Although, the earliest example of the former is a single sherd (Fabric 6) in a

¹⁷⁹ cf. the identification of intrusive rippled sherds in strata IX-VIII.

stratum VIII context, it is possible that this deposit is mixed with material from stratum VII (see above). Thus this example *may* be later. This is admittedly speculative, but if correct means that all examples of this form of decoration come from stratum VII or later. This type of decoration is known from stratum VII in Fabric 2a/b and is common from stratum VI above all in Fabric 1d, but is also known in Fabrics 2a/b, 6 and 8. It is also found on an example in Fabric 15 in an ENIb context from sounding AABB.

Incised Lattice Decoration

Although a single example of incised lattice decoration is known from an ENIa context it is in an unknown fabric and moreover the lattice decoration is diagonal and contained within an incised diamond (see Chapter 7). ENIb lattice decoration only ever occurs in Fabric 5a, is always horizontal in orientation and never occurs as a filling within incised geometric shapes. In addition the single ENIa example occurs on a curved offset bowl, whereas all examples in ENIb, where form can be identified, are from flat-based mugs. Single 'ladder' incised decoration is also known in Fabric 2a/b and occurs on curved and carinated bowls, sometimes in a band below the rim.

Marked Increase in Incised/Pointillé Decoration: Generally speaking, although single examples of different types of incised decoration can be found in strata IX-VIII it is only after stratum VII that these types become more common. Thus four examples of incised/pointillé decoration (in Fabrics 2a/b and 6) are known from ENIa. In contrast just one context (C24) within stratum VI produced 13 examples of incised/pointillé (mostly Fabric 2a/b, but also Fabrics 5a, 6 and 11).

Absence of Internally-Thickened Rims on Shallow Bowls: these first appear in stratum V.

Absence of Shallow Carinated, Flared Carinated Bowls: these first appear in stratum V.

Fabrics:

One of the strongest defining features of ENIb is the appearance of Fabric 1d in stratum VII; indeed the presence of Fabric 1d in conjunction with the absence of Fabrics 1b and 1e could be said to define ENIb. Fabric 2a is extremely common in stratum VI and dominant in stratum V. ENIb also sees the first appearance of Fabrics 10 and Fabric 26. However these latter two are rare and their presence could not be considered diagnostic on their own.

Other Material Changes:

Maceheads: the appearance of maceheads in stratum VI can be taken as a further means of separating ENIa and ENIb deposits. These occur in a variety of shapes and sizes up to including stratum I.

Pisé, Stone and Kouskouras Architecture: the change from mudbrick to pisé architecture between strata VIII and VII is another valuable diagnostic for ENIb. One should note, however, that this transition appears to have taken place prior to the emergence of some features of ENIb in stratum VI (e.g. barbotine, rippled) and thus may have taken place prior to the full transition to ENIb in ceramic terms.

The diagnostic quality of the following material changes is more speculative:

Schist Pot Lids: these are known from stratum VII.

Burnishing Equipment: rubbers and burnishers are first found from stratum VII.

Summary of Strata VII-VI in Ceramic Terms:

The ceramic and other changes that occur during strata VII-VI need not be and indeed are unlikely to be synchronous. Indeed the definition of ENIb and ENIc inevitably suffers from the generally poor temporal resolution provided by Neolithic strata at Knossos: strata are generally deep and are of long duration, most often accumulating gradually in the form of habitation debris. The lack of stratified floor deposits also severely restricts the clarity with which changes in ceramic, form, finish and fabric can be traced. Thus it would appear that neither stratum VII nor stratum VI provide horizons

sufficiently short in duration to capture the series of ENIb-Ic changes in detail sufficient to allow a more discrete stratigraphical definition. It remains possible that some of the changes defined here as characteristic of ENIb may have emerged only during or even after stratum VII. Likewise stratum VI sees the rare appearance of some features which will help to define ENIc in stratum V, such as painted vessels in Fabric 1d, ripple decoration and, if they are not intrusive, the first examples of Fabrics 1b, 1e and 2c. That said however, other features characteristic of ENIa and ENIb and absent from ENIc occur in stratum VI, such as pierced/unpierced ears. The presence, therefore, of these features makes it possible to separate VI and V quite easily (see below for features which separate ENIb from ENIc).

2. Sounding AAB (West Court)

As noted by Evans (1971:98-101, 104-6), this sounding did not produce any traces of an Aceramic stratum. Indeed ENI deposits were only c.2.0m thick, as compared to c.3-4m from sounding AC (Evans 1971:107; 1973:136). A further contrast with sounding AC was the incidence of ENI pottery, which remained plentiful even in the lowest levels (Evans 1971:98). Only building remains of pisé type were identified and only around "half-way up the accumulation", a fact which led Evans to suggest that the lowest ENI levels represent the accumulation of refuse, "probably on the edge of the existing settlement" (Evans 1971:104).

Four ENI strata were identified by Evans (Strata L, M, N, P) (Evans 1973:133). Study of the pottery from these levels suggests that the lowest strata (M, N, P) date no earlier than ENIb. This confirms the impressions of Evans who dates them no earlier than stratum VII (Evans 1994:4). The presence of brushed ware and painted sherds in Fabric 1d dates the final ENI level (stratum L) to ENIc (see below).

3. Sounding X, Levels 13-17 (Evans 1970b:4-6):

'The Great Pit'

Above the ENIa(?) pits (A & B), but within 'the Great Pit' a series of thin deposits (c.0.5 to 0.75m in total) were excavated. The lowest layer consisted of a hard red/brown layer (level 17i), which in the NE graded into lighter soil mixed with kouskouras. Above this

the next layer was soft and dark with very many large stones, similar to fill layers encountered elsewhere on the site. This layer was succeeded by and was partially mixed with level 16, which was red in colour and contained quite a large number of rounded stones (c.20cm diam.). The uppermost levels of 16 and 17 covered the entire area of the trench, filling the 'Great Pit' and burying the Aceramic deposit, both of which had remained exposed up until this point. The absence of any remains of buildings or other structures associated with habitation, as well as the nature of the deposits themselves suggests that these layers represent fill or rubbish deposits, which appear to have built up against the exposed N side of the Aceramic mound (i.e. against the S edge of the 'Great Pit') and which slope down to the North (see Figure I.2).

These lower ENI fill layers produced considerably larger quantities of pottery than the fill of pits A and B (ENIa?): the lowest level alone (level 17ii) produced over five times more pottery (276 sherds) than all the earlier ENI (ENIa?) contexts combined. Study revealed several features characteristic of ENIb:

Flat-Based Mugs: one body sherd with linear, not triangle incised/pointillé decoration (Fabric 2a/b) and one rim strap (Fabric 6).

Pedestalled stand: one sherd (Fabric 2a/b)

Slashed Plastic Cordons/'Rope': one sherd from a deep bowl with slashed cordon decoration (Fabric 2a/b); one sherd from a large diameter shallow bowl with straight sided profile with a rim decorated with short vertical incisions, plastic incised 'rope' decoration c.2cm below rim (Fabric 10).

Scored Decoration: one body sherd in Fabric 2a/b.

Ripple Decoration: one carinated body sherd with ripple decoration (Fabric 8).

Painted Decoration: one body sherd painted with lattice decoration in unique fabric (Fabric 25).

Fabric 1d: several sherds

Fabric 26: one sherd from an unpierced tubular/flared lug.

Fabric 29: one body cream burnish with incised chevron.

None of these features have parallels in strata IX and VIII. Slashed cordons/'rope' in Fabrics 2a/b and 10 are known from stratum VII. Fabric 26 likewise only appears from stratum VII. However early examples of rippled decoration, such as the example in Fabric 8, as well as wiped ware (Fabric 2a/b), unusual painted sherds in unique fabrics and pedestalled stands in Fabric 2a/b are not known before stratum VI. It is not possible to tell whether this is an indication that these features of stratum VI may date earlier or whether they are specific to stratum VI and thus allow for further subdivision of ENIb. Clearly this would require further study of ENIb deposits, which unfortunately lies outside the scope of the present study. Regardless of these issues, the ENIb date of this deposit seems to be clear.

The remaining upper half of the ENI deposit (levels 10-15) consists of thin (0.03-0.3m) dark rubbish layers, containing ash, pottery, obsidian, bone and occasional pits, often alternating with layers containing predominantly kouskouras. There was no evidence for any structures in any of these levels. In total the ENI deposit in sounding X amounts to c.1.5-2.0m of deposit. This compares unfavourably with sounding AC (c.3-4m) even though the deposits in both span the full length of ENI. This, along with the evidence for thin rubbish layers would suggest that after its abandonment at the end of the Aceramic/early ENIa this area remained on the edge of the main area of the ENIa-c settlement.

Early Neolithic Ic (ENIc)

Sounding AC, Stratum V (Evans 1964:157-64)

This was a thick stratum (0.7->1.0m) that consisted of a mixture of habitation debris and building debris. Patches of flooring and wall foundations were noted at many points, but connected remains only found in one area in the western half of AC. These

remains seem to constitute sufficient evidence to reconstruct part of a dwelling, however Evans chose not to include it in his series of houses (A-E), despite the fact that this structure seems at least as well preserved as house D (see Evans 1964:fig.12). The difference in levels between many of these features indicates the presence of more than one phase and suggests that stratum V accumulated gradually over some period of time.

Only pottery from the eastern half of AC (trench C) was studied, because these deposits had not been selected. The existence of a number of cross-joins between different contexts within this stratum demonstrates the integrity of the stratum in this area. However, sherds do not mend up beyond the size of large sherds and there are no large profiles or whole vessels, suggesting that these deposits have been well mixed. Since these contexts represent a series of occupation layers not all in use at the same time, it would seem that the existence of joins between them would be an indication that these deposits had been rearranged more than once during the period in which this stratum accumulated.

Defining EN1b: Ceramic Form, Finish and Fabric in Stratum V

Flared Rim Carinated Bowls: these first appear in stratum V and continue into IV.

Shallow Carinated Bowls: these first appear in stratum V and continue into IV.

Thickening on the interior/exterior of the rims of shallow bowls: this is a rare feature of stratum V found in Fabrics 1d, 1e and 2a/b.

Brushed Decoration (Fabric 2): this type of finish first appears in stratum V and thus far has proved to be confined to this stratum. It is most common in Fabric 1d, but examples in 1e and more rarely 1b are also known.

Dark-on-Light Dribble-Painted Decoration (Fabric 1d/e): a single example of this type of finish is known from stratum VI, but many more come from stratum V. It appears in

Fabrics 1d and 1e. Many are in the form of dark dribbles on light background. An example from level 7 in sounding XY from a collared jar has irregular dribbles running down from the rim.

Red Scribble Burnish Decoration: this first appears in very small quantities in stratum V and continues into ENII. It usually occurs in Fabric 1e, but isolated examples in Fabric 1b and 1d are known. Often the red scribble has a white slipped background.

Rippled Decoration (Fabric 1d): examples in Fabric 1d first occur in stratum V. This type of decoration is also found in Fabrics 5a, 6, 8 and 12.

Incised Pointillé Decoration: this is known in Fabrics 2a/b and for the first time Fabric 1b; very rare examples of this are also found in Fabric 1e (e.g. level 7, sounding XY).

Fabrics: In fabric terms ENIc is best defined as the presence of large amounts of Fabric 1b, the absence of Fabric 1a in conjunction with the very large amounts of Fabric 1d with Fabric 1e rare. There are also large amounts of Fabric 2a/b with 2c rare or absent. Other fabrics previously as common as Fabrics 1a, 1d and 3a in ENIb are now much less common (e.g. Fabrics 5a, 6, 8).

ENIc is also characterised by the disappearance of:

- Pre-Firing Piercing
- Pierced/Unpierced Ears
- Above Rim Lumps

Summary of Stratum V in Ceramic Terms:

In many respects stratum V represents a transitional phase between ENI and ENII since it contains some elements of both. This is not a new observation; for example Warren in a footnote rightly characterises stratum V as "ENI into ENII" (Warren 1968:239 n.1). It should be stressed, however, that stratum V did not simply result from a mixing of ENIb and ENII deposits, but represents a distinct phase of occupation with architecture. Furthermore it can be quite closely isolated in ceramic terms: ENIc can be separated

from ENIb by the absence of a number of features characteristic of ENIb¹⁸⁰ and from ENII, by the dominance of Fabric 1d with Fabric 1b and with Fabric 1e rare. In contrast ENII is dominated by Fabric 1e with 1d rare (see Figures 9.3-4). Thus the relative proportions of Fabrics 1b, 1d and 1e along with the presence of Brushed ware and Dark-on-Light Painted ware in Fabric 1d allow ENIc to be isolated and moreover have proved sufficient to define this phase in stratum L in West Court sounding AABB. No further deposits have been subject to as detailed study as sounding AC¹⁸¹ and so this definition of ENIc will stand or fall on the basis of further research.

Early Neolithic II (ENII)

Sounding AC, Stratum IV (Evans 1964:164-172)

Stratum IV was a thick deposit (c.1.0-1.5m) consisting of many thin habitation levels in association with hearths, small clay structures, pits and pebble pavements. No clear evidence for built structures was found, although evidence for their existence just beyond the sounding was encountered in the form of a short section of wall. Better evidence for structures was excavated in soundings XY and AABB, where three clear building levels were identified by Evans (1964:166-8; 1971:107-9; 1973:136).

The ENII ceramic phase has already been well defined by Furness and J. Evans (Furness 1953:117-20; Evans 1964:212-9). There remains little to add to their definition, beyond perhaps to point out some changes in fabric proportions: in ENII Fabric 1e dominates all others with Fabric 1d rare. Fabrics 1b and 2a/b continue in similar proportions to ENIc and Fabric 2c remains rare. There are small amounts of Fabrics 5a, 6 and 8.

Although well defined stratigraphically and in ceramic terms, Evans' separation of ENII and MN strata has been called into question (Winder 1991:42). Winder points to the overlap in radiocarbon dates between strata IV (ENII), III (MN) and III/II

¹⁸⁰ For example the absence of pierced/unpierced triangular ears, tubular lugs.

¹⁸¹ In describing the lowest level of sounding XY, which he dated ENII, Evans noted an "admixture of sherds of Early Neolithic I type" but "no real Early Neolithic I level" (Evans 1964:138). Preliminary study of this material indicates the presence of several features diagnostic of ENIc in stratum V (dribble-painted in Fabric 2a, majority of sherds in Fabric 2a or 1b, incised/pointillé in Fabrics 3a and 2b). Levels 10a-12 in sounding X were also studied and found also to contain a similar range of features diagnostic of ENIc.

(MN/LN) and suggests that ENII is an "imperfectly defined "Early-Middle" Neolithic" with a time range that overlaps with that of MN, prior to LN. Winder even goes as far to hint at the possibility that there is no MN phase, as defined by Furness at Knossos. In response it should be stressed that in ceramic terms ENII and MN deposits *can* be distinguished: for example a number of MN forms, such as 'fruit stands', are absent from ENII; moreover although ripple burnish occurs in both, ENII ripple is more deeply impressed and more carefully executed and present in much smaller quantities than MN ripple and thus the two can be separated. The overlapping radiocarbon dates are a problem, however playing around with terminology, as Winder would have us do, is not the solution. Nor is it sensible to reject perfectly good ceramic evidence. Rather the problem lies in the general lack of good radiocarbon dates with short standard deviations.

Absolute Dates for Phases ENIa, ENIb, ENIc and ENII

Comparison of ENI-II deposits in soundings AC, X, XY and AABB produces the following table:

Ceramic Phase	Sounding AC	Sounding X	Sounding XY	Sounding AABB
Aceramic	stratum X post-hole structure	levels 24-19, 1 4 building level		
Early Neolithic Ia	strata IX-VIII Houses E & D	level 18 pits		
Early Neolithic Ib	strata VII-VI House C	levels 13-17, 1		Strata M-P
Early Neolithic Ic	stratum V buildings	levels 10a-12	levels 7-7e 1 building level	Stratum L
Early Neolithic II	stratum IV	level 10, level 8	levels 2-6 2 building levels	Strata G-K 3 building levels

Figure I.3 ENI-II deposits in soundings AC, X, XY and AABB

Using the current set of radiocarbon dates, these phases can be given only approximate absolute dates. The most recent calibration to date of the existing Knossos radiocarbon dates is that of Manning (1999:civ). Using the date range, which lies within a 68.2% probability range, it is possible to produce an

approximate estimate of the dates of the various phases of the Cretan Neolithic (see Figure I.4).

It should be acknowledged that these estimates contain a good deal of guesswork. For example the lack of any dates for strata VIII and VII make it impossible to ascertain at which point, within a period between c.6100 and 5500BC, ENIa ends. The date of 5800BC is a guess, which places the transition approximately in the middle of this period (indirect support for this is suggested by integration with Anatolian and Greek sequences, see below). Also in view of the greater depth of Aceramic deposit in sounding X than in stratum X, it is suggested here that the earliest occupation of the site may precede the earliest material from stratum X, thus dating to sometime before 7000BC¹⁸².

¹⁸² Two dates, BM-124 (c.7200-c.6400BC) and BM-278 (c.7000-c.6600BC), suggest a date of around 7000BC for stratum X.

Phase	Provisional Absolute Dates
Aceramic	>7000 ¹⁸³ - c.6400 BC
ENIa [IX-VIII]	c.6400 - c.5800? BC
ENIb [VII-VI]	c.5800? - c.5100 BC
ENIc [V]	c.5100 - c.4900 BC
ENII [IV]	c.4900 - c.4500 BC
MN [III]	[c.4750 - c.4400 BC]
LNI [II]	c.4400 - c.4250 BC
LNII [I]	c.4250 - c.4000 BC
FN [Phaistos]	c.4000 - c.3300 BC

Figure I.4 Absolute Dates for Neolithic Ceramic Phases at Knossos based on dates in Manning (1999:481) produced using the OxCal 2.18 calibration programme.

In addition to this there is a good deal of overlap between phases. The discrepancy between ENII, MN and the transition to LN has been discussed by Winder (1991:42). To this may be added an overlap between a date range for ENIc (stratum V) of c.5200-c.4900BC (BM-274) and one for ENIb (stratum VI) of c.5250-c.4950 (BM-273). There is at present no way of resolving these overlaps satisfactorily and one can only hope that future radiocarbon dates will clarify the issue. Here I have guessed a beginning to ENIc at around 5100 with an end point around 4900 suggested by the absolute dates for the beginning of ENII¹⁸⁴.

Selected EN Ceramic Material from Knossos, Crete and Other Aegean Sites

This section is necessarily selective; a more comprehensive discussion of parallels and connections has already been provided in Chapter 7 and the reader is recommended to consult that section should further detail be required.

(i) Crete

Unfortunately, in advance of new publications there is nothing to add to J. Evans' original conclusions (reported by Weinberg 1970:617) that the EN pottery of Knossos

¹⁸³ The late eighth millennium date for the first settlement at Knossos is well known. Unfortunately people still persist in using the old uncalibrated date of 6000BC (cf. Rackham & Moody 1996:2).

¹⁸⁴ cf. Manning (1999:civ) for ENII dates: BM-719 [c.4900-4800BC], BM-577 [c.4950-4500] and BM-279 [c.4700-4350].

remains unique in Crete, the only certain exception being Katsambas just to the north (see below; Chapter 7). The significance of published ceramic material from this and other sites outside Knossos, for which an EN or MN date has been claimed, is discussed below. A map of sites mentioned in the text is provided (see Figures 1.5, 7.2)

West Crete:

Ayios Ioannis (LN?)

Treuil (1970:20) attributed a late ENI/ENII date to this material on the basis of the presence of wishbone handles. However, wishbone handles are now no longer considered to be diagnostic of EN (cf. Manteli & Evelyn 1995:pl.1(b); Manteli 1993a:47; see Chapter 7); Vagnetti, Christopoulou and Tzedakis (1989:89) now doubt the validity of Treuil's dating. Rather the majority of the Neolithic material appears to date to LN (French 1990:79).

Ellenospilia (MN? LN?)

Marinatos reported rippled ware, however this material remains unpublished (Marinatos 1928:100-1).

Gerani (EN? MN? LN FN)

According to the excavator, material from EN, MN and LN are represented (Tzedakis 1973:474-6). EN and MN levels are thin (<10cm, 8-15cm respectively) and each was sealed by a calcitic layer. While an early date for this material remains possible, it should be stressed that relatively few of the vessels published as EN (cf. Godart & Tzedakis 1992:pl.XCVIII.1; pl.XCVIX.1-2) have good parallels in the Knossos EN sequence. Furthermore Manteli doubts both the stratigraphy and the dating of this assemblage and argues that the "pottery shows closer affinities with LN Knossos and fewer with FN Phaistos (Manteli 1993a:37). However Manteli does note "the sporadic occurrence of EN and MN types" (Manteli 1993a:107) and illustrates a group of profiles, which most resemble late ENI/ENII types from Knossos (cf. especially Manteli 1993b:fig.63.1, 4, 8, 9; fig.64.6, 9; fig.65.1, 6). Furthermore Manteli mentions the presence of EN style "incised square net pattern" (= incised lattice?), trumpet lugs and pronged wishbone handles as well as a the "relatively high popularity of plastic knobs"

on coarseware bowls (Manteli 1993a:118, 120). The site thus remains a possible EN and MN site, although the bulk of the material must be LN-FN.

Kastelli (Chania) (MN? LN FN)

In a recent gazetteer of Neolithic sites, MN is reported from Kastelli (Papathanassopoulos 1996:207), however nothing has as yet been published to support this.

Lentaka Cave (MN? LN)

Hood (1965:112) notes the presence of 'MN rippled ware'.

Lera Cave (MN? LN, FN)

Excavation in the cave did not produce evidence for any clear stratigraphy; all ceramic deposits appear to be mixed (Manteli 1993b:169) and dating of ceramics is purely on typological grounds. The excavators originally proposed an EN-LN date for the cave (Guest-Papamanoli & Lambraki 1980:180); the EN date was surmised on the basis of the supposed similarity of certain perforated lugs and flap handles to examples from EN Knossos (Guest-Papamanoli & Lambraki 1980:187-9). The validity of this comparison has been widely criticised: flap handles are known from LN-FN Phaistos as well as nearby LN/FN Nerokourou (Vagnetti et al. 1989:89; Vagnetti 1972-3:71). Manteli considers the ENI-LN sequence identified by the excavators to be "based on weak and general arguments" and states that "on the basis of pottery typology... the Lera assemblage finds its closest parallels in the LN and FN period (Manteli 1993a:35, 120). Only trumpet lugs could indicate EN occupation, with the presence of rippled ware possibly indicating MN/early LN (Vagnetti et al. 1989:89), otherwise the bulk of



Figure 1.5 Neolithic Sites on Crete

the material forms a homogeneous LN-FN assemblage (Manteli 1993a:120). The supposed parallels with EN Knossos certainly do not seem strong and none of the examples of Lera ceramics published by Davaras need be earlier than LN (Davaras 1969:pl.368.β-γ). The cave is considered only a possible EN site.

Kastelli (Chania) (MN? LN FN)

In a recent gazetteer of Neolithic sites, MN is reported from Kastelli (Papathanassopoulos 1996:207), however nothing has as yet been published to support this.

Lentaka Cave (MN? LN)

Hood (1965:112) notes the presence of 'MN rippled ware'.

Lera Cave (MN? LN, FN)

Excavation in the cave did not produce evidence for any clear stratigraphy; all ceramic deposits appear to be mixed (Manteli 1993b:169) and dating of ceramics is purely on typological grounds. The excavators originally proposed an EN-LN date for the cave (Guest-Papamanoli & Lambraki 1980:180); the EN date was surmised on the basis of the supposed similarity of certain perforated lugs and flap handles to examples from EN Knossos (Guest-Papamanoli & Lambraki 1980:187-9). The validity of this comparison has been widely criticised: flap handles are known from LN-FN Phaistos as well as nearby LN/FN Nerokourou (Vagnetti et al. 1989:89; Vagnetti 1972-3:71). Manteli considers the ENI-LN sequence identified by the excavators to be "based on weak and general arguments" and states that "on the basis of pottery typology... the Lera assemblage finds its closest parallels in the LN and FN period (Manteli 1993a:35, 120). Only trumpet lugs could indicate EN occupation, with the presence of rippled ware possibly indicating MN/early LN (Vagnetti et al. 1989:89), otherwise the bulk of the material forms a homogeneous LN-FN assemblage (Manteli 1993a:120). The supposed parallels with EN Knossos certainly do not seem strong and none of the examples of Lera ceramics published by Davaras need be earlier than LN (Davaras 1969:pl.368.β-γ). The cave is considered only a possible EN site.

Platyvola (MN? LN)

Vagnetti 1996:37 mentions rippled ware of MN/LN character. Manteli notes LN and FN in small quantities (Manteli 1993a:36, 124-7). The site is probably LN-FN in date.

Central Crete:

Eileithya Cave (MN? LN FN)

The majority of the material is dated to FN (Vagnetti & Belli 1978), however one rippled sherd from the cave collected by Hood in the study collection in the Stratigraphical Museum at Knossos must be either MN or early LN. Manteli notes that there are considerable amounts of FN mixed with EMI (Manteli 1993a:33). The site is probably LN-FN in date.

Kastellos (MN? LN/FN)

Pendlebury et al. (1938) report a rippled sherd, which must be MN or early LN. Manteli reports only FN (Manteli 1993a:35). The site is probably LN-FN in date.

Katsambas (ENIa? ENIb, ENIc? ENII)

Lacking the benefit of J. Evans' excavations at Knossos for comparison, this material was originally dated by the excavator to MN (Alexiou 1956, 1957). However, restudy by Manteli has indicated an EN date (Manteli 1990:438 n.1). Of the small selection of decorated sherds published (cf. Alexiou 1956:308, fig.7; 1957:373, fig.4), the majority are either ENIb (i.e. incised lattice decoration, deep incised/pointillé triangles, chevrons and linear bands) or ENIc/ENII (incised chevrons, punctuated/incised). The presence of small amounts of rippled ware would also suggest a date of ENIc or ENII for some of this material. Identification of ENIa material would require careful study of material from well-defined deposits. The site seems to have been a relatively large open settlement with occupation both on the top of a rocky outcrop and below on the edge of the Kairatos drainage (Alexiou 1956:305-8; 1957). The single published house plan is of a large rectangular multi-roomed structure, whose walls appear very regular and well-built (Alexiou 1957:fig.2) and which most closely resembles ENII houses from Knossos. The site remains unpublished, but its status as an ENI-II site is nevertheless certain.

Knossos (Ac ENIa ENIb ENIc ENII MN LNI LNII)

Mitropolis (MN LN)

Vagnetti illustrates MN/LN style rippled ware (1973:pl.I.1.6-10) and MN/LN incised wares (pl.II.1.1-16) from the site of Mitropolis near Gortyn (cf. also Vagnetti 1996:37). Manteli similarly suggests MN/LN occupation, but notes lack of architecture and stratigraphy (Manteli 1993a:37). This site is considered to be an MN to LN site.

Skaphidia Cave (MN? LN)

Pendlebury et al. (1938:17) report a rippled sherd from this cave as part of their survey of sites on the Lasithi Plateau. This was in association with incised pottery compatible with a date after ENI. Other material appears to be LN or FN. Vagnetti & Belli (1978:136) date the rippled sherd to LN. Manteli notes only an FN deposit (Manteli 1993a:38).

East Crete:

Kavousi (EN? MN? LN?)

Haggis found an assemblage of pottery, dumped near the modern village (Locus 92/17), which had originally been excavated prior to the construction of a house near the village plateia (see Haggis 1995:173-4). This excavation went down to bedrock. The assemblage was inevitably mixed and contained Neolithic as well as Bronze Age ceramics up to LMIII. Haggis considers the Neolithic material to most likely date to LN or FN. While this remains possible, an earlier date cannot be excluded for at least one of the published sherds (no. 338), which is a carinated bowl/jar fragment with a strap handle on the carination, examples of which are very numerous at EN Knossos. Moreover, when the opportunity arose to study the fabric of this sherd in thin-section (see sample 93/69)¹⁸⁵, it proved to be indistinguishable from ENI examples of Fabric 12 (cf. especially 97/27) from Knossos, for which an origin in the Bay of Mirabello has

¹⁸⁵ A petrographic study of the ceramic material collected in the Kavousi survey is currently being conducted by Dr. P.M. Day at the Department of Archaeology & Prehistory, Sheffield University.

already been suggested (see Chapters 6 and 7; Appendix V). This site is thus a possible EN site.

Magasa (EN? LN?)

The excavations by Dawkins at Magasa early last century (Dawkins 1905) produced a small amount of ceramic material, which has in its time been assigned to both EN and LN. On the basis of the presence of wishbone handles and other apparent links with EN Knossos, Dawkins gave this material an EN date (1905:268). However Warren (1968:239) and Vagnetti and Belli (1978:137) date this material to LN. Manteli similarly favours a LN date for the bulk of the assemblage, but notes the presence of "a few EN traits", such as plastic knob decoration (1993a:37, 107; 1993b:123; cf. also Evans 1968:275): for example the Magasa ladles with 'knobbed wishbone handle' are considered to find "exact parallels in ENI Knossos" (Manteli 1993b:122; cf. Evans 1964:fig.25.18-22). The source of much of this confusion has been the fact that no-one has actually been able to examine this material since Dawkins and must rely on the small number of sherds illustrated in the 1905 publication. This site remains a possible EN site.

Pelekita Cave (ENII? MN LN)

This cave contains a deep Neolithic deposit, consisting of nine MN to LN strata. Earlier material (EN) has also been claimed. (Davaras 1982:388). Although incised wares are reported, which may if EN suggest a date in ENII, nothing has been published yet to support these claims (Papadakis 1987:402-4). At present this cave must be considered only a possible EN site.

(ii) Central and Southern Greece

In a recent review of the Neolithic of Northern Greece, Andreou, Fotiadis and Kotsakis pointed to several weakness in the chronological scheme being used (Andreou et al. 1996:558): stratigraphic support for the definition of ceramic phases is not always secure; the variability of pottery, both within sites and across regions, cannot be interpreted in exclusively chronological terms; scarcity of supporting radiocarbon dates. These criticisms would be equally applicable to other areas of the Aegean. Thus in the circumstances the absolute dates for the duration of ceramic phases and the points of transition can only be considered to be approximate. The absolute dates for different phases of the Greek Neolithic chronology are generally estimated as follows¹⁸⁶:

Phase	Duration
Aceramic	c.7000-6500BC
Early Neolithic	c.6500-5800BC
Middle Neolithic	c.5800-5300BC
Late Neolithic I	c.5300-4800BC
Late Neolithic II	c.4800-4500BC
Final Neolithic	c.4500-3200BC

Figure I.6 Chronology of Neolithic Greece

(a) Possible Greek Neolithic material at Knossos:

(Stratum VIII)

- buff burnished incurved bowl (Fabric 24) with pellet a little distance below rim and oval lug: most likely EN Peloponnese;
- dark polished curved bowl with offset rim and triangle/diamond with diagonally-incised cross-hatched fill: closest parallels EN/early MN Nemea.

(Stratum VII)

- orange burnished horizontal tubular lugs with tails (Fabric 26): parallels are MN Peloponnese or EC East Aegean.
- ring base (Fabric 24).

(Stratum VI)

¹⁸⁶ See chronological tables in Andreou et al. (1996:538), Gallis (1996:28-9), Demoule & Perlès (1993:366) and Vitelli (1993:table 13). NB although the majority of these chronological schema place the beginning of Aceramic at c.6800BC the radiocarbon dates from Argissa and Franchthi, when calibrated using the most recent calibration curve (OxCal 3 calibration programme), suggest an origin around 7000BC (cf. Vitelli 1993:table 13).

- fine white fabric (unsampled) = parallels are MN Nea Makri/MN Peloponnese.

(*Sounding X - ENIb*)

- cross-hatched painted vessel (Fabric 25): closest parallels MN Peloponnese.

(b) Possible Cretan-Style Material at Greek Sites

Slashed Cordon/'Rope' Decoration

- a dark burnished sherd with fingernail incision from late EN/early MN Nemea is considered by Phelps to be 'odd' for the Peloponnese (Phelps 1975:114; fig. 9.13). However it is closely comparable to ENIb dark burnished examples in Fabric 10, which are decorated with fingernail impressions giving a 'rope' effect (cf. example from sounding X).

- body sherd with slashed cordon decoration from late EN/early MN Nemea is 'unique' for the Peloponnese (Blegen 1975:264, pl.68.4; Phelps 1975:fig. 9.14), but indistinguishable from ENIb examples in Fabric 2a/b.

Barbotine

- one example of barbotine at Nea Makri from an early LN context differs markedly from all other examples of barbotine at the site (Pantelidou Gophas 1995:pl.41.9-23; see Chapter 7). It consists of larger more carefully rounded pellets which partially overlap. In form and execution it is so close to contemporary ENIb and ENIc examples (Fabric 1d) at Knossos as to suggest the possibilities of an import.

- two examples of barbotine are known from LN Saliagos (Evans & Renfrew 1968:43, fig.43:15, 16): no.15 is very irregular but very dense and overlapping and finds close parallels in single example from Emporio VIII and in Fabric 5a in stratum IV; no.16 on a curved body sherd shows the interface between barbotine and an undecorated zone and finds an exact parallel with an example in Fabric 1e in stratum IV. These two examples are otherwise unique at Saliagos and the close contemporary parallels with ENII Knossos suggest the possibility of imports.

Plastic cordon decoration

- a single example from LN Saliagos (Evans & Renfrew 1968:fig.43.10), which consists of three near parallel cordons, closely parallels an example in stratum IV (Fabric 1e) at Knossos.

Rectangular-Sectioned Strap Handles

These first appear in the Peloponnese in the latter half of MN and mark the first appearance of strap handles in this area; they are not common and are found on collar jars, pitchers and large storage jars (Phelps 1975:158; fig.22.15, 16). Rectangular handles are a particular feature of ENIc and ENII at Knossos.

Maceheads

- two fragments of what appear to be maceheads, which come from MN/LN Kouphovouno, are very similar in dimensions and form to Cretan examples; one is in a grey limestone, the other in a yellowy marble (Renard 1989:85; pl.xx.1-2). These are the only examples known at Kouphovouno or at any sites in the Peloponnese and are broadly contemporary with Cretan (ENIb/c) examples.

Pierced Long Handle ('Spout')

- a unique 'double-spouted' bowl from Saliagos (Evans & Renfrew 1968:fig.39) finds a close parallel with a unique vessel from stratum V at Knossos in Fabric 1d or 2a/b.

Concave Base

- There is a single example of a concave base comparable to Knossian types from LN Saliagos (Evans & Renfrew 1968:fig.53.12), which is unique and thus a possible import.

Ripple Burnish

Phelps notes that rippling is found on a small number of black ware and grey ware sherds at LN sites in central and southern Greece (Phelps 1975:233-4). Although the exact form of ripple design does not find parallels at Knossos, the forms on which it occurs are reminiscent of Cretan ENIc and ENII shapes, such as vertical carinated bowls and curved bowls with offset rims. Ripple appears to be confined to Greek LN and FN

deposits and although small quantities are known from Delphi, Elateia, Attica and Euboea, the main centre of distribution appears to be Corinth (Phelps 1975:234)¹⁸⁷.

Conclusion

When taken together these links and parallels suggest several points:

- (1) They suggest that strata IX-VIII are contemporary with Greek EN and indicate a transition to stratum VII at about the same time as the transition to MN in Greece.
- (2) The presence of ENIb/c style barbotine in an early LN context at Nea Makri seems to confirm what is suggested by radiocarbon dates, that ENIb ends sometime after Greek MN and ENIc begins during Greek LN¹⁸⁸. This is also suggested by the increased presence of ripple burnish at Knossos in ENIc/ENII and its first appearance in LN Greek deposits.
- (3) The parallels between Saliagos and Knossos V and especially IV suggest a synchronisation between Saliagos and Knossos ENIc/ENII. This agrees well with radiocarbon dates from these two sites: LN Saliagos dates to c.5100/5000 (P-1311, P-1396) and later, Knossos ENIc/ENII date c.5100-4500BC.

(iii) Links to South-West Anatolia

The problems associated with defining a sequence for south-west Anatolia are addressed in detail elsewhere (Appendix IV) and the chronological phasing followed here is the one presented in Appendix IV.

(a) Possible Anatolian Neolithic/Chalcolithic material at Knossos:

Vertical Tubular Lugs

¹⁸⁷ NB although at Knossos ripple decoration begins as early as ENIb, it only becomes common from ENII-LN (i.e. during the fifth millennium; cf. period of Greek LN and FN).

¹⁸⁸ Unfortunately Nea Makri lacks radiocarbon dates and so must be dated by comparison with other sites. Thus Pantelidou Gophas places the beginning of EN at around or before 6000BC, the beginning of MN to c.5700BC and the end of MN to c.4700BC (1995:308). However regarding this low dating for the end of MN, Phelps argues that the virtual absence of types characteristic of the late phase of LN, such as Matt-painted, Polychrome or Fine Gray, known from sites in Attica and Euboea, implies that settlement ceased at Nea Makri soon after the transition from Middle to Late Neolithic (Phelps 1998:434). This makes the low date for MN unlikely, since strata 9-12 must all belong to a very early phase in LN. This suggests that the LN levels at Nea Makri must date to the late sixth millennium (c.5300-5000? BC). Partial confirmation of this is provided by the single example of Cretan barbotine in the first LN level at Nea Makri (level 9), which suggests a synchronism with strata VI-V at Knossos (dated late sixth millennium BC).

- these (97/36, 98/87) appear in stratum IX in Fabric 28 at Knossos and disappear in Fabric 28 during the course of stratum VII.

Unslipped, Dark-on-Orange/Brown Painted and Burnished

- a single example occurs in stratum VII in Fabric 34.

Unique Incised Designs

- one example in Fabric 27 (98/83) from stratum VII.
- one example in Fabric 28 (98/96) from an ENIb context.

(b) Possible Cretan-Style Material at Anatolian Sites

Plug-Attached Strap Handles

This form of handle join firsts appear in MC and are more common at LC sites in the Elmalı Plain (Eslick 1992:78). It seems to be associated with the first appearance of strap handles in Anatolia, which also are first found from MC. Although the frequency with which plug-attached handles occur in south-west Anatolia marks them out as local products, it is striking that the timing of their appearance parallels plug-attached handles at Knossos (ENIc) and furthermore this technique in south-west Anatolia is closely associated with the first appearance of strap handles, which on Crete have a much more ancient ancestry. These parallels therefore suggest some sort of link or influence between these regions.

Conclusion

- (1) The confinement of vertical tubular lugs to strata IX-VII and their disappearance during stratum VII suggests that the transition from Anatolian LN to EC took place either during the transition from stratum VII to VII or perhaps during the course of stratum VII. This is also suggested by the occurrence of a single painted sherd in stratum VII, which in Anatolia may date to the LN/EC transition or to EC. These appear to confirm what is also suggested by Greek parallels that the transition from ENIa to ENIb should approximately be placed at c.5800BC.

(2) If the connection between ENIc/ENII Knossian plug-attached strap handles and the MC/LC appearance of both strap handles and plug attachment is meaningful, then this would suggest a synchronism between ENIc/ENII and MC/LC.

(iv) Links to the East Aegean

(a) Possible East Aegean Neolithic/Chalcolithic material at Knossos:

- a sherd with red and white painted decoration on orange burnish in Fabric 32 (stratum VI) whose closest parallels are from Ayio Gala (lower cave).
- unique sherd incised with rows of dashes (Stratum V), which has an exact parallel in Emporio VIII.

(b) Cretan-Style Material at Sites in the East Aegean

Incised/Pointillé

The rare (7/40 incised) examples of incised pointillé from the Ayio Gala Lower Cave must date no later than Anatolian EC, making them contemporary with Cretan ENIb. In design and execution these seven sherds are indistinguishable from Cretan incised pointillé: they consist of diagonal bands filled with deep carefully incised and regularly arranged dots, although some appear to be wider than bands and may be triangles. Several of these are filled with a white paste (see Hood 1981:pl.7(c).42-3).

- out of around 70 incised sherds in the Ayio Gala Upper Cave, 12 have pointillé (Hood 1981:60-1). Unfortunately those that most resemble Cretan types have no secure stratigraphic position within this context.
- one sherd combines several Cretan features: a high carinated bowl with offset rim, decorated with incised pointillé on the exterior and vertical ripples inside the rim (Hood 1981:fig.33.202). Another six of the 12 pointillé sherds may belong to this vessel (Hood 1981:60).
- one sherd is well burnished and decorated in a carefully incised/pointillé design featuring incised bands in a chevron arrangement (Hood 1981:61, fig.42.286): numerous parallels exist at Knossos for both design and execution (e.g. Pendlebury 1939:fig.1 bottom far left).

- several other bowls are illustrated which lack decoration but have sharply offset rims (Hood 1981:fig.33.197-204), which are more easily paralleled at Knossos than amongst mainland Anatolian assemblages (see Chapter 7).
- only one or two small sherds have incised/pointillé decoration at Emporio levels X-VIII. These are mostly confined to X-IX and are rare or absent thereafter (Hood 1981:232).

Incised Cordons

- a well-burnished deep jar from the Ayio Gala Lower Cave (Hood 1981:pl.7(d).24, fig.7.24) has a cordon with regular neat incision, which closely resembles examples of incised 'rope' decoration in Fabric 10 at Knossos. This sherd also has incised/pointillé decoration. The co-occurrence of two features considered diagnostic of Cretan ENIb in a deposit broadly contemporary with ENIb makes this a very likely import from Crete.
- from the Ayio Gala Upper Cave comes an example of slashed cordon decoration, which Hood considers 'unique' and a probable import (Hood 1981:61, fig.42.308).

Single Applied Pellet

- one body sherd with single applied pellet from Emporio (X-VIII) (Hood 1981:pl.42.430) closely resembles examples in Fabric 1d from stratum VI at Knossos (ENIb).

Barbotine

- single 'unique' example from Emporio (VIII) is considered an import (Hood 1981:299, pl.41(d).421). Hood notes closest parallels with 'denser barbotine' at Saliagos (also probable Cretan imports, see above) and in stratum ENII Knossos (Evans 1964:214 pl.47(3):6; Furness 1953:115 pl.30, a:10, 11). The ENII parallels from Knossos are in Fabric 5a and are identical to the example from Emporio VIII.

Incised Decoration (Without Pointillé)

- in Emporio VIII incision becomes the most common form of decoration (c.600 examples Hood 1981:295). In terms of execution and design these examples are

strikingly close to ENIc and ENII incised vessels on Crete (see Hood 1981:fig.111.4, 6-16; fig.112.17-20, 25-33).

Red/Light Brown Scribble Burnished Ware

Beginning in Emporio VIII this is common in VII-VI (Hood 1981:305). Hood describes it as a light brown burnished ware and compares MN Greek Urfinis (1981:305-7), however Urfinis parallels are too early. Moreover illustrated examples show a scribble burnish that is almost indistinguishable from red scribble burnished ware found in small quantities in Knossos V and in much larger quantities in IV (ENII). This parallel has the virtue of being both close and seemingly synchronous. In addition the range of forms is very similar to that found in red scribble burnished ware at Knossos: curved jars with 'S' profile and 'necked' jars, long loop handles (Hood 1981:pl.43.a, b). Hood (1981:304) notes that it is used mostly for jugs, but there also a few bowls and jars. The fabric, as described by Hood, seems to be different from Fabric 1e.

Conclusions

The chronological significance of these links between Knossos, Ayio Gala and Emporio largely depends on the absolute and relative dates for the various phases at Ayio Gala and Emporio.

(i) Ayio Gala Lower Cave:

Hood dates this deposit to the Anatolian LN on the basis of comparanda with Hacilar IX-VI, namely vertical tubular lugs (Hood 1981). However the unique red-on-white sherd (no.49) would seem to relate to Hacilar painted wares (Hood 1981:24), which suggests that at least part of this deposit is late LN/EC (Eslick 1980:12; Mellaart 1970b:fig 156:b). An EC date is also suggested by the possible Cretan imports (incised/pointillé, slashed cordon, see above), which at Knossos would all date to ENIb (Stratum VII-VI). The continued presence of tubular lugs (predominantly horizontal) in the lower levels of the Upper Cave, suggests that at least on Chios this form continues into EC (Hood 1981:34). It thus seems probable that the bulk of this deposit dates to Anatolian late LN/EC (contemporary with Cretan ENIa/b and Greek EN/MN)

(ii) Ayio Gala Upper Cave (lower): Early Chalcolithic/Middle Chalcolithic

Using a variety of criteria Hood argues for links between Ayio Gala Lower Cave and Emporio X-VIII (1981:36-7). Some of these criteria, such as horned handles, suggest links with MC material as defined by Eslick (1980; 1992; see Appendix IV). Others, however, such as the increased presence of horizontal tubular lugs and the occurrence of relief decoration, suggest links with EC material in the Lower Cave. Thus this very mixed deposit may contain EC and MC material. This date agrees well with the few sherds (incised/pointillé, slashed cordon), unfortunately without context, which link the Upper Cave to Cretan ENIb and possibly ENIc.

(iii) Ayio Gala Upper Cave (upper): mixed

This deposit is also very mixed. Hood argues for links between the upper part of the Upper Cave deposit and LC Beycesultan (Hood 1981:79). He also notes "many points of comparison with Emporio VII-VI" as well as some VI-IV (Hood 1981:74-6), which also date to the beginning of LC (see below).

(iv) Emporio X-IX: Middle Chalcolithic

Eslick, in her definition of Anatolian MC (see Appendix IV) draws attention to the close parallels between pottery at MC sites in the Elmali Plain (Kizilbel, Lower Bagbasi), Saliagos and Emporio X-IX (incurved shapes, high-sided pans, piercings below the rim, strap handles with knobs placed on bowl rims or sides of jars, incision) (1980:10-12). Since Kumtepe IB rolled rim bowls in level VII at Emporio date this level to LC (see below) Eslick argues that Emporio X-IX must date before LC (Eslick 1980:11; cf. Evans & Renfrew 1968:fig.45.4; pl.xxx.a).

(v) Emporio VIII: Middle Chalcolithic/early Late Chalcolithic

In a later work Eslick draws parallels, such as knobbed strap handles, between MC Kizilbel and Emporio X-VIII (see Eslick 1992:69-70 for list). If so this would suggest that Emporio VIII is at least partly MC. However Eslick also links Emporio VIII with the Anatolian LC (Eslick 1992:70). A number of shared features suggest links between Emporio VIII and Knossos IV (and possibly V):

Red Scribble Burnished Ware: small amounts of red scribble burnished ware are present in both Emporio VIII and Knossos V, becoming more common in Knossos IV. As noted above the examples at Emporio are so close as to be indistinguishable from the Knossos examples in both finish and forms represented.

Incised Ware: both Emporio VIII and Knossos IV see a large increase in incised decoration and both deposits share striking parallels in designs (see Hood 1981:fig.111.4, 6-16; fig.112.17-20, 25-33).

Barbotine Ware: single example of this ware in Emporio VIII finds its Aegean closest parallel in examples in Fabric 5a in Knossos IV.

Incised Rows of Dashes: Emporio VIII has a single example of this decoration, which is considered an import. It is indistinguishable in form and finish and similar in fabric to a similarly unique sherd in Knossos V.

When taken together these synchronisms suggest that

(1) EC Ayio Gala is contemporary with strata VII-VI at Knossos, thus confirming the mid sixth millennium date for ENIb.

(2) Emporio VIII spans part of Knossos V (ENIc) and part of Knossos IV (ENII).

And so when all evidence is taken together it suggests a transition between MC and LC around c.5000/4900BC. Indirect support for this is provided by the links between Saliagos, Knossos IV and Emporio VII-VI. The presence of similar white-on-dark decorated pottery at Saliagos, which is radiocarbon dated to the late sixth/early fifth millennia, and in Emporio VII-VI (Evans 1970c:395), suggests that Emporio VII may date around the same time. This supports a dating of Emporio X-VIII to the late sixth millennium BC. Support for an early fifth millennium date for Anatolian LC, is provided by Joukowsky who notes the presence at early LC Aphrodisias of light on dark painted pottery and some linear white-painted designs which find very close parallels at Saliagos (Joukowsky 1986:432-3).

Summary and Conclusions

The numerous links noted above between Crete, Greece, Anatolia and the East Aegean compliment each other extremely well and provide the basis for the

establishment of a secure relative chronology linking Knossos with sequences from neighbouring sites and regions. These synchronisms can be tabulated as follows (see Figure I.6):

Approx. Dates	Crete	Knossos	Greece/ Cyclades		East Aegean	SW Anatolia		Pan-Aegean Features
>7000	Ac?	Sounding 2 level 24	Mesolithic	Franchthi Mesolithic		EN	Aceramic Hacilar I-VII	aceramic
c.7000 - c.6500	Ac	X	Ac	Franchthi Mesolithic Aceramic		EN	Beldibi B? cf. Çatal Höyük XII	aceramic?
c.6500 - c.6400	Ac/ ENIa	X (surface) Sounding 2 17ii (surface)	Ac/EN	Franchthi Intermed.		EN	Kuruçay 13	first pottery
c.6400 - c.5800	ENIa	IX-VIII	EN	Franchthi EN	Ayio Gala Lower Cave	LN	Hacilar IX-VI Kuruçay	first pottery
c.5800 - c.5300	ENIb	VII-VI	MN	Franchthi MN Nea Makri MN	Ayio Gala Lower Cave Upper Cave	EC	Hacilar VI-I Kuruçay	painted pottery in Greece and Anatolia
c.5300 - c.5100	ENIb	VI (continued)	LNI	Nea Makri level 9 Saliagos	Ayio Gala Upper Cave Emporio X-VI	MC	Elmalı Kızıbeli Lower Bagba	first increase in maritime contact island colonisation
c.5100 - c.4900	ENIc	V	LNI	Saliagos	Emporio VII	MC/LC transition	Lower Bagba Bagbasi	maritime contact island colonisation
c.4900 - c.4500	ENII/ MN	IV-III	LNI	Saliagos	Emporio VIII - VII	LC	Aphrodisias VIIIB Bagbasi	maritime contact island colonisation l-on-d painted w
c.4500 - c.4000	LN	II-I	LNII/FN			LC		
c.4000 - c.3300	FN	?	FN			LC		

Figure I.7 Integrated Relative and Absolute Chronology for the Neolithic Southern Aegean

Through the careful integration of Cretan, Greek, East Aegean and Anatolian chronologies it becomes possible to say more about the nature of the relationships between these regions during the earlier Neolithic (sixth-late fifth millennium BC). It is striking that the first adoption of pottery occurs at approximately the same time on both sides of the Aegean (c.6500BC). Although this pottery exhibits some regional differences, there are also strong similarities in the types of form and finish represented. Also noteworthy is the parallel appearance of painted pottery in Greece (late EN/MN) and Anatolia (late LN/EC) (c.5800-5300BC). However perhaps the most obvious signs of pan-Aegean contacts first emerge late in the sixth millennium with a whole series of sites displaying closer links: cf. ENIc/ENII Knossos with Saliagos (Washburn 1983:141-8) and Emporio VIII-VII, Saliagos with Emporio X-VI and MC/LC sites in

south-west Anatolia and also the spread of light-on-dark painted wares throughout the Cyclades and East Aegean/Aegean-Anatolia littoral. Also Eslick has emphasised (1980; 1992) that from MC south-west Anatolia changes in orientation away from the east and towards the Aegean. It is no accident that the first signs of increased contacts (c.5300BC) probably coincide with the establishment of many permanent settlements in the Cyclades and other Aegean islands.

Recognition of the timing of this increase in contacts beginning in Anatolian MC/ Greek LNI and continuing into LC/LNI-II provides a new perspective on the ceramic links first noted by Evans between Knossos and Greek LN east Aegean and LC western Anatolian sequences (Evans 1968:273-4). Almost all of the 'Cretan' features noted by Evans in these later assemblages, that is flared strap ('trumpet lugs'), flap and wishbone handles, triangular 'ears' on the rim, plastic cordon decoration, pellet/knob decoration and incised/pointillé decoration have been demonstrated in Chapter 7 to be purely Cretan features during the preceding seventh and sixth millennia BC (i.e. Greek EN-MN, Anatolian LN-EC). Evans saw these links as possibly saying something about the origin of the earliest settlers of Crete. However, what seems more likely is that these connections say much more about a probable Cretan origin for some of the first LC settlers of the islands of the south-east/east Aegean.

The changing nature of inter-regional contacts during the earlier Neolithic will be discussed in more detail in the context of EN Knossos in Chapter 12. Here it suffices to emphasise that there is nothing here to suggest that *any* region of the Aegean was ever truly isolated during the earlier Neolithic (*contra* Cherry 1985:27-8), rather the movement of probable imports as well as the identification of other material similarities suggest that there was always some sort of regular small-scale interaction as well as perhaps more infrequent longer-distance movements around and across the Aegean. In this way the contemporary appearance of material similarities in different regions cannot in reality be used to demonstrate waves of advance or the unidirectional trafficking of individuals, innovations and ideas, rather movement was multidirectional criss-crossing the southern Aegean, with all sides (Greece, Crete, east Aegean/south-west Anatolia) having the potential to influence developments in neighbouring regions (see Chapter 12)

APPENDIX II

EARLY NEOLITHIC KNOSSOS: THE GROWTH OF A SETTLEMENT?

In 1971 John Evans published an important study, which, by comparing dated phases of occupation from old and new soundings around the Kephala hill, attempted to document the growth of the Neolithic settlement at Knossos from Aceramic to Late Neolithic (Evans 1971). In addition, Evans and the site architect, Col. A.B. de Quincey, collected together the absolute depths when bedrock was reached in these soundings to make a reconstruction of the original geography of the hill prior to settlement. The picture Evans produced was one of steady growth in size over the duration of the Neolithic, a pattern of growth felt to be in accordance with "the fundamental conservatism and isolation of the community" (Evans 1971:114).

While it is not the intention here to question the methodology behind this reconstruction (see Whitelaw 1992:226-8), it will be argued that Evans' characterisation of EN growth as a "steady and apparently uninterrupted" (Evans 1971:116) must now be recast. Problems with this characterisation have already been noted (Broodbank 1992:44): Using Evans' figures Broodbank plotted changes in site size against a period chronology based on calibrated radiocarbon dates, producing a graph (see Figure II.1), which seemed to indicate that overall growth was not gradual, but actually uneven. For Aceramic and EN, however, Broodbank argued that growth must have been quick steady in order that the small founder population of Knossos might quickly reach a point where it was demographically self-sufficient; this threshold was considered to be a point where population reached the low hundreds (Broodbank 1992:47). Broodbank's graph suggests that Knossos reached the necessary figure for demographic self-sufficiency at some point during ENI. However, it should be stressed that these figures represent the maximum area and hence population for the *end* of each phase. They *do not* indicate how quickly demographic viability was actually reached during the millennium and a half of ENI. Broodbank's curve suggests that growth was gradual and regular; however it is equally possible that growth was uneven and that the settlement either grew in quick bursts or remained small until late in ENI.

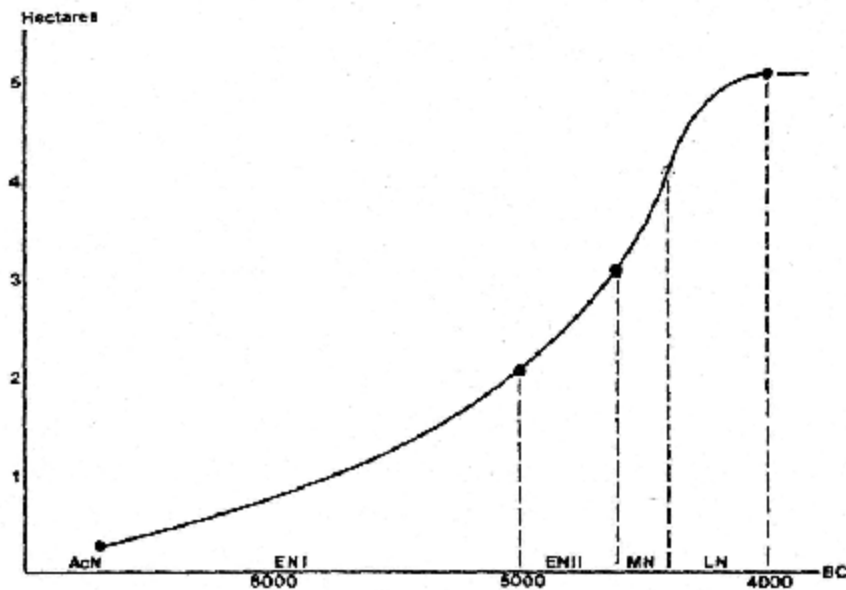


Figure II.1 Graph of Growth of Neolithic Knossos (after Broodbank 1992).

In view of the refinements to EN relative chronology proposed in Appendix I, a new picture of EN site development will be presented here, which traces changes in settlement size and location during ENIa, ENIb, ENIc and ENII. Restrictions of time confined detailed study of ceramic material to only the most important soundings¹⁸⁹, namely soundings AC (Central Court), AABB (West Court) and X (South Ramp) (see Figure I.1).

Changes in Settlement Size and Location (Aceramic - ENII)

Aceramic: further study (see Appendix I) has largely confirmed the picture outlined by Evans (1971:99-103). Settlement appears to have been confined to the top of an oval knoll, situated at the confluence of the Vlychia and the Kairatos. This settlement was long-lived (c. four building phases) and small (c.0.25ha or 50m x 50m) (Evans 1971:103). To the north of the main area of settlement on the lower slopes of the knoll (i.e. sounding AC, stratum X) were work areas, rubbish dumps

¹⁸⁹ The restudy and reinterpretation of material from soundings AC, AABB and X benefited immeasurably from transcripts of the relevant excavation notebooks kindly made available by John Evans (Evans 1959, 1960a, 1960b, 1970b).

(pits), fires and several infant burials but no evidence for permanent mudbrick and stone structures (Evans 1971:103; Appendix I).

ENIa: the definition of an earlier phase within ENI has given greater resolution to the early history of the ENI settlement. Rather than a gradual expansion of the initial Aceramic settlement, several features suggest that late in the Aceramic, or perhaps very early in ENIa the settlement on the knoll was permanently abandoned with occupation shifting onto the saddle to the North:

- (i) In sounding X Evans noted a distinct interface between later ENI and Aceramic deposits, which indicate that the Aceramic deposit had been exposed for some time *prior* to the ENI activity which buried it.
- (ii) My recent study of ENI ceramic material from sounding X suggests a date for these ENI deposits *in the latter half of ENI*, i.e. after the end of ENIa, (after c.5800BC). A post ENIa date is also suggested by the absence of mudbrick debris.
- (iii) While ENIa levels in the Central Court sounding AC contain mudbrick and stone structures, ENI levels from sounding X contain *little evidence for structures* either in the area of the trench or in areas adjacent in the form of building tumble. Rather these thin ENI deposits are either pits or resemble rubbish deposits, such as might be found on the edge of a settlement (cf. Appendix I).

This change in site location is striking, certainly the normal procedure during the Aceramic seems to have been to build a new house upon the ruins of the old in a manner which emphasises continuity of occupation. The reasons for this abandonment are unclear, but it may signify changes in ownership of the site or a desire to break with the past. Not that abandonment necessarily meant obliteration: it seems clear that the top of the Aceramic mound remained exposed for the full length of ENIa and perhaps for a significant amount of ENIb, a period of at least 500 years. Indeed it may have remained free of structures until at least the end of ENII. Certainly the summit of the Aceramic mound (max. c.99m a.s.l.) would have

overlooked the ENI settlement (max. c.96m a.s.l.) until late in its development: cf. sounding X where even late ENI levels dip down, sometimes sharply, to the NE following the natural contours of hill (Evans 1970b:3-4).

The continued presence of the earliest settlement may mean that it retained a significance long after its original abandonment. It is perhaps against this possibility of special significance that the unusually large 'Great Pit' and its associated smaller pits, dug into the Aceramic mound, should be interpreted. These pits may possibly represent some sort of ritual activity perhaps to be connected with some of the perhaps ceremonial aspects of house abandonment, such as the clearing/cleaning of occupation floors and the possible 'votive pottery pits' in the top of the destruction levels of houses, which may have been closure/foundation deposits (Evans 1968:268; 1964:48; 1994:7, 14).

Like its predecessor, the ENIa settlement was small: the absence of ENIa levels from sounding AABB (West Court) as well as from any deposits from North of the Central Court suggest that occupation was confined to the lower northern slopes of the knoll. Evans estimates that the maximum area occupied during the mudbrick period of ENI (i.e. ENIa) cannot have been much more than 0.5ha (Evans 1971:103). Since this figure also includes the area of the Aceramic settlement, of which some if not all seems now not to have been occupied at this time, Evans' original estimate should be revised down to perhaps c. 0.25-0.3ha.

ENIb: Evans estimates that the maximum possible area occupied by the later ENI (i.e. ENIb-c) settlement was c.2ha. It seems likely however that the ENIb settlement did not actually ever reach this size. Evans includes in this estimate the ENI deposits from soundings AABB (West Court) and X. However, the area of sounding X seems to have been on the edge of the ENI settlement (cf. Appendix I), likewise the area of AABB, which was only settled towards the end of ENI: cf. the absence of built structures, sequence of thin layers of mixed refuse, much lower densities of sherd material in comparison with sounding AC (Evans 1971:104-6). Preliminary study of the lowest ENIc levels in sounding XY to the north, suggests that this area was also unoccupied during ENIb. Unfortunately further precision would require the re-study of all ENI deposits from the site, a task beyond the scope of the present

study. At present it seems likely that the actual maximum area of ENIb occupation probably did not exceed c.1.0-1.5ha.

ENIc: definition of the full extent of the settlement during this phase requires further study of late ENI/ENII deposits. However, preliminary study of soundings XY and AABB suggest that during ENIc the settlement may have undergone a period of rapid growth, perhaps doubling in size. In sounding XY, Evans excavated three ENII building levels, the lowest of which rested directly on bedrock and contained an admixture of ENI pottery, without there being a real ENI level (1964:138; 1994:11). Preliminary study of this material (level 7) indicates that this is not an admixture of ENI material but a real ENIc level. This would suggest that the ENIc settlement might have extended at least as far to the north as the later ENII settlement. Moreover the absence of underlying rubbish deposits, a common feature of deposits close to the limits of settlement, may indicate that this expansion was well beyond the limits of the previous ENIb settlement. ENIc is also represented as a distinct phase below ENII in soundings AABB¹⁹⁰ and AC. In the latter, wall foundations and faint traces of structures were also found (Evans 1964:157). Although requiring further investigation, it would seem that the ENIc settlement could have stretched some considerable distance to the north and probably at least as far west as the edge of the West Court¹⁹¹. This would indicate a settlement at least the size of c.2.5ha.

ENII: there is little to add to Evans' discussion of the extent of the ENII settlement (Evans 1971:107-9), except perhaps to emphasise that in none of his tests did Evans reach beyond the northern or western limits of the ENII settlement, the eastern and southern limits being naturally defined by the slope of the mound and the courses of the Vlychia and Kairatos. Thus the real northern and western limits of the ENII settlement remain unknown and require further soundings. The absence of any mention of ENII in connection with excavations into the LN below Middle Minoan

¹⁹⁰ Unfortunately information about the presence or absence of architecture in ENIc levels in AABB was not available to this study.

¹⁹¹ NB in sounding ZH, situated near the ramp running west from the West Court, Evans found ENII but unfortunately did not have time to investigate further (Evans 1971:98-99). Since bedrock was not reached, the limits of the ENIc settlement remain unknown.

houses south of the Royal Road, may suggest a possible limit, but no details of whether bedrock was reached are given (Evans 1971:114). And so, although Evans argues that it was not until MN that the settlement underwent a 'significant acceleration in the rate of change' (Evans 1971:109), this cannot actually be *demonstrated* and an equally significant expansion may have occurred during ENII and possibly as early as ENIc. Certainly the ENII settlement must have been at least as big as 3ha and may well have been much bigger. One should note however that ENII and MN strata were almost entirely absent from sounding X (Evans 1971:102), either through later LN activity¹⁹² or alternatively because this area of the site continued to be free of permanent structures. Nevertheless the failure to identify the northern and western limits of the ENII settlement offsets this and makes c.3.0ha or more a reasonable minimum estimate.

Summary and Conclusions

These new estimates of changes in site growth during the Early Neolithic are collected together in table 1. An approximate minimum (area x 100) and maximum (area x 200) population sizes per phase have been estimated using the same multipliers used by Broodbank (1992:43). Halstead used similar multipliers (e.g. 1989:70), although he favoured a maximum of x300, which may be rather high since it exceeds recent estimates of population density for later early urban centres on Crete (c.240/hectare, Whitelaw 2000).

Phase	Maximum Area (ha.)	Minimum Population (area in hectares x100)	Maximum Population (area in hectares x200)
Aceramic	c.0.25	25	50
ENIa	c.0.25-0.3	25-30	50-60
ENIb	c.1.0-1.5	100-150	200-300
ENIc	c.2.5	250	500
ENII	c.3.0+	300+	600+

Figure II.2 Changes in Estimated Site Size and Population Size at Knossos (ENI-II)

¹⁹² Evans has suggested (Evans 1994:18) that much of the area below the future Central Court of the palace at Knossos was levelled during LN; this would include presumably include the area of sounding X and may help to account for the paucity of ENII and MN material.

The most obvious problem with this method is that it assumes that large gaps in settlement were fairly infrequent (see Evans 1971:116) and that an area with occupation of one date was also occupied during subsequent phases (Whitelaw 1992:226). Although this may have generally been true, the probable abandonment of the area of the Aceramic settlement constitutes a serious exception. In addition, as the discussion of stratigraphy in Appendix I makes clear, smaller gaps in the settlement were probably fairly common (Evans 1994:10): most ENI Houses tend to go through phases of abandonment which may be quite long, where they may act as rubbish dumps (e.g. House D). Also larger areas may be more permanently abandoned, with the movement of site centre to another area of the site: in the case of the Aceramic and ENIa settlements this did *not* entail an increase in site size. These examples suggest that these estimated EN settlement and population sizes should be treated as absolute maxima.

On the basis of Figure II.2, it would seem that contrary to the pattern of growth suggested by Broodbank (see Figure I.1) the population of Knossos during its first millennium of occupation (i.e. from c.7000BC to c.6000BC), did not expand rapidly expanding to reach a demographically viable population figure (*contra* Broodbank & Strasser 1991:240), but actually grew much more slowly, reaching a maximum population of around 60 or so (cf. Cherry's (1985:24) 'founder population' of 12 families). Thus these figures *do not* represent a short-term founder group, which rapidly expanded to reach demographic self-sufficiency, but rather represent the *maximum* population at the site over the period of around a millennium. Halstead has suggested that typical early farming settlements in Greece ranged in size from c.0.5-1.0 hectares, around 50-300 inhabitants (Halstead 1989:70). If so, then in comparison Aceramic-ENIa Knossos was very small indeed. Unfortunately, however, in the absence of available site-size data for other contemporary settlements on Crete, one cannot be sure whether Knossos was small or average in Cretan terms. What is clear, however, is that Knossos could not have been demographically self-sufficient for much of its early existence, a fact which pays indirect testimony to the existence of other (undiscovered) settlements with which Knossos must have been in contact.

APPENDIX III

CRETAN GEOLOGY

III.1 The Pre-Neogene Geology of Crete

The Pre-Neogene rocks of Crete comprise a series of nappes. Geological study has resulted in the division of these nappes into a number of main tectonic units, which are described below. These units are separable because they evidence different depositional environments and histories prior to their emplacement together during the Tertiary formation of Crete (see Figure III.1).

Upper Nappes	Asteroussia & Ophiolite Nappes	highest
Upper Nappes	Vatos, Arvi, Miamou, Spili, Preveli Units ¹⁹³	
Upper Nappes	Pindos Nappe	
Upper Nappes	Tripolitza Nappe	
Lower Nappes	Phyllite-Quartzite Series	
Lower Nappes	Trypali Unit (Omalos)	
Lower Nappes	Plattenkalk Series	lowest

Figure III.1 The Main Cretan Pre-Neogene Tectonic Units in Stratigraphical Order

(1) Plattenkalk Series

Plattenkalk outcrops can be correlated laterally, but these exhibit different sedimentation histories in different parts of Crete: this group is repeatedly influenced by input of continental material throughout, implying a depositional environment close to a land mass (Soujon et al. 1998; but cf. Hall et al. 1996). Widespread occurrence of lithistide silicosponges both laterally and vertically throughout Mesozoic to Tertiary members of the group indicates shallow to intermediate water depths as well as continental influences (Soujon et al. 1998). Rhythmicity in some of the sedimentary sequences is interpreted as showing changes in sea-level, but in general the depositional area of Plattenkalk group was structured and slowly subsiding (Soujon et al. 1998), as indicated by Early Jurassic coarse carbonate breccias passing up into calciturbidites and then into

¹⁹³ These units have recently been grouped together as 'tectonic melange' on the basis of their internal structure and mode of occurrence (Fassoulas 2000:19).

basinal conditions of a bedded chert-limestone sequence (Hall et al. 1996). Basinal conditions probably prevailed for much of Mesozoic with carbonate deposition throughout and occasional disturbances recorded by slumped chert horizons and channelled calcisiltites (Hall et al. 1996).

The Plattenkalk is composed of neretic and pelagic, (mainly carbonate) rocks (see Fassoulas 2000:14). At its base there are Permian schists and clastic sediments. Resting unconformably over these are neretic dolomites and cherty limestones. During the Norian a distinctive stromatolitic dolomite was deposited, indicating inter-tidal sedimentation on continental crust (Hall et al. 1996). Above these rocks are the Gigilos beds (e.g. Omalos area) which contain schists, clastic sediments and dolomites. Finally, from the Middle Jurassic the platy limestone/marble occurs, which gave this unit its name. In some areas (e.g. Nida) this is covered by Oligocene 'meta-flysch' deposits, which contain sericite and calcite schists/phyllites (Soujon et al. 1998:45). In general metamorphic grade and deformation are sufficiently mild to preserve primary sedimentary structures (Lister & Durkin 1985:24).

(2) Trypali Unit

Just above the Plattenkalk in West Crete lies the Trypali Unit. The geotectonic significance of this unit still remains a matter of debate. For a variety of reasons¹⁹⁴ Hall et al. (1996) consider it separate from the Phyllite-Quartzite Series and the Plattenkalk; however Bonneau does not consider it to be a separate unit, but rather a tectonic melange in the thrust-zone between the Phyllite-Quartzite and Tripolitza Nappes¹⁹⁵ (1996:520). The Trypali Unit consists largely of recrystallised coarse carbonate breccias, limestones and dolomites of Triassic to Lower Jurassic age.

¹⁹⁴ i.e. the considerable tectonic thickness of rocks (2-300m+), the fossil evidence of date, the variety of carbonate types as clasts, the obvious sedimentary features in many of the breccia exposures and the absence of assumed large-scale inversion of the Plattenkalk series (Hall et al. 1996).

¹⁹⁵ Bonneau argues that it is identical to the lowest part of the Tripolitza sequence, both in lithology and fossil content; other outcrops south-east of Rethymnon are considered to be recrystallized Tripolitza limestones (Bonneau 1996).

(3) Phyllite-Quartzite Series

The Phyllite-Quartzite series consists of continental to shallow marine siliciclastics and impure carbonates. Despite a strong supply of clastic material (pyroclastic, volcanic and minor intrusive igneous rocks), deposition occurred in a fully marine environment from the Upper Carboniferous to the end of the Lower Triassic, a shallow marine environment in the Upper Triassic and a saliniferous facies/littoral facies at the Triassic/Lias transition. The Phyllite-Quartzite series was probably deposited upon continental crust (Hall et al. 1996:509) and may be related to the low grade Tyros unit of the Peloponnese (Bonneau 1996:520).

All members of the Phyllite-Quartzite series have been deformed and metamorphosed during the Tertiary orogenesis under high pressure/low temperature conditions (Hall et al. 1996). The grade of metamorphism varies from very low grade zeolite/greenschist in East Crete (300°C, 8Kb) to blueschist facies in West Crete (400°C, 10Kb) (Theye et al. 1992). During exhumation (Middle-Late Miocene) a retrograde, low greenschist metamorphism affected the Phyllite-Quartzite series leading to the overprinting of the previous metamorphosed structures by low grade greenschist facies metamorphism (Theye et al. 1992; Fassoulas et al. 1998). The Phyllite-Quartzite series consists of two parts (see Fassoulas 2000:14-18): the upper comprises pelites, phyllites, schists, quartzites, limestones and altered volcanics; the lower contains dolomites and quartzites, locally (West Crete) intercalated with evaporites (gypsum) and metabasalts (Greiling 1982:291). Petrological studies of the Phyllite-Quartzite series in West Crete revealed the metamorphic minerals glaucophane, lawsonite, pumpellyite, aragonite and albite in metabasalts and quartz, muscovite, paragonite, chloritoid and lawsonite in metapelites (Greiling 1982:291). Schists in the area of Platanos (south coast) contain carpholite and chloritoid crystals (Fassoulas 2000:66).

In central Crete the Phyllite-Quartzite series crops out as isolated intensely strained boudinaged bodies between high pressure metamorphosed Plattenkalk and rocks of the upper nappes, with a thickness ranging from a few metres to around 100; this contrasts with West Crete where it is about 1500m thick (Fassoulas et al. 1998:89). In central Crete the Phyllite-Quartzite series was strongly affected by the retrograde greenschist metamorphism which occurred

during exhumation. This resulted in two characteristic types of quartz microstructure (Fassoulas et al. 1998:91):

- (1) Large quartz grains floating in a mass of smaller recrystallised grains (found in quartzites and phyllites);
- (2) Large flattened quartz grains surrounded by phyllosilicate minerals (white mica, chlorite) in association with fine-grained recrystallised quartz (mainly phyllites).

(4) Tripolitza Series

At its base the Tripolitza Series consists of Middle to Upper Triassic dolomites, shales, schists, limestones and clastic sediments (Ravdoucha beds). Above this lies a neretic carbonate series, over which lie Upper Eocene flysch sediments. This is the facies equivalent of the 'classical Triassic to Upper Eocene carbonate platform sequence of continental Greece', which is found also on Kasos, Karpathos, Rhodes and Astypaleia (Bonneau 1996:520-1). There is no information about metamorphic grade, but rocks near Sellia show temperatures of 300-400°C from the *Upper Triassic* (Bonneau 1996:520). Tripolitza limestones are intensely karstified and accommodate most of the aquifers of the island.

(5) Pindos Nappe

This is a sequence of pelagic sedimentary rocks (Late Triassic-Jurassic) and comprises cherts, radiolarites, limestones, calciturbidites and calc-breccias, siltstones; these pass up into turbidite sandstones and shales with intercalated carbonate conglomerate units. (Hall et al. 1996; Fassoulas 2000:19). Bonneau has correlated these with the Oionos-Pindos sequence of mainland Greece and with the Pindos nappe of the Dodecanese (especially Rhodes, Prohitis Ilias Nappe); On Crete characteristic sections occur in the Kedros, Samitos and Assiderotas mountains and in the Mangassa sequence of East Crete (Bonneau 1996:521). South of Apesokari (Mesara) deformed siltstones, sandstones, limestones and slates occur (Fassoulas 2000:48).

(6) Tectonic Melange (Vatos, Arvi, Miamou, Spili, Preveli Units)

The Vatos, Arvi and Miamou Units consist of very low-grade metamorphosed sediments, which comprise a variety of rocks: pillow lavas, pelagic shales, metamorphic rocks, serpentinites, limestones and turbidite sandstones (Hall et al. 1996:506). Bonneau also notes the presence of coarse breccias containing neritic limestone blocks as well as abundant clasts of granite, metamorphic rocks and serpentinite (Lentas and Prinia sections) (Bonneau 1996:521). Mineral assemblages are perhaps referable to sub-sea-floor metamorphism (Bonneau 1996). The Spili unit consists of crystalline, baroisite-bearing and sheared serpentinites, related to an old ophiolitic nappe (Fassoulas 2000:19). The Preveli Unit consists of schists, marbles and high-pressure/low-temperature rocks, including blueschists containing large blue amphiboles (Kilias et al. 1993; Fassoulas 2000:53-4). The Cycladic Blueschist sequence occupies a position equivalent to that of the Pindos nappe (Bonneau 1996:522).

(7) Asteroussia/Ophiolite Nappes

These are high-grade metamorphic rocks and ultramafic rocks with some subordinate microgabbros (Hall et al 1996:506). The Asteroussia nappe comprises Late Cretaceous high-temperature/low-pressure metamorphosed rocks, mainly amphibolites, marbles, quartzites, gneisses, garnet-bearing mica-schists, with deformed and undeformed granitic rocks (Bonneau 1996:522-3; Fassoulas 2000:20). Minerals characteristic of the Asteroussia nappe are sillimanite, andalusite, cordierite, hornblende, garnet and biotite. The Asteroussia nappe is a continental unit which also occurs in the Cyclades and Anatolia. Within Crete it ranges in depth from 600m (Asteroussia) to 4-5m (Anogia) (Bonneau 1996:522). It would appear to have been severely attenuated during Oligocene emplacement in the nappe pile: the Neogene rocks of East Crete, where no outcrops of the Asteroussia Nappe are known, contain abundant gneissic pebbles, which are referable to this nappe, thus indicating its former extent (Bonneau 1996:523). Around Kalo Khorio on the Mirabello Bay (East Crete) there is a distinctive outcrop of acid intrusives (granite, syenite, diorite), which finds little or no parallel on Crete (Becker 1975:251; Fassoulas 2000:85).

The Ophiolite nappe is comprised of ophiolitic remnants thrust onto the Asteroussia nappe, probably during the main Upper Eocene-Oligocene Hellenic phase (Bonneau 1996:523). These are badly preserved and are mainly composed of serpentinite, but also include an ophiolitic suite (e.g. Gonies, Mount Ida), which includes mainly serpentinites and gabbros. The Gonies serpentinites vary in colour from light green to red, brown and black and are found together with chlorite and thin veins of asbestos (Becker 1975:243). Several large deposits of serpentinite occur along the north coast of Crete between Gazi and Phodele (north of Ida). Serpentinite, chlorite and other ultrabasic rocks also occur in the Zaros-Kamarea area to the south of Ida (Becker 1975:244, 249). There is a small outcrop of the ophiolite series near Galeni and Roukani to the south of Iouktas. The ophiolite nappe also occurs in Rhodes.

III.2 The Neogene and Post-Neogene Geology of Crete

The post-Alpine rocks of Crete occur as Neogene and Quaternary sediments and rest unconformably on the upper and lower nappes (see above). Through use of biostratigraphic and chronostratigraphic data it is possible to reconstruct their sedimentary history (see Meulenkamp 1971; Meulenkamp 1985; Meulenkamp et al. 1977; Dermitzakis et al. 1995; Fassoulas 2000:20-2).

(1) Prina Group

These are the oldest Neogene sediments and consist of dark limestone breccias and brecci-conglomerates of continental facies, usually embedded in a well-cemented calcareous matrix. These are clastic deposits of Middle Miocene age (Seravallian-Tortonian) (Dermitzakis et al. 1995:200), which accumulated in graben-like depressions, prior to submergence (see Meulenkamp 1985: fig 15.2A). Submergence began first in the Middle Miocene in the Ierapetra area (Meulenkamp 1971:9). A good example of this group occurs west of Tylissos in the Mylopotamos graben in central Crete (Fassoulas 2000:20).

(2) Tefeli Group

These are sediments, which were deposited during the Late Miocene (Late Serravalian-Earliest Tortonian), when Crete and adjacent areas had been transformed into a mosaic of small-sized horsts and grabens (Meulenkamp 1985:310; fig15.2B). This paleogeographic revolution occurred probably within one million years and was responsible for shaping the general configuration of modern Crete. This group is comprised of conglomerates, sands and clays reflecting deposition in fresh-water, brackish and marine environments (i.e. marly limestones, evaporites). Sediments of the Tefeli group occur in central Crete and around Chania.

(3) Vrysses Group

During the late Tortonian-early Messinian the land became a shallow sea with islands and shoals; in tectonically 'quieter' areas biogenic sedimentation played an important role, but this gradually decreased (Meulenkamp 1971:6). In general this period saw an increase in marine sedimentation resulting in the deposition of bioclastic, often reefal algal-coral limestones with associated alternations of laminated shallow marine marls. Sometimes there occur intercalations of gypsum. The earliest marine sediments in Rethymnon area are early-middle Tortonian (Meulenkamp et al 1977). Rocks of the Vrysses group rest on rocks of the Tefeli group or unconformably on basement rocks (e.g. north of Tyliisos; near Vrysses, Chania).

(4) Hellenikon Group

The early Messinian was a period of high tectonic instability with the 'independent' movement of separate blocks: for example subsidence in Khania occurred probably at same time of the rejuvenation of relief in the south-west Herakleion area; elsewhere, in the north Herakleion area, Rethymnon and Siteia there was a post-early Messinian period of uplift and erosion not followed by renewed subsidence. This resulted in an intricate pattern of fluvatile, brackish and shallow marine sediments, which resulted in the sedimentation of gypsiferous deposits (Meulenkamp 1971:9; Meulenkamp 1985:310). Rocks of this group

consist of coarse, non-marine conglomerates, fluvio lacustrine and lagoonal sediments with gypsum.

(5) Finikia Group

During the early-middle Pliocene there was a period of marine transgression, which was much wider in extension than others which occurred during the Late Neogene. Possibly only the highest parts of Crete, such as the Lefka Ori and Psiloritis, remained above sea-level (Meulenkamp 1971:9). This transgression was the result of a 'conspicuous rise of sea-level'. Sedimentary evidence of the Early Pliocene flooding can be found all over the island, but in central and eastern Crete the lowermost Pliocene sediments are generally found as components in breccia-type conglomerates (marl breccias), which unconformably overlie lower Messinian carbonates (Meulenkamp 1985:310). In West Crete Upper Messinian clastics are conformably overlain by marly limestones of Trubi type (Early Pliocene) (Meulenkamp 1985:310). In general this group consists of marine sediments, comprising marl breccias at the base with open marine, white marls, clays and locally intercalations of brown beds and diatomites (Fassoulas 2000:21-2). Good examples of these beds occur near Herakleion and west of Chania.

During this period (later early Pliocene?-Late Pliocene) strong differential vertical movements occurred in some parts of Crete, which resulted in the uplift and erosion of the lowermost Pliocene beds. This produced a general tilting of blocks to the north, which continued for the Pliocene and into the Pleistocene/Holocene (Meulenkamp 1985:310). Usually the youngest marine sediments found along the north coast form part of shallowing sequences of Middle Pliocene age (Meulenkamp 1985:310). This uplift of Crete coincided with subsidence of adjacent areas, such as Kythira. These movements lifted up the Herakleion area, thus separating it from the Mesara basin, with which it had hitherto shared a common sedimentary history.

(6) Agia Galini Group

The erosion of the uplifted Herakleion basin's sediment supplied the Mesara with coarse (red) non-marine conglomerates and sands, which constitute the youngest Pliocene formation on Crete (Meulenkamp 1985).

(7) Quaternary

Quaternary sediments include marine shallow water sediments and terraces and alluvial and fluvial deposits. Sedimentation was local and mainly continental; marine sedimentation was restricted to some places along the coast and to terrace deposits (Meulenkamp 1971:9). These deposits occur mainly on the north and south coasts of Crete (Fassoulas 2000:22).

III.3 The Geology of the Herakleion Basin

During the Miocene the Herakleion Basin extended to the south as far as the Asteroussia Mountains forming a continuous neotectonic graben with the Mesara (see Papanikolaou & Nomikou 1998:231; Figure III.2). There is a general dip to the north as shown by the orientation of the hydrographic systems, the general dip of the geological strata, especially Pliocene and the distribution of planation surfaces, especially the northward plunge beyond the north coast to the east and west of Herakleion. Mount Iouktas was produced by the uplift of Pre-Neogene rocks within Neogene sediments of the basin and is bounded on its east and west flanks by north-south trending tectonic faults. Iouktas consists of Tripolitza series rocks with Phyllite-Quartzite series rocks at its base. The formation of the Iouktas horst probably took place after the deposition of thick Middle Miocene sediments during the Late Miocene-Quaternary because of

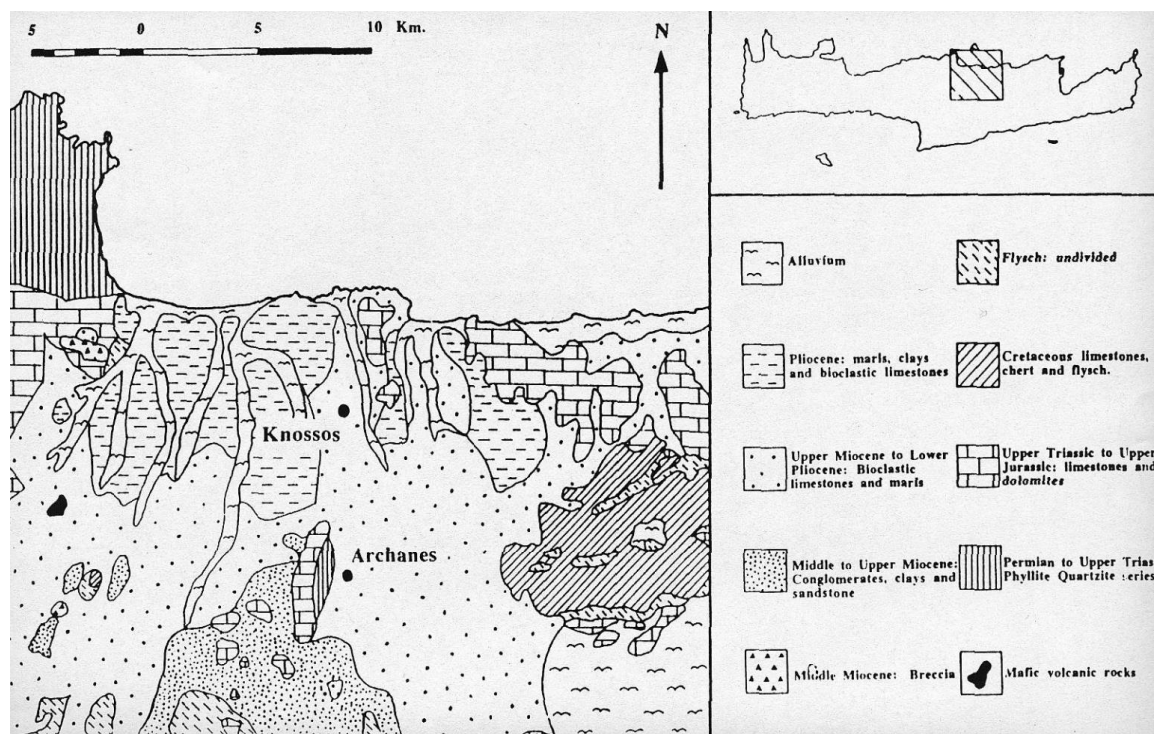


Figure III.1 Geological Map of North-Central Crete

absence of sedimentation (Papanikolaou & Nomikou 1998:235). The Iouktas horst divides the basin into two sub-basins, with the eastern half showing maximum subsidence. At the western and eastern margins there has been pronounced uplift¹⁹⁶. These large scale vertical neotectonic movements were caused by the activity of numerous faults, which have been divided into seven main neotectonic units (see Papanikolaou & Nomikou 1998:233-5). In the western sub-basin, at c.100-300m. the Neogene sediments (c.1000m thick) overlie the Ophiolite Nappe.

The lowest marine deposits (early Tortonian) correspond to the Tefeli group and exhibit a generally similar sedimentation history to the Rethymnon area (Meulenkamp 1971:8). Quite a complex Late Miocene-Early Pliocene history of sedimentation is indicated which included two periods of erosion:

- (i) Subaerial erosion: after deposition gypsum conglomerates and relative uplift produce a rugged topography of gypsum conglomerates, Upper Miocene carbonates and Pre-Neogene rocks. This was flooded by the Pliocene marine transgression and white calcareous muds accumulated over almost entire area.
- (ii) Shortly after, strong vertical movements along existing fracture systems rejuvenated relief. This led to the removal of the lowermost Pliocene marls from rising blocks and their redeposition with elements of older pre-Neogene strata and rocks in deeper parts of the sub-basin.

The Neogene sequence of the south-west part of the Herakleion basin has been studied, resulting in the following stratigraphic sequence (Meulenkamp et al. 1977:143-6).

(1) Ambezoulos Formation (Tortonian)

This corresponds to the Tefeli group and consists of irregular alternations of conglomerates sands and clays deposited in fluvio-lacustrine, brackish and shallow marine environments

¹⁹⁶ The highest rates of uplift occur in the western half of the Herakleion basin: cf. the presence of rocks of the Plattenkalk series at high altitudes (c.1400m).

(2) Varvara Formation (Messinian)

This corresponds to the Vrysses group and consists primarily of bioclastic limestones or laminated-homogenous marl sequences in graben-like depressions. In some places there are evaporites. The uppermost layer (c.50m) near Psalidha-Ploutis reflects an abrupt return to terrigenous-clastic supply and consists of sands, clays and siltstones with irregular gypsum bodies. This layer may correspond to the Hellenikon group. These sands, siltstones and clays show rapid repeated alternations of barren horizons (monotypic or oligotypic, especially *Cyprideis*) and beds with rich and diversified associations of ostracods and foraminifera, which contain *Globorotalia conomiozea*. Some coarse beds contain mollusc fragments; delicate pelecypode shells in some of clayey intervals. These features of the Ploutis member are best explained by deposition in an environment subject to repeated and large fluctuations in marine ingression, as might be the case in embayments separated from the open sea.

(3) Pliocene

No Pliocene beds are found on top of the Varvara formation in the Psalidha-Ploutis area, but nearby white fossiliferous Pliocene marls are in sharp contact with the underlying Varvara formation.

A similar sequence obtains in the northern part of the Herakleion basin:

(1) Lower Varvara Formation

This resembles that from south-west and corresponds to the Vrysses group. Primary gypsum occurrences are concentrated in a strip next to Iouktas (e.g. Gypsades Hill, Knossos).

(2) Laminated gypsum is unconformably overlain by 40-50m of gypsum conglomerates, which may contain older Neogene rocks. This would correspond to the Hellenikon group.

(3) 'Marl breccia'

This comprises a poorly-sorted mixture of components of older Neogene strata, pre-Neogene rocks and in some places marly limestones floating in a marly matrix. These marly limestones are lowermost Pliocene in date and correspond to rocks of the Finikia group. In all places this breccia is in sharp erosional contact with bioclastic limestones and/or laminated-homogenous marl sequences or gypsum conglomerates (Varvara Formation). West of Mount Iouktas marl breccias are deposited along and between culminations of gypsum conglomerates, which suggests that these culminations must have been formed prior to the deposition of Pliocene mass-flow deposits.

(4) White marly limestones (Lower Pliocene)

These are composed of marl breccias, which are succeeded upwards by, and partly interfinger with, white marly limestones and marls, which locally (west of Iouktas) are found immediately above gypsum conglomerate culminations.

(5) Grey silty clays

There is a change from calcareous mud to clastic sedimentation in the later Early Pliocene. This change should be connected with a major tectonic phase that affected whole island. In the east and south parts of the Herakleion basin this is seen in a rapid transition from open marine marls to coarse non-marine conglomerates.

III.4 The Geology of Knossos and Environs

The majority of the immediate area around Knossos (<5km) is comprised of Neogene limestones (often bioclastic), marls and clays (see Figure III.2; Creutzberg 1977). The main geological formation is of Pliocene age and consists of soft white marl, locally known as *kouskouras* (Roberts 1979:232). Related deposits of gypsum comprise the hill of Gypsades to the south (Roberts 1979:232). These Pliocene sediments are laid down unconformably on Cretaceous limestone, which is now exposed on Ailias and also further south on Mount Iouktas (Roberts 1979:232). This *kouskouras* weathers to form a light

brown *rendzina*, very suitable for fruit crops; while on hard Cretaceous limestone *terra rossa* soils have developed, although often these are removed by erosion on steeper slopes, such as on Ailias (Roberts 1979:233-4).

The coarser EBA and MBA pottery of the Knossos area, when subjected to petrographic analysis, proved to be dominated by low grade schists and phyllites as well as a variety of igneous dyke rocks, which appear to be more or less altered (Riley 1983:289; Day 1988:504-6; Wilson & Day 1994:54; 1999:37-9). The phyllites and schists would appear to originate in low grade metamorphic deposits, which probably link to the Phyllite-Quartzite series of Crete. The closest source for these would appear to be the eastern side of Iouktas, which lies approximately 5km to the south of Knossos (Creutzberg 1977). More distant sources lie at the eastern and western edges of the Herakleion basin. In addition phyllite-quartzite rocks have been noted in flysch deposits to the north-east of Iouktas (Day 1988:504, n.3; Wilson & Day 1994:54; 1999:38). The igneous and altered igneous rocks (dolerite, altered basalt, serpentinite) have been taken to have an origin within the ophiolite series of Central Crete (Wilson & Day 1999:37). Rocks of the ophiolite series outcrops near Galeni and Roukani to the south of mount Iouktas and further west in the foothills of mount Ida (Creutzberg 1977). It may be significant that both Bronze Age ceramics and modern roof tiles from the site of Kanli Kastelli, which lies in the region of Galeni and Roukani, frequently contain altered igneous rocks (Day 1988:505). The Galeni source does not, however, appear to contain serpentinite and the closest source for this would appear to be at the western edge of the Herakleion basin (Gonies) (Riley 1983:289-90).

APPENDIX IV.

THE NEOLITHIC AND CHALCOLITHIC SEQUENCE IN SOUTH-WESTERN ANATOLIA

There are a host of problems involved in attempting to relate the Cretan Neolithic sequence to that of South-western Anatolia. First and foremost is the problem of establishing a coherent sequence for different sites in this large and, for the Neolithic and Chalcolithic, relatively under-explored region:

"Our knowledge of the Neolithic and Chalcolithic periods of south-western Anatolia is... derived from only a few, widely scattered sites and is still incomplete. It is based mainly on pottery, as there is little other evidence available. We do have a basic sequence for the south-west and, in general terms, it is no doubt correct, although its validity for any one part of the area has yet to be shown. Not one complete local sequence, verified by stratigraphy, has been produced, nor is there information available to construct one" (Eslick 1992:xvii).

A basic Neolithic sequence for south-western Anatolia can be reconstructed using a series of excavated site sequences (see Figure IV.1).

Early Neolithic¹⁹⁷ (EN) (c.7000?-6400BC)

Secure EN deposits are extremely rare in Southwest Anatolia. The earliest ceramic phase at Kuruçay (level 13) is unparalleled in the LN material excavated at Hacilar by Mellaart, although some recent soundings at Hacilar recovered similar pottery pressed into the surface of red plastered floors, a type of floor which previously had only been found in the latest aceramic layers (I-II) (Duru 1994:103; Mellaart 1970a:4). The absence of pottery from the latest aceramic layers excavated at Hacilar by Mellaart, would seem to indicate that these new layers date after level I, while Duru argues that level 13 ceramic technology is much simpler and must be earlier than Hacilar IX (Duru 1994:103, 114-5). Thus this type of pottery first appeared after Aceramic Hacilar I, but before LN Hacilar IX, at a time when red plastered floors were

¹⁹⁷ Both Eslick and Duru describe an Early Neolithic ceramic phase for the south-west, however radiocarbon dates from Kuruçay appear to indicate that this phase should not be dated earlier than the mid seventh millennium. This places it contemporary with the first half of the Late Neolithic as defined in Joukowsky (1996:32).

still in use. Duru would like to date this material to around 7100-6900BC (see footnote 3), however this earliest material does not find parallels in the early material from Çatal Höyük (Duru 1994) and radiocarbon dates would place level 13 closer to the middle of the seventh millennium BC, which together suggest a late EN date.

The only other EN pottery in the south-west is that from the Beldibi Cave (level B), which was found in association with a 'Mesolithic' tool industry (Bostanci 1959). This pottery was compared by Mellaart to the earliest pottery from Catal Höyük (Yakar 1991:123), which makes an early EN date likely (cf. also Eslick 1992:xvii-xviii).

Ceramic Phases	Site Sequence	Absolute Dates ¹⁹⁸
Aceramic	Hacilar I-VII	= eighth millennium BC
Early Neolithic	Beldibi B Kuruçay 13	= c.7000?BC ¹⁹⁹ = mid seventh millennium ²⁰⁰
Late Neolithic	Hacilar IX-VI Kuruçay 12-11	= c.6400 - 6000BC = c.6200 - 5800BC
Early Chalcolithic	Hacilar V-I Kuruçay 10-7	= c.6000 - 5500BC = c.5800 - 5600/5500BC ²⁰¹
'Middle Chalcolithic'	Elmalı Kızılbey/ Lower Bağbasi Emporio X-VIII	= c.5500? - 5000?BC
Late Chalcolithic	Bagbasi Aphrodisias VIIIB-VII Emporio VIII-VI Beycesultan XL-XX Kuruçay 6a-3	= c.5000 - 4500BC = c.5000 - 4500BC = c.5000 - 4500BC = c.4500 - 3500BC = c.3700 - 3200BC

Figure IV.1 Ceramic phases, site sequences and absolute Dates for South-western Anatolian Neolithic and Chalcolithic (Based on data from Eslick 1980, Eslick 1992:xvii-xviii, Duru 1994:103-5, 114-5, Duru 1996:143-4)

¹⁹⁸ All radiocarbon dates, apart from those for Kuruçay, were calibrated using the OxCal 3 calibration programme. Kuruçay dates are from Duru (1994:114-5). Note also that absolute dates for the 'Middle Chalcolithic' rely on synchronisms with Aegean sequences outside Anatolia which have radiocarbon dates.

¹⁹⁹ There are, unfortunately, no radiocarbon dates from Beldibi. The ceramics from level B were considered by Mellaart to be comparable to those found in the earliest levels at Çatal Höyük (Yakar 1991:123). This synchronism is accepted here.

²⁰⁰ Although the radiocarbon dates for Kuruçay 13 overlap with those for Hacilar IX, Duru argues that the Kuruçay 13 ceramics have no parallels in Hacilar IX, despite the proximity of the sites (Duru 1994:114). Rather, their closest parallels are in pottery excavated by Duru at Hacilar, which was found pressed into 'aceramic' red plaster floors and is thus likely to be earlier than that Hacilar IX. He thus prefers to ignore the radiocarbon dates and to date Kuruçay 13 to the period 7100 - 6900BC. However, since on their own the radiocarbon dates for levels 13 to 11 otherwise present a coherent series, they are preferred here.

²⁰¹ Duru's absolute dating of Kuruçay 7 is based on a comparative synchronism with Hacilar I (Duru 1994:114). He considers Kuruçay 7 to end before Hacilar I, however he uses an uncalibrated rather than a calibrated date for Hacilar I. Here his argument for dating the end of level 7 slightly earlier than Hacilar I has been retained, but a calibrated date for Hacilar I has been used.

Late Neolithic (LN) (6400-5800BC)

As first noted by Mellaart (1970a:146), LN monochrome wares, similar to those from Hacilar VI have a wide distribution. This homogeneity has also been stressed by Eslick, who notes that LN pottery, similar pottery to that from Hacilar and the Elmalı Plain, has been found over a wide area from Karain near the south coast, throughout the Tefenni, Burdur and Dinar areas (1992:81). This leads her to hypothesise that during this phase villages kept up regular contacts with their neighbours (1992:82).

Hacilar

Hacilar (IX-VI) provides the defining LN sequence for the Southwest (Mellaart 1970). This sequence is now complemented by that recently excavated at Kuruçay Höyük, where the close similarities between level 11 and pottery from Hacilar IX-VI have allowed a close synchronisation (Duru 1994).

Erbaba

At Erbaba, to the east of Hacilar, the pottery of the upper Neolithic levels is also red or brown monochrome, in a fabric dominated by gastropod shells; shapes are holemouth jars with straight rims, flat bases and crescentic ledge handles or lugs (Eslick 1992:81-2; Yakar 1991:149).

Elmalı Plain

The earliest pottery from the Elmalı Plain, to the south-west of Hacilar, is Late Neolithic and similar to that of Hacilar IX-VI (see Eslick (1992:81) for details). The fabric is tempered and black cores (cf. 'sandwich effect') are said to be common. Vessels are coil-built with handles applied flat against the wall of the vessel. This pottery is characterised by the "extensive use of red slips and tubular lugs" (Eslick 1992:81). Hole-mouth jars have straight rather than curved upper walls. Flared rim bowls are also common, e.g. at Gökpınar and Akçay (Eslick 1992:67-8).

Aphrodisias

Late Neolithic pottery from level VIIIIC (Pekmez trench) at Aphrodisias is entirely monochrome, the majority being red (34%) and slipped (59%); vertical and flaring rim bowls were very common, large handles dominate over loop handles; flat bases account for 38% of the assemblage (Yakar 1991:177). This small assemblage exhibits close parallels with that of Hacilar IX-VI (Joukowsky 1986:431).

Aegean Coast/West-Central Anatolia

The first LN sites in this area were noted by French in a survey along the rivers Gediz and Büyük Menderes. Sites such as Ulucak (Kemalpasa), which lies not far from the Bay of Izmir, and Morali (Akhisar) have produced pottery with similar forms and finishes to that from Hacilar IX-VI (French 1965:18-20). Surveys by Meriç have added a further ten Neolithic sites along the floodplain of the Gediz river, along a natural route from the Aegean coast to the Burdur district of Central Anatolia (Meriç 1993:144). A number of sites are also known from the Aegean coast: Coskuntepe, and Edremit in the North, Bornova, Uluçek Höyük and Liman Tepe²⁰² in the Bay of Izmir, Ayio Gala Cave on Chios (lower cave), as well as from further south around Ephesus²⁰³ (Çukurici Höyük, Arvalya Höyük) and around Miletus²⁰⁴ (Killikitepe, near Yeniköy) (Meriç 1993 1997; Eslick 1992:81; Hood 1981:14-24, pl.4-5; Büyükkolancı 1997; Niemeier, Niemeier, Greaves & Raymond 1997; Tuncel 1997). Indeed when these surveys are combined it becomes clear that Central-West Anatolia was "as densely inhabited in the Late Neolithic Period as the region of Hacilar" (Meriç 1997).

Neolithic pottery from West-Central Anatolia, like that from the Southwest, is very homogeneous: all sherds are burnished on both surfaces and most are slipped with the colour varying from buff and orange to reddish brown (Meriç 1993:145). Generally 'grit' or organic temper are used, sometimes, as in sherds from Tepeköy, together (Meriç 1993:145). Most pottery from sites along the Gediz and Büyük Menderes has a red slipped and burnished finish with black or grey surfaces rare; fabrics are micaceous, organic tempered with around 75% exhibiting a black core 'sandwiched' between red

²⁰² Unstratified LN material has been noted in recent excavations at Liman Tepe (Sahoglu pers. comm.). In addition LN ceramics, comparable to Hacilar VI, are known from Barlaros and Aratepe (Tuncel 1997).

²⁰³ see Büyükkolancı 1997; Meriç 1997.

²⁰⁴ For Killikitepe see W. Voigtländer 'Frühe Funde von Killikitepe bei Milet', in *Istanbuler Mitteilungen* 33 (1983) 5-39; for near Yeniköy see Niemeier et al. 1997.

(French 1965:18; Meriç 1993:146). LN pottery from Ayio Gala (lower cave) is predominantly in micaceous fabrics²⁰⁵ (both gold and silver mica), with little evidence for organic temper and surfaces are predominantly red burnished, although some mottling occurs (Hood 1981:14).

Shapes are bowls or jars and are often thin-walled with 'S' curved profiles; a large number of vessels have vertically-placed tubular lugs, flattened rims and raised bases (French 1965:19; Meriç 1993:145, fig. 3.1-4; Tuncel 1997). There are also some rectangular vessels with short feet, one of which has deeply incised decoration²⁰⁶ (Meriç 1993:145, fig. 3.5). Particularly characteristic is the presence at all sites of pierced vertical tubular lugs. Most shapes, including the 'S' profile bowls and tubular lugs have parallels in Hacilar IX-VI, however raised bases appear to be characteristic only of this region (French 1965:19; Meriç 1993:145-6). The rectangular vessels are known from only three sites in Western Anatolia (Coskuntepe, Höyücek II and Çaltidere); such vessels are more common in the Marmara region than around Hacilar (Meriç 1993:145). Both French and Meriç argue that the points of similarity and difference between these sites and Hacilar do not suggest that connections between Hacilar and the west coast were close (French 1965:19). However Meriç still sees the links to Hacilar as closer than links to pottery from sites of the 'Fikirtepe culture' to the north and agrees with others who have argued that the 'Hacilar culture' has a coastal expansion further north from this region (Meriç 1993:145).

²⁰⁵ cf. predominantly micaceous fabrics at LN sites in the nearby Izmir region (Tuncel pers. comm.).

²⁰⁶ Incision itself is rare in the West-Central region (1 sherd). It may, however, have been more common further south: in a recent rescue excavation near Miletus a number of incised Late Neolithic(?) sherds were recovered (see Niemeier et al. 1997).

Early Chalcolithic (EC) (c.5800-5500BC)

In contrast to the homogeneity of LN ceramics, painted pottery, characteristic (20%) of the EC assemblage at Hacilar (IV-II) has a much narrower distribution and is known from only a handful of sites, one of which being Kuruçay (Mellaart 1970a:146; Duru 1994). Mellaart suggests that during EC most SW Anatolian sites continued to make monochrome wares like those also known at Hacilar in EC levels, whereas only a few 'centres', such as Hacilar, produced painted pottery, which may then have been 'exported' to other sites (Mellaart 1970a:146). However, pottery of the last EC level at Hacilar (level I) once again has a wide distribution, covering the greater part of the south-west and has been found as far west as the Ayio Gala cave on Chios (Mellaart 1970a:147). Here one might also note the few sherds of red-on-white painted pottery from Kos (Aspri Petra) and Rhodes (Kalythies), for which an EC date has been suggested (Joukowsky 1996:114-40; Broodbank 1999:33).

Eslick (1992:82) also notes a weakening in the former LN ceramic homogeneity at EC sites in the Elmalı Plain and points to an increase in local features. Some sites in the Dinar region and others on the Elmalı and Korkuteli plains, have produced a few sherds of painted pottery which share some similarities with Hacilar I pottery; however in each case there are also differences in shape and finish. Many of the EC and MC brown orange wares from sites on the Elmalı Plain are decorated with a "brush-applied streaky slip, most often coloured scarlet ranging to brown, and burnished" and at Akçay were found together with local variations of painted and incised wares (Joukowsky 1996:134). Eslick notes that sites in the Tefenni and Bucak areas have monochrome wares, which *can* be paralleled amongst monochrome wares at Hacilar, however these sites lack any of the corresponding Hacilar painted pottery. Thus, as Eslick rightly points out, this general absence of painted pottery in the south-west outside Hacilar rather undermines the suitability of terming material from this area Early Chalcolithic based on the presence of painted pottery (Eslick 1992:68).

As noted above, the general absence of tubular lugs from EC or later assemblages makes them one of the main diagnostic features for LN sites (cf. absence at EC Kuruçay, Hacilar and sites in the Elmalı Plain). However, there is growing evidence to suggest that tubular lugs may continue at least some sites along the

Anatolian-Aegean coast and on islands of the East Aegean. In the Ayio Gala lower cave horizontal tubular lugs are in the minority, however in lower levels of the upper cave, they are in the majority, occurring in a red-burnished ware (Hood 1981:34). The material from the lower deposit of the upper cave is generally dated to EC, thus indicating that horizontal tubular lugs are a feature of EC at this site. The small amounts of horizontal lugs in the lower cave join other small amounts of EC material and Cretan ENIb material (see Chapter 7, Appendix I) in suggesting that this deposit, although largely dating to LN, also contains some EC material. Red-burnished horizontal lugs have also been found at the site of Baraklı, south of Izmir. These are survey material and thus without stratigraphic position, but it has been suggested that these are EC in date (Meriç 1997). If so then this would confirm that in the central east Aegean and coastal west-central Anatolia *horizontally-pierced* tubular lugs are an EC feature. It is also worth noting that this makes them broadly contemporary with the similar MN Peloponnesian practice of using horizontally-pierced tubular lugs.

Recently French has noted (1997) that the site of Galhisar, a rock shelter which lies between the Menderes and Çesme regions, has an EC sequence which may be compared to Hacilar I and thus this site might begin to fill the gap between Miletus and Antalya. However, this leaves the majority of EC (pre-Hacilar I) still poorly defined outside Hacilar. Indeed it is far from clear exactly where in this period certain key ceramic assemblages belong. It is thus perhaps here that the absence of a well-dated and well-stratified excavated sequence spanning the EN, 'MC' and LN phases is most keenly felt (cf. Duru 1996:141-2).

'Middle Chalcolithic' (MN) (5500?BC-5000BC)

After Hacilar I (EC) and before Beycesultan XL (LC) there is a gap, which is both ceramic stylistic and temporal. This cannot be simply a product of regionalism since there is LC Beycesultan-style pottery in the immediate area of Hacilar (e.g. Kuruçay) (Eslick 1980:5-8; Duru 1996:142-3). Absolute dates for the end of the EC (5500BC) and for sites of the LC (fifth-fourth millennium BC) suggest a long gap. However Duru has suggested that the early LC levels at Kuruçay should be pushed back

to as early as the mid fifth millennium BC (Duru 1996:144; cf. also Joukowsky 1986:431-2, 471-3).

Eslick (1980) has attempted to define a 'Middle Chalcolithic' phase using material from two sites in the Elmalı Plain (Kizilbel & Lower Bagbasi). The pottery itself (see Eslick 1980:8-9) has a coarse 'grit-tempered' fabric, which also contains some organic material, and which usually has a black core. Vessels are coil-built and given a well-smoothed surface finish whose colour varies from red to black. Thick flat bases are common; handles are usually strap and applied flat to a scored area of the vessel. Hole mouth pots and flattened rims predominate. Decoration is rare: single knobs on strap handles, rare incision and some red-painted sherds.

Although the Kizilbel material is unstratified, the Lower Bagbasi assemblage comes from a layer stratified below material closely related to Beycesultan LC 2-3, thus providing a lower limit (LC) to pottery from the Kizilbel and Lower Bagbasi Group (Eslick 1980:8-9). Eslick considers that diagnostic LN and EC from neighbouring sites and the well-defined LC material from excavated sites of Karaburun, Boztepe and Bagbasi provide upper and lower limits for this group. Citing the prevalence of hole-mouth shapes, flat-rimmed curved bowls as well as the flat application of handles (contrast LC plug-attachment), Eslick, considers this material to be closer to the Late Neolithic/Early Chalcolithic than to Late Chalcolithic (Eslick 1980:9-10; 1992:69).

This definition of a Middle Chalcolithic phase has been criticised because the material upon which it is based retains a certain ambiguity (see Duru 1996:143). However, the stratigraphic position of the Kizilbel/Lower Bagbasi sequence is fixed before the beginning of LC and moreover the character of this sequence is only ambiguous when viewed purely in Anatolian terms. Unlike previous Anatolian ceramic phases the closest parallels for this material are *not* with sites further east such as Hacilar (cf. absence of comparable strap handles), but with assemblages further west, from islands of the Aegean, above all levels X-IX at Emporio (incurved shapes, high-sided pans, piercings below the rim, strap handles with knobs placed on bowl rims or sides of jars, incision) (Eslick 1980:10-12). Since Kumtepe IB rolled rim bowls in level VII at Emporio date this level to LC and the pattern burnishing of level VIII, comparable to that of Besikatepe, dates to early in LC, Eslick argues that Emporio X-IX must date before LC (Eslick 1980:11). Although lacking radiocarbon dates Emporio X-IX and

VIII can be dated through parallels with Aegean assemblages which have absolute dates (see Appendix I on Saliagos, Knossos). These suggest a date for Emporio X-IX in the last quarter of the sixth millennium and for Emporio VIII in the first half of the fifth millennium. This agrees well with the date range of the EC-LC gap. These synchronisms therefore suggest an end for MC and a beginning for LC around 5000BC.

APPENDIX V

PETROGRAPHIC DESCRIPTIONS

(1a) Calcareous, Rare Quartz, Fine-Grained Sparite.

Samples: 97/4, 97/7, 97/22, 97/49, 97/51, 97/62, 97/107, 97/118, 98/1

Microstructure

Very few to rare macro to meso planar voids, very few to rare mega to meso vughs. Voids and inclusions generally exhibit local long-axis parallel orientation; the angle of this orientation may vary from parallel to perpendicular to vessel margins, even within a single section (e.g. 97/22). Darkened areas around some voids may indicate the incomplete combustion of organics within the clay body. Some voids in samples 97/49, 97/107 and 97/118 have a calcite lining. Inclusions are close or single-spaced.

Groundmass

The fabric is homogenous: colour varies from yellow/orange to brown (PPL, x40) and yellow/orange to yellow/brown (XP, x40). The micromass varies in optical activity from low (e.g. 97/118) to high (e.g. 97/107). B-fabric is medium to thick crystallitic/porostriated (e.g. 97/107).

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.5mm to 0.2mm.

Fine fraction = 0.2mm or less.

Coarse Fraction:

Predominant to dominant : **sparite**, a-sa, equant to elongate. Grain size varies from 0.05 to 0.35, mode = 0.1mm. Size = 2.5mm to 0.2mm

Rare to absent: **monocrystalline calcite**, a-sa, equant. Probably derives from limestone (sparite). Size = 0.9 to 0.2mm

Rare (97/107) to absent: **fossilised shell frags.**, sa-sr, elongate. Size = 1.5 to 0.25mm

Rare to very rare: **micrite with iron concentrations**, sr-r, equant; sometimes contains isolated clasts of quartz (max. 0.15mm) or foraminifera. Size = 0.85mm to 0.2mm

Very rare (97/49) to absent: **ostracods**. Size = 0.25mm.

Very rare (97/107) to absent: **plagioclase feldspar**, r, elongate. Size = 0.3 to 0.2mm.

Rare (97/7, 97/62) to absent: **monocrystalline quartz**, sa-r, equant. Size = 0.4 to 0.2mm.

Very rare to absent: **polycrystalline quartz**, sa-r, equant; sometimes sutured contacts. Size = 0.5 to 0.2mm.

Very rare (97/49) to absent: **biotite schist**, sa-r, equant. Size = 0.5 to 0.2mm.

Very rare to absent: **chert**, r, equant to elongate. Size = 0.65 to 0.2mm.

Very rare to absent: **opaques**, r, equant; sometimes contain tiny (0.02mm) quartz or plagioclase. Size = 0.5mm to 0.2mm

Fine Fraction:

Predominant to dominant: **monocrystalline calcite**.

Common: **ostracods, foraminifera**.

Very few to very rare: **quartz**.

Very few to very rare: **iron oxide**.

Rare to absent: **epidote**.

Rare to absent: **clinozoisite**

Very rare: **mica**

Very rare to absent: **chert**

Very rare to absent: **plagioclase feldspar**.

Very rare (97/49) to absent: **biotite schist**

Very rare to absent: **brown chert**.

Textural Concentration Features (TCF)

Rare to very rare: **clay pellets**, r, merging to clear boundaries, equant to elongate, usually diffuse to merging; colour varies from yellow/orange (PPL, XP) (x40) to red (PPL, XP) (x40). Size = 1.1mm to 0.1mm, mode = 0.25mm. These clay pellets appear to have two different compositions:

(1) yellow to brown (XP) (x40), which are almost entirely free of inclusions except for some calcite and very rare to absent fine quartz, mica, plagioclase feldspar (see 97/22). These clay pellets lack foraminifera and epidote.

(2) yellow to brown (XP) (x40), containing ostracods, foraminifera, epidote, very rare quartz, alkali and plagioclase feldspar, calcite, opaques (see 97/49, 97/107).

Very rare to absent: **clay striation**, oriented parallel to vessel margins; contains calcite, rare quartz. Colour is yellow (PPL, XP) (x40). Size = 3.5mm long, 0.2-0.1mm thick.

Very rare to absent: **red streaks**, very thin, Size = 0.25mm long.

Amorphous Concentration Features (ACF)

Very few to very rare: **unburnt/partially burnt organics**. N.B. all samples contain examples of unburnt organic material.

Comments

This fabric is characterised by a buff-firing, calcareous clay, which is dominated by large limestone (sparite) non-plastics and which also contains monocrystalline calcite, ostracods and foraminifera, micrite with iron concentrations and rare quartz, mica, chert and biotite schist. The presence of clay pellets of two different types may suggest that this fabric is a mix of two different calcareous clays (see also Fabric 1b): one containing ostracods and epidote and one which is almost entirely clay, but which in view of the very rare presence of mica and quartz might also be the source of the very rare rounded biotite schists which occur in some samples (e.g. 97/49). Neither of these, however, contain the larger rounded quartz grains found in some samples (e.g. 97/62, 97/118) and the most likely origin for these is as clasts within the rounded micrite with iron concentrations, which are a feature of Fabrics 1a-i. The rare occurrence of thin red streaks (e.g. 97/22) may be explained as resulting from iron migration; this iron is most likely to originate from the alteration of micrite with iron concentrations (see below on Fabric 1c). The third component of this fabric is sparite, which does not appear in either type

of clay pellet, is angular and poorly sorted. In view of these features it seems likely that sparite was added to the clay mix as temper.

The closest fabrics to this are Fabrics 1b and 1c (see below), which differ only texturally from Fabric 1a. Fabric 1a also shares similarities in groundmass with Fabrics 1d (calcareous, biomicrite), 1e (calcareous, coarse sparite, well-formed monocrystalline calcite) and 1f (calcareous, crushed coarse-grained sparite). These fabrics are also tempered with forms of calcite. What distinguishes Fabric 1a from all others is the dominant presence of fine-grained sparite. Although sparite is a feature of Fabrics 1d, 1e and especially 1f and 2a, it is never as frequent as the sparite in Fabric 1a (or Fabrics 1b, 1c) and moreover it usually more coarse-grained. Fine-grained sparite is also a dominant feature of Fabric 7, however this fabric has a quite different groundmass (doleritic rocks). Fabrics 1a (and Fabrics 1b and 1c) also differ from Fabrics 1d, 1e and 1i due to the complete absence of grog (see below on Fabrics 1d, 1e and 1i).

Consideration of void, inclusion and b-fabric orientation in conjunction with study using a lambda plate allowed the identification of coil-building in sample 97/107. The evidence for forming in other samples is less clear, although nothing was observed which would be inconsistent with the use of coil building. Some samples exhibit slip layers, which appear to be calcareous (e.g. 97/107). Other slip layers appear to be non-calcareous (cf. 97/7, 97/22, 97/51, 97/62, 98/1); this has been confirmed using SEM (see Chapter 8). These non-calcareous slips correspond to the presence of dark brown polished surfaces and suggests that these slips were deliberately used to create a dark finish on an otherwise generally buff-firing fabric. Others lack evidence for slip layers, but have areas near their surface which exhibit slightly different optical activity (e.g. 97/49, 97/118): these seems to be consistent with compaction due to burnishing. This is consistent with macroscopic study of the surfaces of such samples.

The micromass of samples in Fabric 1a exhibits considerable variability in optical activity, varying from low (e.g. 97/118) to high (e.g. 97/107) and colour, from brown-yellow (97/49, 98/1) to yellow. This variation suggests that vessels were fired to a variety of temperatures and were exposed to an atmosphere which varied between oxidising and reducing. All samples contain some traces of unburnt organic material (e.g. 97/4, 97/7, 97/22, 98/1, etc.). The presence of unburnt and partially burnt organic material might be an indication that the overall duration of firing was short (see Chapter 5). All these features taken together would not be inconsistent with fast firing in an open environment (pit, bonfire) (see Chapter 10).

Examples of Fabric 1a become rare to absent from stratum V-IV (cf. 97/107, 97/118; see also Fabric 1c). Macroscopic study of fabric indicates that during this period Fabric 1b is most common, while Fabric 1a or Fabric 1c (coarser versions of Fabric 1b) seem to occur most often in thicker-walled buff burnished samples (cf. also 97/118 and in Fabric 1c 97/119, 97/120).

Fabric 1a contains no features which are sufficiently distinctive to allow a confident assessment of provenance. All elements are consistent with a sedimentary environment consisting of calcareous marls and limestone, examples of which can be found all around Crete, including Knossos. In view,

however, of the high frequency with which this fabric occurs at Knossos and its compatibility with the local geological environment (limestone, marls; see Appendix III), it seems most likely that this fabric is local to Knossos.

(1b) Calcareous, Rare Quartz, Crushed Fine-Grained Sparite.

Samples: 97/53, 97/55, 97/81, 97/83, 97/116, 97/117, 97/130, 97/135, 97/136, 98/71, 98/97

Microstructure

Very few to rare macro to meso planar voids, very few to rare mega to meso vughs. Voids and inclusions generally exhibit local long-axis parallel orientation; the angle of this orientation may vary from parallel to perpendicular to vessel margins, even within the same section (e.g. 97/130). Darkened areas around some voids may indicate the incomplete combustion of organics within the clay body (cf. 97/81, 97/130). Some voids have calcite linings (e.g. 97/116, 97/117, 97/136). Inclusions are close or single spaced.

Groundmass

The fabric is homogenous. Colour varies from yellow or orange to yellow-brown or orange-red (PPL, XP) (x40). The micromass varies in optical activity from low to high. B-fabric is medium to thin crystallitic/porostriated.

Inclusions

c:f:v_{10µm} c.30:67:3

Coarse fraction = 3.75mm to 0.25mm.

Fine fraction = 0.25mm or less.

Coarse Fraction:

Frequent to absent: **sparite**, a-sa, equant to elongate. Grain size varies from 0.05 to 0.35, mode = 0.1mm. Size = 1.0mm to 0.25mm, mode = 0.5mm.

Rare to very rare: **monocrystalline calcite (sparite)**, a-sa, equant. Size = 0.45 to 0.25mm.

Rare (97/130) to absent: **shell frags.**, a-sa, elongate. Size = 0.8mm.

Very rare (97/117) to absent: **ostracods**. Size = 0.25mm.

Few to rare: **micrite with iron concentrations**, sr, equant; fine grained with occasional coarser grained areas which resemble very fine sparite; often contains isolated quartz, feldspar, foraminifera, opaques; often large in size (e.g. 3.25mm (97/135), 2.75mm (97/117)). One example (0.8mm) in sample 97/53 contains grains of monocrystalline calcite, foraminifera and monocrystalline quartz. Size = 3.25 to 0.25mm.

Rare to absent: **monocrystalline quartz**, sr-r, equant. Size = 0.5mm to 0.25mm.

Rare to absent: **polycrystalline quartz**, sr-r, equant to elongate; sometimes sutured contacts, sometimes in association with mica (e.g. 98/71). Size = 0.45 to 0.25mm.

Rare (e.g. 98/71) to absent: **biotite schist**, sr-r, equant to elongate. Size = 0.40 to 0.25mm.

Very rare (97/55) to absent: fine-grained **chert**, sr-r, equant. Size = 0.35mm to 0.25mm.

Very rare (97/53) to absent: **iron oxide**, sr, elongate, contains quartz, mica, micrite. Size = 0.5mm

Fine Fraction:

Predominant to dominant: **fine-grained monocrystalline calcite (sparite)**.

Few to rare: **foraminifera, ostracods**.

Very few to rare: **monocrystalline quartz**.

Very rare: **polycrystalline quartz**, sometimes contains mica.

Very few to very rare: **opaques**, iron oxide(?).

Rare: **epidote**.

Rare to absent: **clinozoisite**

Rare to very rare: **chert**; sometimes contains larger clasts of quartz and feldspar.

Very rare: **plagioclase feldspar, alkali feldspar**.

Rare (e.g. 97/130): **mica**.

Textural Concentration Features (Tcf)

Very few to very rare: **clay pellets**, r, equant to elongate, usually clear to merging. Size = 3.75mm to 0.1mm. These clay pellets seems to have two distinct compositions:

(1) yellow/orange (PPL, XP) (x40) to dark brown (PPL, XP) (x40); contain rare fine quartz, alkali and plagioclase feldspar, calcite, mica, opaques, shell, epidote (cf. 97/117, 97/130).

(2) yellow/orange (PPL, XP) (x40) to brown (PPL, XP) (x40); very fine, rich in ostracods, with rare calcite and very rare to absent fine quartz; example in 97/136 contains rounded altered volcanic (cf. 97/136).

Clay layer, (c.0.5mm to 0.9mm) on exterior surface of sample 97/130, merging boundaries with rest of sample, contains monocrystalline calcite, rare quartz, yellow-brown in colour, probably same composition as body. Distinguishable by different texture and parallel orientation of b-fabric and planar voids (cf. also 97/53, 97/81, 97/130). Sample 97/130 also has a non-calcareous slip layer running over this clay layer. In sample 97/83 the added layer is red, quartz-rich and seemingly non-calcareous; this layer also has a slip layer running over it.

Amorphous Concentration Features (Acf)

Very few to very rare: **unburnt/partially burnt organics**.

Rare (e.g. 97/117) to absent: **thin red streaks**; these red streaks are most likely to have resulted from the migration of iron during firing (see 97/65 Fabric 1c).

Comment

As with Fabric 1a this fabric is characterised by a buff-firing, calcareous clay groundmass, which contains ostracods and foraminifera, micrite with iron concentrations and rare quartz, mica, chert and more rarely biotite schist. Fabric 1b, like Fabric 1a, also appears to result from the mixing of a calcareous clay rich in ostracods and a fine clay, which contains of rare mica and quartz. The latter might also be the source of the quartz-biotite schist (see above on Fabric 1a). The rare occurrence of thin red streaks (e.g. 97/117) may be explained as resulting from the migration of iron during firing from the iron-rich micrite (see below on

Fabric 1c, 97/65). The third component of this fabric is sparite, which does not appear in either type of clay pellet, is angular and poorly sorted. In view of these features it seems likely that sparite was added to the clay mix as temper. This clay groundmass is dominated by crushed calcite temper, which seems to derive from a fine-grained sparite, identical to that found in Fabric 1a. In this way Fabrics 1a, 1b and 1c differ only in terms of texture, average size of large non-plastics and packing. Fabric 1b may be characterised thus as a finer version of Fabric 1a. Fabric 1b first appears in quantity late in ENIb (stratum VI/V) and continues into ENII and is used for burnished (e.g. 98/71) or polished vessels (e.g. 97/117). Although a single stratigraphically earlier example of this fabric is known from stratum VIII (97/55), this more closely resembles later examples and comes from a context which contains other intrusive sherds.

Fabric 1b also has a very similar groundmass to Fabrics 1d-i; in addition to high degree of visual similarity, groundmasses in Fabrics 1a-i all contain epidote. Also a clay pellet in 97/136 contains a rounded altered volcanic rock fragment which links to similarly rare examples of rounded altered volcanic rocks in Fabric 1d (e.g. 97/84). However, Fabrics 1d-i differ significantly in the form of the dominant limestone present and/or in the presence of other large non-plastics absent from Fabrics 1a-c (grog, siltstones). In texture and packing Fabric 1b shares some similarity with Fabric 1e (crushed euhedral calcite), 1f (crushed coarse-grained sparite) and 2c (crushed sparite), these however differ in the form or size of the crushed calcite.

Consideration of void, inclusion and b-fabric orientation in conjunction with study using a lambda plate allowed the identification of coil-building in samples 97/130 and 98/97. The evidence for forming in other samples is less clear, although nothing was observed which would be inconsistent with the use of coil building. Several samples suggest that there was a secondary forming stage, which involved the addition of a thin clay layer to the surface of the vessel, which probably served to create a very smooth surface prior to polishing, since all samples, which evidence this added layer are polished. Added layers in samples 97/53, 97/81 and 97/130 resemble Fabric 1b in composition, while the layer in sample 97/83 might derive from a different clay, which is more red-firing and quartz-rich.

In many cases slip layers can be seen running over these added layers (97/83, 97/130). Some samples exhibit slip layers, which appear to be calcareous (e.g. 97/117). Other slip layers appear to be non-calcareous (cf. 97/83, 97/116, 97/130); this has been confirmed using SEM (see Chapter 8). These non-calcareous slips correspond to the presence of dark brown polished surfaces and suggests that these slips were deliberately used to create a dark finish on an otherwise generally buff-firing fabric. Other samples lack evidence for slip layers, but have areas near their surface which exhibit slightly different optical activity (e.g. 97/117, 98/71): these seems to be consistent with compaction due to burnishing (98/71) or polishing. This is consistent with macroscopic study of the surfaces of these samples.

Samples in Fabric 1b vary in optical activity from low (97/53, 97/116) to high (98/71, 98/97). Colour varies considerably from yellow or yellow-orange through red to brown. In several samples there is partially or unburnt organic material. All of these features are consistent with firing in an open environment, where temperature and atmosphere can vary more severely and where firing times are usually very short. As with Fabric 1a, 1b provides no clear indication as to the

location of the source of its raw materials. In view of its high frequency during stratum V-IV, its close relationship with Fabric 1a and its compatibility with the local geology, it seems most likely that Fabric 1b is local to Knossos.

(1c) Calcareous, Rare Quartz, Coarsely/Finely Crushed Fine-Grained Sparite

Samples: 97/65, 97/103, 97/119, 97/120

Comment

This fabric falls within the range of mineralogical and technological variation described above for Fabrics 1a and 1b (see on Fabrics 1a and 1b). Sample 97/65 is particularly noteworthy in the context of the thin red streaks noted above as a rare feature of some samples in Fabrics 1a-b: in sample 97/65 a micritic clot can be seen in close association with thin red striations, which suggests that these striations result from the migration of iron from iron concentrations in the micrite. Fabric 1c differs from Fabric 1a in having large quantities of crushed fine-grained sparite and from Fabric 1b in containing a small number of larger sparite inclusions. In this way Fabric 1c links groups 1a and 1b. Macroscopic study of fabric suggests that the large majority of sherds, which can be assigned to Fabrics 1a-c, fall discretely into Fabrics 1a and 1b. Fabric 1c thus represents those few samples which overlap between these two fabrics. Fabric 1c demonstrates a continuum of variability between Fabrics 1a and 1b and further emphasises that Fabrics 1a, 1b and 1c were produced from the same set of raw materials using slightly different techniques of paste preparation.

(1d) Calcareous, Rare Quartz, Biomicrite/Micrite +/- Grog

Samples: 97/84, 97/105, 97/109, 97/111, 97/115, 98/51, 98/53, 98/54, 98/70, 98/85, 98/98.

Microstructure

Few to very rare mega to meso planar voids, very few to very rare mega to meso vughs. Some voids contain a calcite lining or are completely in-filled with calcite (e.g. 97/111). Many voids are surrounded by darker patches, some contain opaque, possibly organic, material. Assessment of the orientation of voids and inclusions is difficult because inclusions and voids are predominantly equant; however, when inclusions and voids are more elongated, local long-axis parallel orientation can often be observed (e.g. 97/105, 97/109); the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Within single samples the groundmass is generally homogenous, however there is variation between samples. In some samples the groundmass is very fine and contains very few ostracods or foraminifera (e.g. 97/105, 98/54), others are richer in either ostracods (e.g. 97/84, 97/109, 97/111, 98/51, 98/53) or fine quartz (e.g. 98/85) or biotite schist (97/105). It is therefore the distinctive large non plastics

(bioclastic limestone), which serve best to define this group (see comment below). Colour varies from yellow (PPL, XP) (x40) to dark brown (PPL, XP) (x40). The micromass varies in optical activity from low (e.g. 97/105, 98/98) to high (e.g. 98/54). B-fabric is medium to thick granostriated/porostriated.

Inclusions

c:fv_{10µm} c.25:73:2 to 30:64:6

Coarse fraction = 3.5mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant to common: **bioclastic limestone** (biomicrite and oomicrite), a-sr, equant to elongate; contains shell frags, oolites, foraminifera (e.g. 98/54); bioclastic zones sometimes in association with areas which have a purely micritic or sparite structure (fine to medium-grained) (e.g. 97/111); sometimes contain chert (97/115), radiolaria(?) infilled with chalcedonic quartz (e.g. 97/111, 98/53). Size = 3.5 to 0.2mm., mode = c.0.6mm.

Rare (98/85) to absent: **micrite with iron-rich concentrations**, r, equant to elongate; sometimes contains discrete r quartz, calcite, foraminifera (cf. 97/105, 98/53), opaques, epidote; varies in colour from light to dark brown (XP) (x40). Size = 3.5 to 0.2mm.

Rare to absent: **foraminifera/shell frags.**; Size = 0.8mm to 0.2mm (cf. 97/115, 98/85).

Very rare to absent: **monocrystalline calcite**, sa, equant to elongate. Size = 0.4mm to 0.2mm.

Very few (97/105) to absent: **biotite schist**, sa-r, equant to elongate. Size = 1.25 to 0.2mm.

Rare to absent: **polycrystalline quartz**, sa-r, equant to elongate; often with sutured contacts; one example in 97/115 contains a radiolarian(?) infilled with chalcedonic quartz. Size = 1.0 to 0.2mm.

Rare to very rare: **monocrystalline quartz**, sa-r, equant. Size = 0.9 to 0.2mm., mode = c.0.2mm.

Very rare (97/115) to absent: **radiolarian test(?)**, equant; infilled with chalcedonic quartz. Size = 0.8mm.

Rare to absent: **chert**, a-r, equant; one example in sample 98/98 also contains mica (cf. also 97/115); sometimes contains large clasts of quartz (e.g. 98/53). Size = 1.1mm. to 0.2mm.

Rare to absent: **coarse siltstone/fine sandstone**, sa-sr, elongate; grains are well-sorted, unimodal, equant to elongate, sa-sr, no preferred orientation, size varies from 0.05 to 0.3mm, mode = 0.1mm; mostly quartz, feldspar, with some chert, mica, opaques and more rarely calcite (98/85); fabric is usually grain-supported with point-contacts; matrix, where visible, is orange-red (XP) (x40). Size = 1.3mm to 0.6mm (cf. 97/115, 98/85, 98/98).

Rare to very rare: **opaques**, sr, equant to elongate; sometimes contain isolated tiny quartz. Size = 1.1mm. to 0.2mm.

Very rare (97/84) to absent: **altered volcanic rock fragment**, r, equant; contains plagioclase laths in an opaque/glassy matrix. Size = 0.7mm.

Very rare to absent: **epidote**, r, equant. Size = 0.25mm to 0.2mm

Very rare (97/105) to absent: **alkali feldspar**, r, equant. Size = 0.3mm.

Fine Fraction

Frequent: **micrite**.

Common to few: **foraminifera**, **ostracods**.

Few to rare: **calcite**.

Few to rare: **quartz**.

Rare: **opaques**.

Rare: **chert**.

Rare: **biotite mica**.

Rare to absent: **plagioclase/alkali feldspar**.

Very rare to absent: **epidote**.

Very rare to absent: **clinozoisite**.

Very rare to absent: **radiolarian test(?)** infilled with chalcedonic quartz.

Textural Concentration Features (Tcf)

Rare to absent: **clay pellets**, r, equant, clear to merging boundaries, colour varies in XP (x40) from yellow-orange to dark brown; some pellets contain fine clay, very rare very fine quartz, mica, others are richer in ostracods. Size = 1.5 to 0.1mm, mode = c.2mm.

Very few (97/109) to absent: **grog**, a-sa, equant to elongate, sharp to merging boundaries. High to neutral optical density. Burnished surfaces are visible in sample 97/109. Fabric is yellow to brown in colour (XP) (x40). Examples in 97/109 contain fine quartz, biomicrite and calcite. Fabric resembles Fabric 1d. Size = 0.9 to 0.2mm.

Rare to absent: **clay layer**, (0.75mm to 0.2mm), visible on exterior surface of samples 97/111, 98/98 as differentially oriented b-fabric. Same composition as body. Possibly formed from extensive smoothing and compaction of clay body during burnishing.

Amorphous Concentration Features

Very few to very rare: **burnt/partially burnt organics**, sr-r, equant to elongate. Size = 0.6 to 0.1mm.

Comment

This fabric is characterised by a calcareous clay groundmass, which contains rare quartz, epidote and sometimes ostracods. This groundmass is generally homogenous within single samples, but may vary between samples: in some cases the groundmass is very fine and contains very few ostracods or foraminifera (e.g. 97/105, 98/54), others are richer in either ostracods (e.g. 97/84, 97/109, 97/111, 98/51, 98/53) or fine quartz (e.g. 98/85) or biotite schist (97/105). Those groundmasses which are richer in ostracods and contain rare rounded quartz and epidote closely resemble the groundmass in Fabrics 1a-c, others which lack ostracods closely resemble the non-fossiliferous clay component of Fabrics 1a-c. Fabrics 1a-c and Fabric 1d also both contain rare rounded quartz and micrite with iron concentrations. However, in general the groundmasses of Fabric 1d contain more chert, more sedimentary rocks and more altered volcanics than those of Fabrics 1a-c. One may also point to differences in form and finish between vessels in these fabrics (see Chapter 7). Nevertheless the significance of these links is confirmed by a join between two coils, one in Fabric 1b and one in Fabric 1d

within a single sherd (Fabric 3). What distinguishes Fabric 1d from all others is therefore not so much its groundmass, but its distinctive large non plastics (bioclastic limestone). Similar forms of bioclastic limestone occur in Fabrics 1e (97/50, 97/122), Fabrics 1g (97/133) and 1h (97/122), and 2b. However these groups are distinguished from Fabric 1d variously by the presence of large quantities of crushed euhedral calcite (Fabric 1e), euhedral calcite and coarse-grained sparite (Fabric 1g), sandstone (Fabric 1h) or by a different clay groundmass (Fabric 2b, red, fine quartz rich). These differences should not however be allowed to obscure the clear connections which also exist between Fabrics 1d-1i. For example the rare to absent siltstones in Fabric 1d link it to the rare siltstones/sandstones in Fabrics 1h (97/122) and 1i (98/68). Likewise the presence of grog in some samples of Fabric 1d (e.g. 97/109) links it to grog-tempered Fabrics 1i and 2e.

An unusual texture in sample 97/105, composed of swirls and streaks in brown and yellow may indicate that the groundmass of Fabric 1d was, at least on some occasions created by the mixing of two clays. However, the variability observed in groundmass would seem to suggest that there was some variability in this mixing process and perhaps that clay mixes were not always used.

Consideration of void, inclusion and b-fabric orientation in conjunction with study using a lambda plate did not identify clear examples of coil joins, however such structural discontinuities that were observed would be consistent with coil forming. The regular presence of large planar voids may indicate that cracking, due either to poorly joined coils or to shrinkage was relatively common. Vessels in Fabric 1d seem to have received a variety of surface treatments: a non-calcareous slip layer is visible in sample 97/111, while a differentially birefringent surface layer in sample 98/98 is suggestive of compaction of an unslipped surface due to burnishing. As with Fabrics 1a-c the use of a non-calcareous slip layer coincides with the creation of dark (red-dark brown) polished surfaces. In this way Fabric 1d is linked by a shared finishing technique to Fabrics 1a-c and 1e-f.

Samples exhibit different degrees of optical activity from high (e.g. 97/109) to low (e.g. 98/98). Colour (XP, x40) also varies from yellow (e.g. 98/70) to dark brown (e.g. 98/53). This would seem to suggest that vessels in Fabric 1d were fired to a variety of temperatures and were exposed to an atmosphere which varied between oxidising and reducing. The frequent presence of burnt, partially burnt and complete organics may indicate that the overall duration of firing was short. Although none of these features alone indicate the type of environment the occurrence together would not be inconsistent with fast-firing in an open environment.

Fabric 1d, like related Fabrics 1a-c, 1e-i contains no features which are sufficiently distinctive to allow a confident assessment of provenance. However, all elements are consistent with a sedimentary environment consisting of calcareous marls and limestone, examples of which can be found all around Crete, including Knossos. In view, however, of the high frequency with which this fabric occurs at Knossos (especially stratum V) and its compatibility with the local geological environment (bioclastic limestone, marl; see Appendix III), it seems most likely that this fabric is local to Knossos.

(1e) Calcareous, Rare Quartz, Crushed Euhedral Calcite, Biomicrite.

Samples: 97/50, 97/121, 97/126, 97/127, 97/132, 98/79, 98/82, 98/86, 98/95

Microstructure

Very few to very rare mega to meso planar voids, very few to rare mega to meso vughs. Voids generally exhibit local long-axis parallel orientation with inclusions, however this relationship may be at any angle with the vessel margins and different local arrangements may exist within a single section (e.g. 97/126). Some voids are surrounded by darker patches, some contain opaque, possibly organic material. Inclusions are close to single-spaced.

Groundmass

Generally homogenous within single samples, but may vary between samples from samples which contain only rare quartz (98/82) to those which are rich in quartz (98/79). Colour varies from yellow-orange or orange (PPL) (x40) and yellow-brown (XP) to dark brown in (PPL, XP) (x40); sometimes some colour variation between core and margins ('sandwich effect') (e.g. 98/82). Optical activity varies from low (e.g. 97/132) to high (e.g. 97/126). B-fabric is thin to medium granostriated/ porostriated.

Inclusions

c:f:v_{10μm} c.20:76:4 to 30:64:6

Coarse fraction = 4.5mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Predominant to very few: **monocrystalline euhedral calcite**, a-sa, equant to elongate, well-sorted. Size = 1.75mm. to 0.2mm., mode = c. 0.2mm.

Few to very rare: **coarse grained polycrystalline calcite (sparite)**, a-sa, equant. Grain-size varies from 0.05mm to 1.6mm., mode = 0.2mm. Grains are often elongate. Size = 2.3 to 0.2mm, mode = c.0.4mm.

Few (97/50) to absent (97/132): **biomicrite**, sa-sr, equant to elongate; contains traces of foraminifera and larger shell frags. One example in sample 97/126 contains an oolith (0.15mm). Some samples (e.g. 97/127, 98/82) suggest that biomicrite may be associated with coarse-grained sparite. Size = 1.8mm to 0.2mm
Rare (98/82) to absent: **micrite with iron concentrations**, r, equant to elongate; sometimes contains isolated r quartz, epidote. Size = 4.0mm to 0.4mm

Very few to rare: **ostracods**. Size = 0.4 to 0.2mm.

Very few (98/79) to absent: **monocrystalline quartz**, sr, equant. Size = 1.4mm to 0.2mm., mode = 0.2mm.

Rare to absent: **polycrystalline quartz**, sa-sr, equant to elongate. Size = 0.6 to 0.2mm, mode = 0.2mm.

Rare (97/127) to absent: **chert**, r, equant. Size = 0.5 to 0.2mm.

Very rare to absent: **plagioclase feldspar**, sr, elongate. Size = 0.5 to 0.2mm (e.g. 97/127, 98/79).

Very few to very rare: **opaques**, sr, equant to elongate. Size = 1.9mm. to 0.2mm.

Very rare (97/50) to absent: **biotite schist**, sr, elongate. Size = 0.2mm.

Fine fraction

Predominant to dominant: **monocrystalline calcite**.

Few: **polycrystalline calcite**.

Very few to absent: **biomicrite/micrite**.
 Common (98/79) to few: **monocrystalline quartz**.
 Very few: **polycrystalline quartz**.
 Few to rare: **foraminifera, ostracods**.
 Few (98/79) to rare: **plagioclase feldspar**.
 Very few to very rare: **opaques**.
 Very rare: **chert**.
 Rare to absent: **clinozoisite** (97/127).
 Very rare to absent: **epidote**.

Textural Concentration Features (Tcf)

Rare to absent: **clay pellets**, r, equant to elongate, diffuse to merging boundaries, coloured yellow-orange to dark brown in XP (x40). Size = 4.5 to 0.05mm, mode = c.0.2mm.

Clay pellets seem to have two compositions:

(1) fine clay with foraminifera and rare rounded quartz, epidote and biotite schist (e.g. 97/50);

(2) fine clay without foraminifera or quartz.

Rare (98/95) to absent: **grog**, a-sa, equant to elongate, clear boundaries; colour (PPL, XP x40) is brown to dark brown; contain fine quartz, calcite (mono-, polycrystalline). Size = 1.1 to 0.2mm.

Amorphous Concentration Features (Acf)

Rare to very rare: **burnt/partially burnt/unburnt organics**, r, equant to elongate. Several samples (e.g. 97/126, 97/127) contain examples of unburnt/partially burnt organic material.

Comment

This fabric is characterised by a calcareous clay groundmass, usually very low in quartz, with opaques (iron oxide?), chert and biotite schist rare to absent. As with Fabric 1d this groundmass exhibits some variability between samples. Most are poor in quartz and lack chert and feldspar, but 98/79 is rich in quartz and feldspar. This group is therefore best distinguished by its crushed euhedral calcite temper. This calcite seems to have originated as a very coarse sparite (cf. examples in 98/86) and during processing has fractured along cleavage lines to produce much smaller often elongated calcite grains. This fabric shares a similar range of similarities with Fabrics 1a-d and 1f-i as have been outlined elsewhere: i.e. similar groundmass, micrite with iron concentrations, epidote, foraminifera, rare rounded quartz. Fabric 1e has particularly close links with Fabric 1d (similar biomicrite, rare rounded biotite schists, grog).

The presence of two types of clay pellet suggests that on at least some occasions the groundmass of Fabric 1e was created by mixing two similar calcareous clays, one fine containing few inclusions, the other containing foraminifera and rare rounded quartz. To this was added a crushed calcite temper. Grain-size seems to vary between samples from coarse (e.g. 98/86) to very fine (97/132): in general there seems to be a tendency for thicker walled vessels to be built in a coarser version of the fabric and thinner walled vessels in a finer form (cf. Fabric 5a). The coarse texture of 98/86 and the presence of crushed euhedral calcite and coarse sparite links this sample to Fabric 1f and particularly to Fabric 1g (97/133). Sample 98/79 exhibits a very clear coil join, while other observed

structural discontinuities would be consistent with coil forming. As with Fabrics 1a-d, non-calcareous slips seem to have been applied (e.g. 97/50, 97/127, 98/95) and these closely correspond to dark surfaces (red, brown, dark brown). It is worth noting also that all examples of Fabric 1e date either to late in ENI (stratum VI or V) or ENII (stratum IV); during ENII Fabric 1e is very frequent (see Chapter 9). In addition biomicrite is much more frequent in the earliest examples of Fabric 1e (e.g. 97/50, 97/121). See variously on Fabric 1a and Fabric 1d concerning the likely local provenance of Fabric 1e.

(1f) Calcareous, Rare Quartz, Crushed Coarse-Grained Sparite

Samples: 97/125, 97/131, 97/134, 98/76, 98/81

Microstructure

Very few to rare macro to meso planar voids, very few to rare macro to meso vugs. Some of the voids have calcite linings (e.g. 97/131). Voids generally exhibit local long-axis parallel orientation with inclusions, however this relationship may be at any angle with the vessel margins and different local arrangements may exist within a single section (e.g. 97/131). Some voids are surrounded by darker patches, some contain opaque, possibly organic material. Inclusions are close to single-spaced.

Groundmass

Fabric is generally homogenous, although one sample (i.e. 98/76) is richer in fine quartz and chert; colour varies from yellow or yellow-orange (PPL, XP) (x40) to dark orange (PPL, XP) (x40); sometimes some colour variation between core and margins - the 'sandwich effect' (e.g. 97/134). Optical activity is generally low (e.g. 98/81). B-fabric is thin to medium granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse/fine fraction = 1.7mm. to 0.05mm.

Coarse/Fine Fraction

Predominant to dominant: **monocrystalline calcite (sparite)**, a-sa, equant to elongate, well-sorted. Size = 0.7mm. to 0.2mm., mode = c. 0.2mm.

Very few to very rare: **coarse-grained sparite**, a-sa, equant. Grain-size varies from 0.05mm to 0.7mm., mode = 0.2mm. Grains are often elongate. Size = 1.6 to 0.2mm.

Rare: **micrite with iron concentrations**, r, equant to elongate. Size = 1.15mm to 0.1mm

Rare: **ostracods**. Size = 0.25 to 0.1mm.

Rare to very rare: **monocrystalline quartz**, sr, equant. Size = 0.5mm to 0.05mm

Rare to very rare: **polycrystalline quartz**, sr, equant to elongate. Size = 0.5 to 0.1mm.

Rare to absent: **chert**, r, equant. Size = 0.4 to 0.2mm.

Rare to very rare: **opaques**, sr, equant to elongate; sometimes contain isolated r quartz, feldspar, amphibole, mica (cf. 98/81). Size = 1.7mm. to 0.05mm.

Very rare: **plagioclase/alkali feldspar**, sr, equant to elongate. Size = 0.5 to 0.1mm.

Very rare (98/76) to absent: **altered igneous rock frag.**, r, equant. Fine grained, contains tiny plagioclase laths, in a fine green (serpentinised?) matrix. Size = 0.75mm.

Very rare to absent: **epidote**. Size = 0.1mm.

Textural Concentration Features (Tcf)

Very few to very rare: **clay pellets**, r, equant to elongate, size = 1.6 to 0.05mm, diffuse to merging boundaries, coloured yellow-orange to dark brown in XP (x40); contains grains of monocrystalline quartz and calcite.

Amorphous Concentration Features (Acf)

Rare to very rare: **burnt/partially burnt/unburnt organics**, r, equant to elongate. Many samples contain examples of unburnt/partially burnt organic.

Comment

This fabric is characterised by a calcareous clay groundmass, which is usually low in quartz and contains ostracods and to which a crushed coarse-grained sparite temper has been added. Close similarities in groundmass between Fabric 1f and Fabrics 1a-e can be noted (rare rounded quartz, foraminifera, micrite with iron concentrations, epidote), which have been discussed at length for Fabric 1d. Therefore the most distinctive feature of this fabric is the form of the crushed sparite temper, which appears to derive from a coarser-grained sparite than Fabrics 1a-c. A similar coarse-grained sparite appears in Fabric 1g (97/133) and Fabric 1e (98/86), which suggests that these groups may be particularly closely linked. A similar crushed coarse-grained sparite temper is also a feature of Fabric 2c, but this occurs in a different clay groundmass (red, fine quartz rich, rare siltstone). Vessels in fabric 1f seem to have been subject to a similar range of finishing techniques as Fabrics 1a-e with samples variously evidencing compaction due to burnishing (98/76) or the use of non-calcareous slips to create dark (red, brown) polished surfaces (97/125, 97/131, 97/134).

(1g) Calcareous, Rare Quartz, Euhedral Calcite, Coarse-Grained Sparite, Biomicrite

Sample: 97/133

Comment

This single sample effectively demonstrates the links between Fabrics 1d, 1e and 1f. It has a groundmass which appears calcareous, containing rounded quartz, epidote, chert, but no foraminifera. In composition it therefore resembles clay pellets in Fabrics 1a-c and 1d which lack foraminifera. This groundmass is dominated by a variety of large calcareous non-plastics, which vary in form (coarse-grained sparite, iron-rich micrite, biomicrite, monocrystalline euhedral calcite) and which variously link this sample to Fabrics 1d-f. In texture and packing, the closest parallel for 97/133 is 98/86 in Fabric 1e.

(1h) Calcareous, Rare Quartz, Biomicrite, Sandstone

Sample: 97/122

Comment

This sample is identical to examples of Fabric 1d, except for the presence of large sandstone rock fragments. Coarse siltstone/fine sandstone is a rare component of Fabrics 1d and 1i, however in sample 97/122 they are frequent and large (size = 2.6mm to 0.25mm): subangular to subrounded, elongate; grains are well-sorted, unimodal, equant to elongate, sa-sr, no preferred orientation; mostly quartz, feldspar, with some chert, mica, opaques and more rarely calcite (cf.98/85); fabric is usually grain-supported with point-contacts; matrix, where visible, is orange-red (XP) (x40).

(1i) Calcareous, Rare Quartz, Grog, Sparite/Micrite

Samples: 97/40, 98/68, 98/69, 98/75

Microstructure

Very few to rare mega to meso planar voids, very few to rare macro to meso vughs. Inclusions are close to single-spaced.

Groundmass

Fabric is generally homogenous; colour varies from yellow or yellow-orange (PPL, XP) (x40) to dark brown (PPL, XP) (x40). Optical activity is generally high (e.g. 98/68, 98/69). B-fabric is thin to medium granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.75mm. to 0.2mm.

Fine fraction = 0.2mm or less.

Coarse Fraction

Frequent to common: **limestone (micrite, sparite)**, sa-sr, equant to elongate. Varies in form from a fine sparite to a micrite. Some examples show micrite in association with sparite (e.g. 98/68); occasionally bioclastic (e.g. 98/68). Size = 1.8mm to 0.2mm.

Very rare (97/40, 98/68) to absent: **shell fragments**, sa, elongate. Size = 1.1mm to 0.8mm.

Very rare (97/40) to absent: **ostracod**. Size = 0.8mm.

Rare to absent: **micrite with iron concentrations**, r, equant to elongate. Size = 3.2mm to 0.2mm.

Rare to very rare: **monocrystalline quartz**, sr-r, equant. Size = 0.25 to 0.2mm.

Rare to absent: **polycrystalline quartz**, sr-r, equant to elongate. Size = 1.5 to 0.2mm.

Very rare to absent: **chert**, sr-r, equant. Size = 0.35 to 0.2mm.

Very rare to absent: **coarse siltstone/fine sandstone**, sa-sr, elongate; grains are well-sorted, unimodal, equant to elongate, sa-sr, no preferred orientation, grain size = 0.05 to 0.3mm: mostly quartz, feldspar, with some mica; fabric is usually grain-supported with point-contacts; matrix, where visible, is orange-red (XP) (x40). Size = 0.8mm.

Very rare (97/40, 98/69, 98/75): **phyllite**, r, elongate; contains mica, quartz. Size = 0.6 to 0.2mm.

Fine Fraction

Frequent: **micrite/sparite**.

Common to few: **foraminifera, ostracods**.

Few to rare: **calcite**.

Few to rare: **quartz**.

Rare: **opaques**.

Rare: **chert**.

Very rare to absent: **epidote**.

Very rare to absent: **biotite schist**.

Textural Concentration Features (Tcf)

Frequent to common: **grog**, a-sa, equant to elongate, sharp to merging boundaries. High to neutral optical density. Burnished surfaces visible in some samples (e.g. 98/69). Size = 2.75 to 0.15mm. At least two different types of grog can be distinguished:

(1) Colour dark brown to brown (PPL, XP x40), rich in fine quartz, biotite mica, alkali feldspar, chert, altered volcanics (e.g. 98/69), epidote. One example in 98/69 contains no limestone and has a visible burnished surface; others also contain limestone (sparite, micrite). These latter resemble Fabrics 2a and 2b in both groundmass and large non plastics. (cf. 97/40, 98/68, 98/69, 98/75).

(2) Colour orange brown to dark brown (PPL, XP x40), rare large rounded quartz, micrite (sometimes bioclastic), sparite; (cf. 97/40, 98/68, 98/69, 98/75). This resembles Fabrics 1a-d.

Rare: **clay pellets** and **clay streaks** (e.g. 98/68, 98/69): colour is yellow to orange (PPL, XP x40); examples in 98/69 lack foraminifera and quartz. One very large swirl in 98/68 is rich in foraminifera. Size = 4.5 to 0.15mm.

Comment

This fabric is characterised by a groundmass similar to that found in Fabrics 1-h, which hosts limestone non-plastics and frequent grog. Evidence for clay mixing in 98/68 and 98/69 once again (cf. Fabrics 1a-c, 1d) suggests that the groundmass was created by mixing two clays, one of which is rich in ostracods and foraminifera. The closest links are with Fabrics 1d and 1h (sandstone, bioclastic limestone, biotite schist). Sample 98/75 has traces of a non-calcareous slip and this, as with other examples in Fabrics 1a-f coincides with a dark (brown) surface. All samples of Fabric 1i date to late in ENI (strata VI-V); a single example from a context in stratum VIII (97/40), which contains other intrusive material, finds its closest parallels in finish and form with examples in stratum V.

(2a) Low/Non Calcareous, Fine Quartz-Rich, Chert, Sparite

Samples: 97/24, 97/37, 97/64, 97/85, 98/2, 98/5, 98/24, 98/34, 98/37, 98/42, 98/50

Microstructure

Rare to very rare mega to meso vughs, rare to absent mega to meso planar voids.

Some larger voids are surrounded by darker patches, some contain opaque, possibly organic material (e.g. 98/34, 98/37). Assessment of orientation of voids and inclusions is difficult because inclusions and voids are predominantly equant; however, when inclusions and voids are more elongated, local long-axis parallel orientation can be observed (e.g. 98/2, 98/34); the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Fabric is homogenous. Colour varies from orange or orange-red (PPL, XP) (x40) to dark brown (PPL, XP) (x40). Sample 98/37 has a dark core. The micromass varies in optical activity from low (e.g. 98/42) to high (e.g. 98/2). B-fabric is medium to thick granostriated/porostriated (e.g. 98/2).

Inclusions

c:f:v_{10µm} c.25:70:5 to 30:65:5

Coarse fraction = 2.4mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant to frequent: **sparite**, a-sa, equant to elongate. Grain size varies from 0.05 to 0.4mm, mode = 0.1mm. Sometimes interstices between individual grains within a sparite cluster are blurred and individual grains do not exhibit separate extinction, but rather have a similar form and texture to micrite (cf. 97/85, 98/2, 98/24). This is found particularly (e.g. 98/24) in association with a darker brown clay matrix (PPL, XP x40) and may be connected with secondary calcite formation (see comments below). Sometimes contains discrete clasts of quartz (e.g. 98/2). Size = 2.4 (98/24) to 0.2mm.

Rare to absent: **micrite**, r, equant to elongate; sometimes contains iron concentrations (e.g. 98/50); sometimes contains rare discrete clasts mostly of quartz (e.g. 98/37); sometimes bioclastic. Size = 0.9 to 0.2mm.

Very rare (97/85, 98/50) to absent: **shell fragments**, sa-r, elongate. Size = 0.4mm.

Rare (98/37) to absent: **monocrystalline calcite**, a-sa, equant; resembles sparite in form. Size = 0.4mm to 0.2mm.

Very rare (97/64, 98/42) to absent: **foraminifera**. Size = 0.25 to 0.2mm.

Very few (98/2) to very rare: **monocrystalline quartz**, sr-r, equant. Size 1.4 (97/64) to 0.2mm.

Rare to absent: **polycrystalline quartz**, sr-r, equant. Size = 0.5 to 0.2mm.

Very few (97/64) to very rare: **chert**, sa-r, equant; varies from fine to medium-grained, but predominantly fine. Sometimes (e.g. 98/37) larger clasts of quartz and plagioclase are set in a chert-rich matrix. Size = 0.7 to 0.2mm, mode = 0.2mm.

Rare (97/24, 98/37) to absent: **coarse siltstone/fine sandstone**, r, equant to elongate. Grain-size varies from 0.3mm to 0.05mm; contains clasts of monocrystalline quartz, polycrystalline quartz/chert, feldspar, biotite mica; usually grain-supported; well sorted; matrix is usually orange (PPL, XP x40). Size = 0.8mm to 0.2mm

Very rare (98/5) to absent: **fine siltstone**, sa-sr, equant; occasional clasts of quartz, biotite mica (c. 0.02), matrix supported. Size = 0.7mm.

Rare (97/64, 98/42) to absent: **quartz-biotite schist**, r, equant to elongate. Size = 0.6 to 0.2mm.

Very rare (98/2) to absent: **alkali feldspar**, sa-sr, equant. Size = 0.3 to 0.2mm

Very rare (97/37) to absent: **plagioclase feldspar**, sa, elongate. Size = 0.3 to 0.2mm.

Very rare (98/2) to absent: **igneous rock fragment**, sr, equant to elongate; contains quartz with sutured contacts in association with plagioclase feldspar laths and some alkali feldspar and rare biotite. Size = 0.8mm.

Very rare to absent: **opaques (iron oxide?)**. Size = 0.25 to 0.2mm.

Fine Fraction

Frequent to common: **monocrystalline/polycrystalline quartz**.

Frequent (98/24) to very few: **monocrystalline calcite (sparite)**.

Common: **chert**.

Rare: **alkali feldspar**.

Rare: **plagioclase feldspar**.

Rare: **biotite mica**.

Rare to very rare: **quartz-biotite schist/phyllite**.

Rare to very rare: **epidote**.

Very rare: **foraminifera**

Very rare: **opaques**.

Textural Concentration Features (Tcf)

Rare (98/5) to very rare: **clay pellets**, sr-r, equant, high sphericity, merging (98/24) to clear boundaries; contain fine rounded quartz (monocrystalline, polycrystalline), chert, feldspar (plagioclase, alkali), biotite mica, epidote, quartz-biotite schist (cf. 97/24, 97/37, 98/5, 98/24). Colour varies from red (PPL, XP) (x40) to dark brown (PPL, XP) (x40). Size = 1.3 to 0.1mm.

Rare to absent: **clay layer**; in sample 98/42 a clay layer is visible on exterior edge (PPL) as a slightly darker area (c. 0.2mm to 0.4mm thick) and (XP) as a b-fabric

parallel in orientation to vessel margins; this area is texturally distinctive being generally composed of non-plastics at the lower end of the size range (<0.6mm) and is of similar composition to the fine fraction of Fabric 2a (cf. also 97/85, 98/34). This clay layer always corresponds to the use of non-calcareous slips (see comments below).

Amorphous Concentration Feature (Acf)

Rare to very rare: **burnt/partially burnt organics**; all samples contain examples of voids with traces of burning around them; some samples also contain traces of unburnt/partially burnt organic (cf. 98/24, 98/37).

Comment

This fabric is characterised by a groundmass which seems to be low or non-calcareous rich in fine quartz and also containing chert, coarse siltstone/fine sandstone, feldspar (plagioclase, alkali), biotite mica. Dominated by sparite, which appears to have been added as temper, this groundmass appears to be generally consistent between samples. Clay pellets contain most components of the groundmass (i.e. contain fine rounded quartz (monocrystalline, polycrystalline), chert, feldspar (plagioclase, alkali), biotite mica, epidote, quartz-biotite schist), however they do not appear to be the source of the rare foraminifera and these may derive from another clay similar to that identified in Fabric 2b (see below). The groundmass of Fabric 2a is very close to that of 2b-e (although poorer in foraminifera) and therefore the most distinctive feature of this group is the presence of sparite. The sparite varies considerably in grain-size from very fine (0.05mm) to coarse (0.4mm). The presence of sparite and micrite together in Fabric 2b (e.g. 97/2) sometimes within a single inclusion (97/66) suggests the possibility that Fabrics 2a and 2b may actually grade into one another; a close link is also suggested by the presence of biomicrite (98/50), quartz-biotite schist, coarse siltstone/fine sandstone and fine siltstone in Fabrics 2a and 2b. Further support for a close link is provided by macroscopic study of fabric and form, which failed to distinguish between Fabrics 2a and 2b and which demonstrated that identical forms of deep incised/pointillé decoration are common to both groups. The presence of sparite in Fabric 2a also links it to Fabric 2c; indeed the differences between these two groups are largely textural. The generally coarse-grained sparite in Fabrics 2a, 2b and 2c also links in to the similarly coarse-grained sparite in Fabrics 1f-g.

No clear coil joins could be identified in Fabric 2a, however structural discontinuities would be consistent with coil forming. Samples exhibit a variety of surface finishes: most samples appear to have been simply burnished, with some of these exhibiting compaction due to burnishing (e.g. 98/5); others appear to have a thin clay layer (0.2-0.4mm) of similar composition to the body, although with few to none limestone inclusions. This thin layer lies over the large non-plastics apparently smoothing the vessel surface, prior to the application of a non-calcareous slip. All samples finished in this way are polished rather than burnished (e.g. 97/85, 98/2, 98/34, 98/42). Sample 98/37 contains a long void where a clay strip (cordon) has been poorly joined to the body of the vessel.

The variety in the degree of optical activity and the colour range suggests that samples of Fabric 2a had been exposed to a variety of temperatures and atmospheres (oxidising/reducing). In several samples calcitic inclusions exhibit only a relict primary grain texture (sparite): the interstices between individual

grains within a sparite cluster are blurred and grains do not exhibit extinction, but rather have a similar texture to micrite. This is particularly found (e.g. 98/24) in association with a darker brown clay matrix (PPL, XP x40), which is itself suggestive of more strongly reducing atmosphere. The presence of micritic clots would seem to indicate the alteration of calcite during firing. If so this would suggest that in these examples vessels may have been fired over c.800°C (see also Chapter 8). All samples had traces of either burnt, partially burnt or even unburnt organic material. All of these above features would be consistent with firing of short duration in an open environment.

Fabric 2a unfortunately contains no features which are distinctive of specific provenance; however it remains broadly consistent with the local geology around Knossos (limestone, bioclastic limestone): cf. bioclastic limestone (98/50) with bioclastic limestone in Fabrics 2b, 1d-h (see Appendix III). Support for local provenance is also provided by consideration of the high frequency with which Fabric 2a occurs at Knossos (see Chapter 9) and by the technological/mineralogical similarities shared with Fabric 2b (see below) and Fabrics 1a-i, for which a local provenance has also been suggested.

(2b) Low/Non Calcareous, Fine Quartz-Rich, Chert, Micrite/Biomicrite

Samples: 97/2, 97/3, 97/5, 97/44, 97/54, 97/63, 97/66, 97/82, 97/104, 97/106, 97/110, 98/3, 98/6, 98/36, 98/38, 98/49, 98/56, 98/77, 98/84.

Microstructure

Very few to very rare mega to meso vughs, very few to absent mega to meso planar voids. Occasionally voids have calcite linings (e.g. 97/66, 98/6). Some larger voids are surrounded by darker patches, some contain opaque, possibly organic material (e.g. 98/84). Assessment of orientation of voids and inclusions is difficult because inclusions and voids are predominantly equant; however, when inclusions and voids are more elongated, local long-axis parallel orientation can be observed (e.g. 97/110, 98/50, 98/77); the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Fabric is generally homogenous within individual samples, but exhibits some variety between samples from those rich in fine quartz (e.g. 98/36) to those poorer in quartz (e.g. 98/56). Colour varies from yellow-orange or orange-red (PPL, XP) (x40) to dark brown (PPL, XP) (x40). Sample 98/84 has a dark core. The micromass varies in optical activity from medium (e.g. 97/63, 98/77) to high (e.g. 97/54, 98/36). B-fabric is medium to thick granostriated/porostriated (e.g. 98/36, 98/49).

Inclusions

c:f:v_{10µm} c.25:70:5 to 30:65:5

Coarse fraction = 3.35mm. to 0.2mm.

Fine fraction = 0.2mm or less.

Coarse Fraction

Dominant to few: **micrite/biomicrite**, sa-sr, equant to elongate; sometimes micrite is bioclastic (e.g. 97/66, 98/6, 98/84) or in association with fossilised shell frags (e.g. 97/44, 97/104, 98/36, 98/49, 98/50). Micrite varies in form from very fine to coarse and appears to grade into sparite (see below); in several instances this grading is visible within a single inclusion (e.g. 97/66). Size = 2.4mm. to 0.2mm.

Frequent (98/56) to rare: **sparite**, a-sa, equant to elongate; sparite varies from a coarse micrite/fine sparite (c.0.05mm) to a medium-grained sparite (c. 0.4mm) and thus seems to grade into micrite (see above); several sparite inclusions in 97/63 exhibit a recrystallised ring and, although texturally sparitic, do not exhibit extinction (cf. 98/2). These features are suggestive of secondary calcite formation (see comments below). Size = 1.8 to 0.2mm.

Common (97/104) to absent: **shell fragments**, a-sa, elongate. Size = 2.0 to 0.2mm.

Rare (98/49, 98/77) to absent: **foraminifera**. Size = 0.3 to 0.2mm.

Rare to very rare: **micrite with iron concentrations**, r, equant to elongate; sometimes contains discrete clasts of fine quartz (e.g. 97/3, 98/56, 97/66), chert (98/77), feldspar (98/36); one example in 98/56 in association with sparite. Size = 3.35 to 0.2mm.

Very few (98/77) to very rare (97/54): **monocrystalline quartz**, sr-r, equant. Size = 1.4 (97/64) to 0.2mm

Rare to absent: **polycrystalline quartz**, sr-r, equant; sometimes sutured contacts. Size = 1.5mm to 0.2mm.

Rare to very rare: **chert**, sa-r, equant; varies from fine to medium-grained, but predominantly fine. Sometimes (e.g. 97/5, 97/66) larger clasts of quartz and plagioclase are set in a chert-rich matrix; one example in 97/2 contains radiolarian test(?) infilled with chalcedonic quartz. Size = 1.4 to 0.2mm, mode = 0.2mm.

Very rare (97/82, 98/3, 98/77) to absent: **quartz-biotite schist**, sr-r, equant. Size = 0.7 to 0.2mm

Very few (97/3) to absent: **fine siltstone**, sa-sr, equant to elongate; occasional clasts of quartz, more rarely calcite, mica (c. 0.02), matrix supported. Size = 1.0mm to 0.2mm.

Rare (97/63, 97/106) to absent: **coarse siltstone/fine sandstone**, r, equant to elongate. Grain-size varies from 0.3mm to 0.05mm. Contains clasts of monocrystalline quartz, polycrystalline quartz, chert, feldspar, biotite mica; grain-supported, well sorted. Size = 0.6mm to 0.2mm.

Rare (98/77) to absent: **calcareous siltstone**, sr-r, equant to elongate; contains quartz, feldspar, biotite mica and epidote. These resemble micrite with iron concentrations and it is possible that the two grade into each other. Size = 2.1 to 0.2mm.

Rare (98/3) to absent: **dioritic rock fragments**, r, equant; one example in 98/77 contains large biotite mica in a finer mosaic of biotite and amphibole (diorite?); one example in 98/3 rich in fine plagioclase in association with biotite and amphibole (diorite?); one example in 98/3 contains plagioclase with some alkali feldspar (diorite?); one example in 97/110 contains plagioclase, biotite, some alkali feldspar (diorite?). Size = 0.7 to 0.4mm

Very rare (97/110) to absent: **altered volcanic rock fragment**, r, elongate; contains plagioclase laths, biotite. Size = 0.5mm.

Very rare (97/66) to absent: **altered rock fragment**. Size = 1.2mm.

Very rare (98/56) to absent: **radiolarian test(?)**, sa-sr, equant; infilled with chalcedonic quartz. Size = 0.35mm.

Very rare to absent: **plagioclase feldspar**, sa, elongate. Size = 0.4 (98/36) to 0.2mm.

Very rare to absent: **alkali feldspar**, sa, equant. Size = 0.2mm

Rare to very rare: **opaques**, sa-r, equant. Sometimes contain grains of quartz, mica (97/5), calcite (98/49). Size = 0.7 to 0.2mm.

Fine Fraction

Dominant to common (98/56): **monocrystalline/polycrystalline quartz**.

Common to few: **calcite/micrite**.

Very few (98/49) to very rare: **foraminifera**

Common to few: **chert**.

Rare to very rare: **alkali feldspar**

Rare to very rare: **plagioclase feldspar**.

Rare to very rare: **biotite mica**

Rare to absent: **igneous rock frags.** (e.g. 98/36)

Rare to very rare: **quartz-biotite schist/phyllite**.

Rare to very rare: **epidote**.

Very rare to absent: **clinozoisite** (e.g. 98/77, 97/110)

Very rare: **opaques**.

Textural Concentration Features (Tcf)

Rare (98/49) to very rare: **clay pellets**, sr-r, equant, high sphericity, merging to clear boundaries. Size = 1.3 to 0.1mm. Two types are apparent with the first most frequent:

(1) colour orange-red (XP) to dark brown (PPL) (XP) (x40), containing fine quartz, larger rounded quartz, feldspar, chert, biotite mica (e.g. 98/77)

(2) colour yellow (PPL, XP x40), rich in foraminifera, also containing rare large rounded quartz, epidote, calcite (e.g. 97/66).

Rare (97/66, 98/56) to absent: **grog**, a-sa, equant to elongate, sharp to clear boundaries; contain quartz, mica, feldspar, calcite, rounded altered igneous rock frag.; colour varies from brown to dark brown (PPL, XP) (x40). (cf. 97/66, 97/82, 97/104, 98/56). Size = 1.0 to 0.15mm.

Amorphous Concentration Feature (Acf)

Rare to very rare: **burnt/partially burnt organics**. N.B. samples 97/5, 97/63, 98/84 contain several examples of unburnt/partially burnt organic.

Comment

This fabric is characterised by a low to non-calcareous groundmass (see Chapter 8 for confirmation), rich in fine quartz, but also variously containing larger rounded quartz, chert, foraminifera, biotite mica, feldspar, siltstone, sandstone, quartz-biotite schist and dioritic igneous rocks. This groundmass is dominated by limestone (sparite, micrite, biomicrite), which has been added as temper. Most samples contain a mixture of sparite and micrite (e.g. 97/63), although some are predominantly micrite or biomicrite (e.g. 98/84). Often limestone inclusions exhibit rings or exhibit the relict primary form of sparite but do not go in and out of extinction (e.g. 97/2, 98/6). The frequent presence of these micritic clots suggests that the form of calcite inclusions in Fabric 2b may have been frequently altered during firing. This is perhaps clearest in sample 98/84, where carbonate inclusions grade from those in one portion of the section which exhibit a clear unaltered bioclastic form to those on the other side of the section which resemble micrite: this grading through the sherd would seem to reflect changes in the form of calcite occurring after the formation of the vessel, probably during the firing process. If so then this may mean that some of the frequent micrite inclusions in Fabric 2b may have originally been bioclastic or sparitic prior to secondary calcite alteration during firing. Recognition of this phenomenon increases the likelihood that Fabrics 2a and 2b may grade into each other to form a large group characterised mainly by the presence of coarse-grained sparite and/or biomicrite.

Groundmass is homogenous within single samples, but exhibits some variation between samples, from those which are quartz rich (e.g. 97/2) to those which are relatively quartz poor (e.g. 98/56) or those which are more yellow-orange firing and rich in foraminifera and larger rounded quartz (e.g. 98/49) to those which are not (e.g. 97/2). Some of this variability in groundmass may be due to clay mixing since clay pellets of two different compositions were observed: one red firing and rich in fine quartz, chert, mica, feldspar; one yellow firing rich in foraminifera, larger rounded quartz, calcite, epidote. This latter clay would seem to be the source of the foraminifera and for the few samples which fire with a slightly more yellow colour (e.g. 98/49). See also clay-mixing in Fabric 2d. A similar type of clay mix - between a calcareous fossiliferous clay and a non-calcareous quartz-rich clay - can also be seen in Fabric 37. In this way subtle inhomogeneities in groundmass may result from the mixing of two clays in different proportions.

Fabric 2a shares a similar groundmass with Fabrics 2a, 2c, 2d and 2e and therefore its most distinctive feature is the large limestone non-plastics. However, the presence of sparite in Fabric 2b in conjunction with other close similarities may indicate that groups 2a and 2b grade into another; moreover Fabric 2d (98/74) is closely linked to Fabric 2b by the presence of smaller quantities of similar calcareous siltstones in 98/77 and by similar texture in 97/104: these again suggest that Fabric 2d may grade into Fabric 2b. Fabric 2e (grog) is closely linked to Fabric 2b by the presence of grog in 97/66. Fabric 2b also shares a similar groundmass with Fabric 15 (organic tempered). Fabric 2b has similar limestone inclusions to Fabric 4 (micrite), but these are in a groundmass which is poor in quartz. Fabric 2b also has similar limestone inclusions (micrite, biomicrite) as

Fabric 2d. The presence in Fabric 2b of micrite with iron concentrations also provides a general link with Fabrics 1a-i.

Consideration of void, inclusion and b-fabric orientation allowed the identification of coil-joins in sample 97/66. Other structural discontinuities in other samples would be consistent with coil-forming. Most samples seem to have been burnished or polished without the use of added slips; instead samples generally exhibit compaction due to burnishing (e.g. 98/38) or polishing (98/3). However, a non-calcareous slip layer was noted in sample 97/54. Samples exhibit a range in optical activity from medium (e.g. 97/63, 98/77) to high (e.g. 97/54, 98/36) and a range in colour from orange yellow to dark brown. This would suggest that vessels were fired to a variety of temperatures and were exposed to an atmosphere which varied between oxidising and reducing. Evidence for secondary calcite formation would seem to suggest that vessels in Fabric 2b were often fired over c.800°C and were generally more highly fired than vessels in Fabrics 1a-i. Burnt, partially burnt and unburnt organic material was frequently observed in samples of Fabric 2b. All of these above features would be consistent with fast firing within an open environment.

As with Fabric 2a, Fabric 2b unfortunately contains no features which are distinctive of specific provenance; however it remains broadly consistent with the local geology around Knossos (bioclastic limestone): cf. bioclastic limestone (98/84) with bioclastic limestone in Fabrics 1d-h (see Appendix III). Support for a broadly local provenance is also provided by consideration of the high frequency with which Fabric 2b occurs at Knossos (see Chapter 9) and by the technological/mineralogical similarities shared with Fabric 2a (see below) and Fabrics 1a-i, for which a local provenance has also been suggested.

(2c) Low/Non Calcareous, Fine Quartz, Chert, Crushed Coarse-Grained Sparite

Samples: 97/42, 97/58, 98/58, 98/72

Microstructure

Rare to very rare mega to meso vughs, very few to rare macro to meso planar voids. Sometimes voids are in-filled with calcite (e.g. 97/42). Some voids are surrounded by darker patches, some contain opaque material (e.g. 98/58). Inclusions are generally close-spaced.

Groundmass

Fabric is generally homogenous. Colour varies from orange to dark brown (PPL, XP) (x40). The micromass varies in optical activity from low (98/72) to high (97/58). B-fabric is medium and granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.25:70:5 to 30:65:5

Coarse fraction = 2.3mm. to 0.1mm.

Fine fraction = 0.1mm. or less.

Coarse Fraction

Dominant: **monocrystalline calcite (sparite)**, a-sa, equant to elongate. The form of the grains suggested that they derive from a sparitic limestone; this would seem to be confirmed by the presence of sparite (see below). Size = 0.45 to 0.1mm.

Few to rare: **sparite**, a-sa, equant to elongate. Size = 1.9 to 0.2mm.

Very rare (97/58) to absent: **shell fragment**, sr, equant. Size = 0.9mm.

Rare to very rare: **monocrystalline quartz**, r, equant. sometimes ophitic, containing mica (e.g. 98/58, 98/72). Size = 1.0mm to 0.1mm

Very few to very rare: **polycrystalline quartz**, sr, equant to elongate. sometimes in association with mica. Size = 0.6 to 0.2mm

Rare to very rare: **chert**, r, equant to elongate. Size = 0.8 to 0.1mm

Very few (98/58) to absent: **quartz-biotite schist**, r equant to elongate; also contains opaques. Size = 2.0 to 0.2mm.

Rare to absent: **coarse siltstone/fine sandstone**, r, equant to elongate; contains grains (c.0.05mm to 0.2mm) of monocrystalline/polycrystalline quartz, mica, feldspar (plagioclase, alkali), quartz-biotite schist. Size = 0.8mm to 0.35mm.

Very rare to absent: **amphibole**, sr, elongate. Size = 0.35mm.

Very rare to absent: **plagioclase**, r, elongate. Size = 0.25mm to 0.1mm

Very rare to absent: **alkali feldspar**, r, equant to elongate. Size = 0.2mm to 0.1mm.

Rare to very rare: **opaques**, sr, equant; some contain isolated mica grains. Size = 0.4mm to 0.1mm.

Fine Fraction

Frequent to common: **monocrystalline calcite**.

Common: **fine monocrystalline quartz**.

Very few to rare: **biotite mica**.

Rare: **plagioclase feldspar**.

Rare: **alkali feldspar**.

Very rare: **chert**.

Very rare: **epidote**.

Rare to very rare: **opaques**.

Textural Concentration Features (Tcf)

Very few to absent: **clay pellets**, sr-r, equant, diffuse boundaries; contain very few inclusions: rare fine quartz (max. size 0.05mm), biotite mica, some feldspar, chert; colour varies from orange or orange-red to dark brown (PPL) (x40) and orange-red to very dark brown (XP) (e.g. 97/42, 98/72). Size = 2.3 to 0.1mm.

Amorphous Concentration Features (Acf)

Rare to absent: **burnt/partially burnt organics**; samples 97/58 and 98/58 contain examples of unburnt/partially burnt organic.

Comment

This fabric is characterised by a groundmass which is red firing (non-low calcareous), rich in fine quartz and also containing biotite, chert, siltstone/sandstone and quartz-biotite schist. This groundmass is dominated by a crushed coarse-grained sparite temper. The groundmass is very close to that found in Fabric 2a-b (quartz-rich, biotite, quartz-biotite schist, siltstone/sandstone). It differs from Fabric 2b in its lack of foraminifera. Generally the groundmass is homogenous between samples, although sample 98/58 contains much more

quartz-biotite schist than other samples. Study of clay pellets suggest the use of a fine non-calcareous clay containing fine quartz and biotite mica. The source for the larger rounded schist and siltstone/sandstone remains unclear: these may also derive from the same clay as the clay pellets or from another clay. Certain similarities in texture and limestone non-plastics may be noted with Fabrics 1b and 1f, which also contain crushed sparite; closest is Fabric 1f which is also a coarse-grained sparite, however neither Fabric 1b or 1f has a groundmass comparable to Fabric 2c.

The similarities in groundmass and limestone non-plastics between Fabrics 2a and 2c suggest that Fabric 2c is likely to be a technological variant of Fabric 2a. Fabric 2c first appears in stratum VI and continues into stratum IV (NB sample 97/58 is from a context in stratum VIII which contains other intrusive material) (see Chapter 9). The surface of samples 98/58 and 98/72 have differently oriented birefringence which suggests that compaction of the surface took place as a result of polishing. Differences in colour and optical activity suggest that vessels were exposed to a variety of temperatures and atmospheres (oxidising to reducing). Partial alteration to the structure of sparite grains in sample 97/42 are suggestive of secondary calcite formation (micritic clots). This sample also has calcite infilling of voids, which could conceivably be allochthonous in origin, however several considerations would seem to suggest that it is only partially allochthonous: firstly as already noted there are micritic clots suggestive of calcite alteration during firing; secondly 97/42 has a very dark brown clay matrix suggestive of exposure to a reducing atmosphere (over-fired?); thirdly if the calcite infilling resulted from the percolation of calcite bearing groundwater then one would expect to see its random occurrence in all fabrics; however calcitic infilling of voids is almost never found in other well-sampled fabrics at Knossos (see Fabrics 5a, 6 and 8), which notably lack a calcareous components (clays, inclusions) even though they shared the same burial environment as Fabric 2c (and Fabrics 1a-i, 2a-e). Thus the calcite infilling in the voids of sample 97/42 is more likely to originate within the sherd itself. In this way consideration of secondary calcite formation in sample 97/42 would suggest that sample 97/42 was fired to over c.800°C. For provenance see on Fabrics 2a and 2b.

(2d) Low/Non Calcareous, Fine Quartz, Biomicrite, Calcareous Sandstone

Sample: 98/74

Comment

This fabric has a groundmass very similar to that of Fabric 2b. Links with Fabric 2b are also suggested by the presence of siltstone/sandstone and calcareous sandstone (cf. Fabric 2b 98/77) and bioclastic material (shell) (cf. Fabric 2b, 97/106). In this way Fabric 2d is only distinguished from Fabric 2b by the presence of much larger quantities of sedimentary material. A large clay pellet in 98/74 is yellow-firing (calcareous?) and contains calcite (sparite), and rare rounded quartz and biotite. This would suggest that the groundmass of Fabric 2d resulted from a mix of a quartz-poor calcareous clay with a non-calcareous quartz rich clay. A similar mix was suggested for Fabric 2b.

(2e) Low/Non Calcareous, Fine Quartz-Rich, Biomicrite, Grog

Sample: 97/46

Microstructure

Very rare meso planar voids, very few macro to meso vughs. Some voids contain opaque material. Voids exhibit no preferred orientation. Voids and non-plastic inclusions are close to single-spaced.

Groundmass

Colour is yellow/brown (PPL, XP) (x40). Micromass is slightly optically active.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse fraction = 1.5mm. to 0.2mm.

Fine fraction = 0.2mm or less

Coarse Fraction

Dominant: **micrite/biomicrite**, sa-r, equant to elongate; mostly micrite; sometimes contains or is in association with coarse-grained sparite (c.0.05 - 0.1mm). Size = 1.5 to 0.2mm.

Rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.65mm to 0.2mm.

Rare: **polycrystalline quartz**, r, equant to elongate; sometimes with sutured contacts; sometimes in association with mica. Size = 0.9mm to 0.2mm.

Rare: **chert**, r, equant to elongate. Size = 0.4mm to 0.2mm.

Rare: **quartz-biotite schist**, r, elongate. Size = 1.35mm to 0.4mm

Very rare: **siltstone**, r, elongate; contains quartz and mica. Size = 0.4mm

Very rare: **plagioclase feldspar**, r, elongate. Size = 0.2mm

Very rare: **alkali feldspar**, r, elongate. Size = 0.2mm

Very rare: **opaques**, r, equant. Size = 0.25 to 0.2mm.

Fine Fraction

Dominant: **monocrystalline quartz**.

Frequent: **biomicrite/micrite**.

Few: **foraminifera**.

Very few: **plagioclase/alkali feldspar**.

Very few: **chert**.

Very few: **biotite mica**.

Rare: **monocrystalline calcite**.

Rare: **opaques**.

Very rare: **epidote**.

Textural Concentration Features (Tcf)

Common: **grog**, s-sr, equant to elongate; sharp to diffuse boundaries. Size = 1.4 to 0.1mm. Two fabrics identifiable:

(1) Colour varies from red to dark brown (XP) (x40); rich in fine quartz, with mica, chert, feldspar and opaques; some contain large (0.4mm) limestone (micrite); one example has a burnished surface.

(2) Colour varies from yellow to brown (XP) (x40); rare fine quartz, with calcite, micrite; one example contains large sparite (0.9mm) non-plastic.

Very few: **clay pellets**, r, equant to elongate; sharp to diffuse boundaries. Size = 0.8 to 0.1mm. Two compositions identifiable:

- (1) brown (PPL) (x40) and dark brown (XP); contains fine quartz, mica, opaques
- (2) yellow-orange (PPL, XP) (x40); rare quartz, calcite.

Amorphous Concentration Features (Acf)

Rare: **burnt/partially burnt organics**, sr-r, equant.

Comment

This fabric is characterised by a groundmass rich in fine quartz and foraminifera, containing chert, biotite, quartz-biotite schist, micrite. This groundmass is dominated by a biomicrite and grog temper and it is these features which distinguish Fabric 2e. The groundmass of Fabric 2e is very close to that of Fabric 2b; indeed that of sample 98/49 (Fabric 2b) and sample 97/46 are indistinguishable. Comparison of clay pellets suggests that this groundmass was produced by mixing a calcareous clay rich in foraminifera and containing rare rounded quartz with a non-calcareous quartz-rich clay containing chert, biotite and quartz-biotite schist. This sort of mix was also suggested for Fabrics 2b and 37. For provenance see on Fabric 2b.

(3) Fabric 1b + Fabric 1d

Sample: 97/140

Comment

Sample 97/140 contains a join between a coil in Fabric 1b and a coil in Fabric 1d. It therefore adds to the other links between these two groups (see on Fabrics 1a-c, 1d-f). The join between the two coils occurs at the point of carination: this would be an obvious point at which to pause in forming not only because it allowed the lower part of the vessel to dry and thus gain structural strength prior to the next stage of forming, but also because it facilitated the abrupt change of direction in forming necessitated by the carination. Clear clay layers can be seen forming the outer and inner surfaces of 97/140. These are in Fabric 1b, even when they overlie Fabric 1d and suggest that the final creation of the surface took place using an added clay layer (in Fabric 1b) after the formation of the section of the vessel which was formed using Fabric 1d.

(4) Low/Non Calcareous, Rounded Quartz and Chert, Micrite

Samples: 97/25, 98/25, 98/73

Microstructure

Very few to rare mega to meso planar voids, rare mega to meso vughs. Some voids are surrounded by darker patches, some contain opaque material (e.g. 98/25). Voids and inclusions exhibit local long-axis parallel orientation (e.g. 98/73); the angle of this orientation may vary. Voids and non-plastic inclusions are close to single-spaced.

Groundmass

Fabric is homogenous. Colour varies from yellow-orange or orange (PPL, XP) (x40) to dark brown (PPL, XP) (x40). Micromass varies in optical activity from medium (97/25) to low (98/73).

Inclusions

c:f:v_{10µm} c.25:70:5 to 30:65:5

Coarse fraction = 2.6mm. to 0.1mm.

Fine fraction = 0.1mm or less

Coarse Fraction

Dominant: **micrite**, a-sr, equant to elongate; sometimes with iron concentrations; sometimes contains discrete clasts of rounded quartz, epidote, siltstone/sandstone, feldspar (e.g. 98/73); some examples are more coarse and approach a very fine sparite; very rarely bioclastic (e.g. 98/73). Size = 2.6 to 0.1mm.

Very few to very rare: **fine-grained sparite**, a-sa, equant to elongate. Size = 2.6 to 0.1mm.

Few: **monocrystalline quartz**, r, equant. Size = 0.4 to 0.1mm.

Rare: **polycrystalline quartz**, r, equant. Size = 0.4mm to 0.1mm.

Rare: **chert**, r, equant to elongate. Size = 0.5mm to 0.1mm.

Rare: **alkali feldspar**, r, equant. Size = 0.4 to 0.1mm.

Rare: **plagioclase feldspar**, r, equant. Size = 0.25 to 0.1mm.

Rare to very rare: **quartz-biotite schist**, r, equant. Size = 0.3 to 0.4mm.

Very rare: **biotite mica**, sr, elongate. Size = 0.15 to 0.1mm.

Very rare: **epidote**, r, equant to elongate. Size = 0.15 to 0.1mm.

Very rare: **opaques**, r, equant. Size = 0.25 to 0.1mm.

Fine Fraction

Frequent: **calcite/micrite**.

Very few to rare: **quartz**.

Rare: **biotite mica**.

Rare: **chert**.

Rare: **opaques**.

Very rare: **epidote**.

Amorphous Concentration Features (Acf)

Rare (98/25) to absent: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a groundmass rich in rounded quartz, chert and quartz-biotite schist, which is dominated by micrite temper. The colour of groundmass varies from yellow-orange to orange, which suggests a low calcareous or non calcareous clay (see Chapter 8 for confirmation). The quartz, chert and schist component of Fabric 4 exhibits a narrow size range (0.4 to 0.1mm) and is well sorted. This material could possibly derive from the clay used or have been added as sand; however, the presence of rounded grains of quartz, chert and sandstone/siltstone within the added micrite inclusions (see 98/73) would seem to suggest that this sandy material derived from the micrite temper. The presence of micrite, often with iron concentrations and sometimes containing discrete clasts of quartz links Fabric 4 generally with Fabrics 1a-i and Fabric 2b. However, in none of the fabrics is this sort of micrite as common as in Fabric 4; moreover the groundmass of Fabric 4 is unlike the groundmasses of Fabrics 1a-i and 2a-e (no ostracods, foraminifera). The samples of Fabric 4 also comprise a very good macroscopic group since they have all been covered in a white slip prior to burnishing (see Chapter 8). Fabric 4 unfortunately contains no material diagnostic of a specific origin, although there is nothing inconsistent with a local provenance.

(5a) Low Calcareous, Fine Quartz, Biotite/Muscovite, Micrite/Calcinudstone

Samples: 97/9, 97/15, 97/23, 97/29, 97/48, 97/52, 97/87, 97/93, 97/95, 97/98, 97/99, 97/112, 97/113, 97/114, 97/123, 97/128, 97/129, 98/39, 98/41, 98/52, 98/63

Microstructure

Few to very rare mega to meso planar voids, very few to very rare mega to meso vughs. Very rarely (e.g. 97/15) these voids are calcite-filled or have a calcite lining. Voids generally exhibit local long-axis parallel orientation with inclusions, however this relationship may be at any angle with the vessel margins and different local arrangements may exist within a single section. In 97/9 the orientation of voids and inclusions curves round roughly following the curve of the rim and vessel margins. Voids and inclusions are close to single-spaced.

Groundmass

Groundmass is generally homogenous within single samples but may vary between samples: some samples are rich in quartz, mica (muscovite, biotite) and schist (e.g. 97/52) others are not (e.g. 97/99). Colour varies from orange in PPL (x40) and orange-red (XP) to very dark-brown/black (PPL, XP) (x40). Sample 97/9 has a dark-brown to black (PPL) (x40) core and a dark red outer (PPL) (x40). The size and frequency of non-plastics and voids also varies. Likewise the micromass varies in optical activity from very low to medium (97/29, 97/114, 97/123, 98/41, 98/63) to high (97/23). The b-fabric, where visible, tends to be thin and locally granostriated/porostriated (e.g. 97/114, 98/63).

Inclusions

c:f:v_{10μm} c.20:77:3 to 30:64:6

Coarse fraction = 3.0mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Predominant (97/123) to frequent: **micrite/calcimudstone**, sa-sr, equant to elongate, well-sorted, unimodal. The micrite sometimes has a bedding structure so that it appears to grade into a calcimudstone; often contains foraminifera and other bioclastic material; also contains concentrations of calcite (rounded micrite, sparite), radiolarians(?) infilled with chalcedonic quartz (e.g. 97/52) and more rarely small (c.0.05mm) grains of monocrystalline quartz and mica. Sometimes when mica is more frequent and parallel extinction can therefore be measured, it appears that the calcimudstone may be very slightly metamorphosed (e.g. 97/48). Size = 3.0mm. to 0.2mm., mode = 0.5mm.

Very few (97/9) to very rare: **monocrystalline quartz**, sa-sr, equant, moderately sorted. Size = 1.1mm (97/9) to 0.2mm.

Very few (97/9) to very rare: **polycrystalline quartz**, equant to elongate, well-sorted, sa-r; sometimes resembles a coarse chert. Size = 2.0 (97/9) to 0.2mm.

Very few (97/9) to absent (97/15): **chert**, sa-r, equant to elongate; medium to coarse-grained; sometimes in association with clasts of alkali and plagioclase feldspar (cf. 97/9). Size = 1.1 to 0.2mm, mode = 0.4mm.

Few (97/52) to very rare: **quartz-mica schist**, sa-r, equant to elongate; contains quartz, biotite, muscovite and opaque material; low grade metamorphism. Size = 2.0mm to 0.2mm, mode = 0.4mm.

Rare (97/52) to absent: **muscovite**, a, laths. Size = 0.5 to 0.2mm.

Very rare to absent: **siltstone/pelite**, sr, equant. Generally contains sa-sr quartz/meta-quartz, calcite and mica; retains structure of siltstone. Size = 1.5mm to 0.3mm. (97/15, 97/29, 97/87, 97/99).

Rare (97/98) to absent: **sparite**, sa-sr, equant to elongate. Size = 1.5mm to 0.2mm.

Very rare to absent: **monocrystalline calcite**, a, equant. Size = 0.7mm to 0.2mm.

Rare (97/98) to absent: **micrite with iron concentrations**, r, equant to elongate; sometimes contains discrete clasts of quartz. Size = 2.0 to 0.2mm.

Rare (97/9) to absent: **plagioclase** and **alkali feldspar**, sa-sr, equant to elongate. These are most common as single grains but occasionally are found associated together. Alkali feldspars sometimes enclose mica laths. Size = 0.8mm to 0.2mm

Very rare: **iron oxide**, sa-sr, equant to elongate, size = 0.9 to 0.2mm.

Fine Fraction

Dominant to few (97/99): **monocrystalline quartz**.

Common to few: **polycrystalline quartz**.

Common to few: **muscovite/biotite**.

Very few to very rare: **micrite/calcite**.

Very few to rare: **chert**.

Rare: **iron oxide**.

Very rare to absent: **epidote**.

Very rare to absent: **quartz-mica schist**.

Very rare to absent: **plagioclase feldspar**.

Very rare to absent: **alkali feldspar**.

Rare to very rare: **foraminifera**.

Textural Concentration Features

Few (97/123) to very rare: **clay pellets**, sr-r, usually equant with high sphericity, sharp to clear boundaries. Colour varies from orange-red (PPL) (x40) and red (XP) to dark brown in PPL (x40) and black (XP) (cf. 98/63). Size = 2.5 to 0.2mm., mode = 0.3mm. Two types are identifiable:

- (1) fine clay containing rare fine quartz and biotite (e.g. 98/39);
- (2) quartz-rich, also containing biotite, chert and quartz-mica schist fragments (e.g. 97/93, 97/113, 98/41).

Amorphous Concentration Features

Very few (98/63) to very rare: **burnt/partially burnt organics**; sample 98/63 contains several examples of elongate unburnt/partially burnt organic (largest 0.7mm) in planar voids.

Comment

This fabric is characterised by a groundmass which is usually rich in quartz and also contains biotite, muscovite, chert and quartz-mica schist fragments. Groundmass is homogenous within samples but varies between samples from those which are rich in quartz, mica and schist (e.g. 97/52) to those where quartz, mica and schist are more rare (e.g. 97/99). All of these samples are however linked by the dominant presence of a distinctive bioclastic micrite/calcmudstone temper. Study of clay pellets strongly suggests the use of two clays: a fine red clay containing only rare fine quartz and mica and a coarser red clay rich in quartz and mica and containing also chert and quartz-mica schist. This latter clay therefore seems to be the most likely source of the sometimes large rounded quartz-mica schist grains. The mixing of two clays in different proportions would help to explain the differences in groundmass noted above. Fabric 5a is distinctive and shares few similarities with other fabrics. The presence of micrite with iron concentrations links it generally to Fabrics 1a-i, 2b and 4. However, it differs in all other respects from these groups (groundmass, large non-plastics). Fabric 5b has similar large limestone inclusions to Fabric 5a, however it has a groundmass which is richer in foraminifera.

There is some indication that thicker walled burnished vessels have non-plastic inclusions at the upper end of the size range (e.g. 97/9, 97/87, 97/112, 97/123, 98/39), while thinner walled polished vessels have inclusions at the lower end. However there are several borderline cases (e.g. 97/52, 97/93, 98/52), which demonstrate that this is only a tendency and *not* a clear distinction. No clear examples of coil-joins could be identified, but structural discontinuities observed in a number of samples would be consistent with coil forming. Areas of differential birefringence near the surfaces of some samples suggest that surfaces were compacted during polishing (e.g. 97/23, 97/114 98/63); on some (i.e. 97/93, 97/95, 97/128) there is also a layer which appears too thin (0.01-0.02mm) to be a slip and may be a thin layer of fine clay created by the process of burnishing or polishing; in one example there appears to be a non-calcareous slip layer (97/48), however this layer also contains quartz and may therefore not so much a slip as a more plastic version of the body. Some vessels were also incised: the incision in 97/99 appears to have been done with a tool with square-shaped tip, while the scoring in 97/98 was done with a tool with curved tip. The variety in the degree of optical activity and the colour range suggests that vessels were fired to a variety of temperatures and were exposed to a variety of atmospheres (oxidising to

reducing). In many samples there are traces of burnt, partially burnt and even unburnt organic material. These features would be consistent with fast firing in an open environment.

The raw materials present in this fabric (biotite, muscovite and quartz-mica schist) originate in low grade metamorphic deposits whose source cannot be within the immediate area of Knossos (c.0-5km) (see Appendix III). Instead these would seem to link to rocks of the Phyllite-Quartzite series, the nearest outcrops of which are to the east or west of the Herakleion basin or possibly around Iouktas (see Appendix III). The frequently bioclastic micrite/calcimudstone temper would be compatible with a source somewhere in north-central Crete. The presence of micrite with iron concentrations may suggest a source within the same general area as Fabrics 1a-i, 2a-e and 4. A source within the general area (>5km) of Knossos is also suggested by the high frequency with which this fabric consistently occurs at Knossos (see Chapter 9). In addition the clay component rich in quartz and containing quartz-mica schist may have parallels in an EMIB cooking pot fabric at Knossos (i.e. Group 4, Wilson & Day 1999:38-9, 50-2).

(5b) Low/ Non Calcareous, Fine Quartz, Foraminifera, Micrite/Calcimudstone

Sample: 98/9

Microstructure

Very rare meso planar voids, very few mega to meso vughs. Some voids contain opaque, possibly organic material. Inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins, forming what appears to be a curve. Inclusions are close to single-spaced.

Groundmass

Colour is yellow to orange-yellow (PPL, XP) (x40). The micromass is very mildly optically active.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse fraction = 2.2mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **bioclastic micrite limestone**, sa, equant to elongate; fine-grained, show bedding structures; occasionally contain tiny rounded isolated clasts of calcite, quartz, opaques. Size = 2.2mm to 0.2mm.

Few: **foraminifera/large shell frags..** Size = 0.9 to 0.2mm

Very rare: **sparite**, sr, equant to elongate; also contains shell fragment. Size = 1.8mm.

Rare: **micrite with iron concentrations**, sr, equant; some contain quartz. Size = 1.75 to 0.2mm.

Rare: **monocrystalline calcite**, r, equant to elongate. Size = 0.4 to 0.2mm

Rare: **chert**, r, elongate. Size = 0.4mm

Rare: **opaques**, sa-r, equant to elongate; sometimes contain fine quartz. Size = 0.45 to 0.25mm.

Very rare: **plagioclase**, r, elongate. Size = 0.4mm

Fine Fraction

Frequent: **micrite/calcite**

Frequent: **monocrystalline quartz**

Few: **foraminifera**

Very few: **mica**

Very few: **chert**

Rare: **opaques**

Very rare: **plagioclase**

Textural Concentration Features (Tcf)

Rare: **clay pellets**, r, equant, high sphericity; colour is red to red brown (XP) (x40); clear boundaries. Size = 0.5 to 0.1mm. Two types are identifiable:

- (1) red, quartz-rich, also contains biotite mica, quartz-mica schist, opaques;
- (2) red, rich in foraminifera, also contains rare quartz.

Comment

This fabric is characterised by a groundmass rich in quartz and foraminifera, also containing mica, chert and micrite with iron concentrations. This groundmass is dominated by micrite limestone which link this fabric to Fabric 5a. However the groundmass of 5b differs from 5a in the frequent presence of foraminifera. Study of clay pellets suggests that these derive from one component of a mix of two clays: one rich in quartz, containing mica and quartz-mica schist (similar to one of the clay components of Fabric 5a) and one containing little quartz and mica, but rich in foraminifera. In view of the connections noted with Fabric 5a it is likely that Fabric 5b and 5a share the same provenance.

(5c) Low/Non Calcareous, Calcareous Sandstone/Siltstone

Sample: 98/57

Microstructure

Very few mega to meso vughs, rare meso planar voids. Some voids are surrounded by darker patches. Inclusions and voids exhibit local long-axis parallel

orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour is brown (PPL) (x40) and brown-red (XP). The micromass is strongly optically active. B-fabric is medium to thick granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.27:68:5

Coarse fraction = 2.0 mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **calcareous siltstones**, a-sr, equant to elongate; well-sorted; grain size is 0.05mm or less; consists of rounded quartz, mica, calcite, opaques; high sphericity; matrix-supported; mica shows varying orientation. Size = 2.0 to 0.2mm, mode = 0.7mm.

Rare: **monocrystalline quartz**, sr-r, equant to elongate. Size = 0.4 to 0.2mm

Very rare: **polycrystalline quartz**, sr, equant. Size = 0.2mm

Very rare: **quartz-biotite schist**, sr, equant. Size = 0.2mm.

Very rare: **opaque**, r, equant; contains quartz, mica. Size = 0.25mm to 0.2mm

Fine Fraction

Dominant: **monocrystalline quartz**.

Very few: **chert**.

Few: **calcareous siltstone**.

Few: **mica**.

Rare: **opaques**.

Very rare: **alkali/plagioclase feldspar**.

Very rare: **epidote**.

Amorphous Concentration Features (Acf)

Rare: **burnt/unburnt burnt organics**; several voids contain organic material.

Comment

This fabric is characterised by a red-firing clay groundmass, rich in fine quartz with mica and chert and dominated by calcareous siltstones. The groundmass is not unlike that of Fabric 5a (quartz rich, micaceous, quartz-biotite schist); no parallels however are possible for the large calcareous siltstone non-plastics, which appear to have been added as temper.

(6) Non-Calcareous, Quartz-Rich, Altered Volcanics, Siltstone/Sandstone, Dolerite

Samples: 97/8, 97/13, 97/21, 97/45, 97/67, 97/68, 97/74, 97/80, 97/96, 97/97, 98/12, 98/13, 98/14, 98/15, 98/16, 98/18, 98/23, 98/31, 98/61, 98/64, 98/100

Microstructure

Very few to rare macro to meso vughs and very few to very rare macro to meso planar voids. Voids are single to double-spaced. In many samples (e.g. 97/9, 97/45, 97/96, 98/16, 98/31, 98/68, 98/100) planar voids are locally oriented parallel to each other and vary from parallel to c.45° to vessel margins. The angle may vary between different areas of the same sample. In some samples (e.g. 97/9, 97/45, 97/68, 97/96, 98/16, 98/18, 98/100) the larger non-plastics exhibit a crude orientation parallel to the planar voids. Inclusions are close to single-spaced.

Groundmass

Groundmass is generally homogenous within single samples, but may vary between samples from one rich in schist (e.g. 97/68) with no igneous rocks, to one with igneous rocks (e.g. 97/8, 98/18); others are richer in sandstone (e.g. 97/13) or siltstone/pelite (e.g. 97/74, 97/80). Usually there is colour variation between cores and margins (e.g. 97/8, 97/13, 97/45, 98/14, 98/23, 98/61, 98/64). Generally colour varies from orange margins in PPL (x40) and orange-red in XP to dark brown cores in both PPL (x40) and XP. However samples 97/21 and 97/97 are entirely dark brown in PPL (x40) and dark brown to black in XP. Colour variation is particularly striking in sample 98/61, where in XP a dark brown core is 'sandwiched' between an orange-red outer. The micromass varies in optical activity from low to high (97/68, 98/13, 98/15, 98/18, 98/31). Thin to medium parallel striated b-fabric present in samples 98/16, 98/18, 98/31; thin to medium porostriated b-fabric in samples 97/8, 97/13, 97/67, 97/68, 97/96, 98/13, 98/64, 98/100.

Inclusions

c:f:v_{10µm} c.25:72:3 to 30:64:6

Coarse fraction = 3.0mm to 0.2mm

Fine fraction = 0.2mm or less

Coarse Fraction

Frequent to very few: **altered volcanic rock fragments**, a-sa, equant to elongate; generally composed of plagioclase feldspar laths within a devitrified groundmass; often these are altered (chloritised e.g. 98/12; serpentinised e.g. 98/18) sometimes to biotite (e.g. 98/64). Probably originally a basalt. May sometimes contain calcite in the interstices (e.g. 98/12); in sample 97/68 there is a large (2.75mm) altered calcite-rich rock fragment; more rarely texture is porphyritic with discrete rounded altered volcanic phenocrysts set within a mica-rich matrix (e.g. 98/31). Size = 2.75 to 0.2mm.

Very few (97/8, 98/18) to absent: **igneous rock fragments (dolerite)**, sa-r, equant to elongate; usually rounded; contain clinopyroxene with laths of plagioclase, sometimes with an ophitic texture, also contains biotite, amphibole and rarely clinozoisite (97/67): resembles dolerite (e.g. 97/96) or basalt. Some of these also appear to be chloritised/serpentinised (e.g. 98/13, 98/23). Size = 3.0 to 0.2mm.

Rare to absent: **serpentine**, sa-sr, equant to elongate; (cf. 97/45, 98/12, 98/18, 98/64). Size = 1.5 to 1.0mm.

Few (97/13, 97/96) to absent (98/12): **sandstone**, sa-sr, high sphericity; mostly fine-medium sandstone, some grade into siltstone; fairly well sorted; contains predominantly quartz, some feldspar and occasional mica, chert and opaques; grain-supported with little matrix; grains are generally sa-sr, equant (some

elongated) with low sphericity. More rarely (e.g. 97/96) sandstone has been partially metamorphosed to form biotite laths which are aligned to form a schistosity. Size = 2.35 to 0.2mm.

Few (97/74, 98/61) to absent (98/12): **siltstone/pelite**, sr-r, equant to elongate; contains quartz and biotite; varies from red-brown matrix-supported bedded structure to a grain-supported well-sorted structure; example in 97/45 shows interface between these two structures; some appear to be siltstones (e.g. 97/45), but more usually partially metamorphosed to form biotite laths which show parallel alignment (pelite). Size = 2.75 to 0.2mm.

Few (97/68) to very rare: **quartz-biotite/muscovite schist**, a-r, equant to elongate; sometimes also contain opaques. Size = 1.6 to 0.2mm.

Very few: **monocrystalline quartz**, sa-r, equant. Size = 0.9mm to 0.2mm.

Very few to rare: **polycrystalline quartz**, a-r, equant to elongate. Size = 1.6 to 0.2mm.

Rare (97/68) to very rare: **biotite mica**, sr-r, elongate. Size = 1.25 to 0.2mm.

Very few (97/8) to very rare: **chert**, sr, equant to elongate; some contain calcite or mica (97/96); sometimes has a muddy brown appearance (brown chert) (e.g. 98/16); one example contains radiolarians(?) infilled with chalcedonic quartz (98/16). Size = 3.0mm to 0.2mm

Very few (98/100) to absent: **micrite**, sr-r, equant to elongate; sometimes with iron concentrations; sometimes contains discrete clasts of quartz or plagioclase feldspar. Size = 1.75 mm to 0.2mm.

Very rare to absent: **epidote**, r. Size = 0.25 to 0.2mm.

Very rare (97/8, 97/74, 97/80) to absent: **foraminifera**. Size = 0.2mm.

Rare to very rare: **plagioclase feldspar**, sa. Size = 0.7 to 0.2mm.

Rare to very rare: **alkali feldspar**, sr-r; usually associated with mc/pc quartz or plagioclase, sometimes poikilitic enclosing laths of mica (98/13). Size = 0.5 to 0.2mm.

Very rare (98/13) to absent: **pyroxene**, sa. Size = 0.75 to 0.2mm.

Very rare (97/8) to absent: **olivine**, r. Size = 0.25mm.

Very rare (97/8, 97/96) to absent: **amphibole**, sa. Size = 0.3 to 0.2mm.

Very rare (97/13) to absent: **chlorite pseudomorph**, equant, sr. Size = 0.3mm.

Very rare (e.g. 98/12, 98/31) to absent: **opaques**, usually containing quartz grains. Size = 0.75mm to 0.2mm.

Very rare (98/61) to absent: **radiolarian test(?)**; infilled with chalcedonic quartz. Size = 0.55mm.

Fine Fraction

Dominant: **monocrystalline quartz**.

Common: **polycrystalline quartz**.

Common to few: **biotite**.

Very few to rare: **plagioclase/alkali feldspar**.

Very few to rare: **chert**.

Rare **epidote**.

Rare **opaques**.

Rare to absent: **micrite**.

Rare: **igneous rock fragments**.

Very rare to absent: **pyroxene**.

Very rare to absent: **olivine**.

Very rare to absent: **amphibole**.

Very rare (98/13) to absent: **foraminifera**.

Textural Concentration Features (Tcf)

Rare to absent: **clay pellets**, sr-r, equant; diffuse to clear boundaries; low to medium optical density. Size = 2.2mm to 0.1mm. Two main types are identifiable: (1) orange to brown (XP x40), fine quartz, pyroxene, biotite, feldspar, containing igneous rock fragments (plagioclase, alkali feldspar, clinopyroxene, biotite = dolerite or basalt?) (e.g. 97/8, 97/45, 97/67, 98/16); igneous rock fragments are sometimes rounded (e.g. 97/8, 97/67); also contains some calcite (e.g. 97/8); (2) orange-red to dark brown (PPL, XP x40), contains quartz, biotite, r quartz-mica schist, r pelite, brown chert (e.g. 97/96, 98/13).

Amorphous Concentration Features (Acf)

Rare to very rare: **burnt/partially burnt organics**; sample 98/31 contains voids in shape of organics; 97/67 has a single macro channel with smudged edges; 98/12 contains unburnt organic material (0.3mm). Size = 0.5 to 0.2m.

Comment

This fabric is characterised by a groundmass which is red-firing (non-calcareous?), rich in quartz, chert and mica and variously containing igneous rock fragments (dolerite), sandstone, siltstone/pelite, sandstone. This groundmass is dominated by altered volcanic rock fragments which, to judge by their angularity and size distribution were added as temper. The groundmass is generally homogenous within single samples, but may vary between samples from one rich in schist (e.g. 97/68) with no igneous rocks, to one with igneous rocks (e.g. 97/8, 98/18); others are richer in sandstone (e.g. 97/13) or siltstone/pelite (e.g. 97/74, 97/80). Study of clay pellets suggests that two clays were mixed: one orange-red (non-calcareous?) containing fine quartz, pyroxene, biotite, feldspar and dolerite and more rarely calcite; the other red (non-calcareous?) containing quartz, biotite, rounded quartz-mica schist, rounded pelite, brown chert. The mixing of these two clays in varying proportions would help to account for the variability observed in groundmass. Fabric 6 is distinctive and shares no obvious similarities with any other fabric. One might have expected to observe a relationship with Fabric 10 (serpentine), however the groundmass of Fabric 10 is quite different (mafic rocks) from that of Fabric 6 (dolerite, sandstone, siltstone/pelite). The closest fabric to Fabric 6 is Fabric 7 which shares similar dolerites (cf. 98/12 (Fabric 6) to 97/14 (Fabric 7)); however Fabric 7 lacks altered volcanic rocks and is instead dominated by fine-grained sparite.

No clear examples of coil building were noted. Several samples have areas of differential birefringence near their surfaces, which suggest that compaction due to burnishing or polishing has taken place (e.g. 98/31, 97/80, 97/13, 98/13); some samples have a very thin (0.01 to 0.02mm) layer, which looks like a non-calcareous slip layer (e.g. 98/16, 98/18). It remains possible, however, that this layer is a natural result of intensive burnishing or polishing. The variation in colour both within and between samples suggests that during firing vessels were exposed to a range of atmospheres (oxidising/reducing). Samples exhibit a range of optical activity from low to high. In most samples there are traces of burnt or partially burnt organic material. All of these features are consistent with fast firing in an open environment.

The raw materials present in this fabric (altered volcanic rocks, dolerite, quartz-mica schist, siltstone/pelite, sandstone) originate in deposits whose source cannot be within the immediate area of Knossos (c.0-5km) (see Appendix III). The quartz-mica schist and siltstone/pelite would seem to link to rocks of the Phyllite-Quartzite series, the nearest outcrops of which are to the east or west of the Herakleion basin or possibly around Iouktas (see Appendix III). The distinctive altered volcanic and doleritic inclusions may have an origin within the ophiolite series of Central Crete, the nearest outcrops of which are in the foothills of mount Ida or near Galeni and Roukani to the south of mount Iouktas (see Appendix III). The generally high frequency with which Fabric 6 occurs at Knossos (see Chapter 9) may suggest that its source is not too distant from Knossos. A broadly local north-central Cretan provenance is suggested by similarities between Fabric 6 and an EMIIB cooking pot fabric from Knossos (i.e. Group 3, Wilson & Day 1999:48-50).

(7) Non-Calcareous, Fine Quartz, Dolerite, Fine-Grained Sparite

Samples: 97/6, 97/14, 97/17, 97/26

Microstructure

Rare to very rare macro to meso vughs and rare to very rare meso planar voids. Some voids are surrounded by darker brown patches, others contain opaque material (e. 97/17). Inclusions are close to single-spaced.

Groundmass

Fabric is homogenous. Colour is orange-red to brown (PPL, XP x40). The micromass is optically active. B-fabric is thin porostriated granostriated.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.0mm to 0.2mm

Fine fraction = 0.2mm or less

Coarse Fraction

Dominant to frequent: **fine-grained sparite**, a-sa, equant to elongate; grain-size c.0.05 to 0.4mm, mode 0.1mm) in sample 97/6 some sparite has been altered (see below on secondary calcite alteration). Size = 1.9 to 0.2mm.

Few to rare: **igneous rock fragments (dolerite)**, sa-r, equant to elongate; usually rounded; contain laths of plagioclase with biotite, amphibole, clinopyroxene; sometimes with an ophitic; resembles dolerite. Some of these also appear to be chloritised/serpentinised (e.g. 97/26). Size = 1.4 to 0.2mm.

Few to rare: **altered volcanic rock fragments**, a-sa, equant to elongate; generally composed of plagioclase feldspar laths within a devitrified groundmass; often these are altered (chloritised e.g. 97/26). Probably originally a basalt. Size = 1.4 to 0.2mm.

Rare to very rare: **monocrystalline quartz**, sa-sr, equant. Size = 0.6 to 0.2mm.

Rare to very: **polycrystalline quartz**, r, equant to elongate. Size = 1.7 to 0.2mm.

Rare: **chert**, sa-sr, equant to elongate. Size = 2.0 to 0.2mm

Very rare (97/6): **sandstone/siltstone**, r, equant; contains predominantly quartz, some mica, chert and opaques; grain-supported with little matrix; grains are generally sa-sr, equant (some elongated) with low sphericity. Size = 0.9 to 0.2mm.

Very rare (97/6): **quartz-biotite schist**, sr, elongate. Size = 0.7mm.

Very rare (97/6): **monocrystalline calcite**, sa, equant to elongate. Size = 0.6 to 0.2mm.

Very rare (97/17) to absent: **opaques**, r, equant. Size = 0.2mm.

Fine Fraction

Frequent: **quartz**.

Common to rare: **calcite**.

Rare: **chert**.

Rare: **plagioclase feldspar**.

Rare: **alkali feldspar**.

Rare: **biotite**.

Rare: **epidote**.

Rare: **igneous rock fragments**.

Very rare: **opaques**.

Textural Concentration Features (Tcf)

Very rare to absent: **clay pellets**, sr-r, equant; diffuse to clear boundaries; low to medium optical density; orange-red (XP x40), contain quartz, pyroxene, biotite, rounded igneous rock fragment. Size = 0.3mm to 0.1mm.

Amorphous Concentration Features (Acf)

Rare to absent: **burnt/partially burnt organics**; in sample 97/17 void has shape of organic and still contains some opaque material.

Comment

This fabric is characterised by a groundmass which is red-firing (non-calcareous), rich in quartz and also contains altered volcanic rocks, dolerite and sandstone. This clay groundmass is dominated by a coarse fine-grained sparite temper. The fabric is homogenous with little variation in groundmass or large non-plastics between samples. The groundmass is very similar to the dolerite-rich clay component of Fabric 6. Fabric 7 however has very little quartz-mica schist and siltstone pelite, characteristic of the other clay component of Fabric 6. The absence of this material may suggest that Fabric 7 is formed from only one of the clay components of Fabric 6. Study of clay pellets would also support this. The sparite closely resembles that found in Fabrics 1a-c. Some of the sparite in 97/6 has been altered to form micritic clots, which retain only a relict primary sparite structure. This suggests that some alteration of calcite occurred during firing, which may in turn indicate that this vessel was exposed to temperatures exceeding c.800°C. See on Fabric 6 for likely provenance.

(8) Non-Calcareous, Quartz-Rich, Siltstone/Pelite, Micrite

Samples: 97/1, 97/19, 97/20, 97/31, 97/35, 97/47, 97/69, 97/70, 97/75, 97/94, 98/8, 98/11, 98/19, 98/28, 98/30, 98/45, 98/46, 98/55, 98/59, 98/60, 98/66, 98/93

Microstructure

Very few to rare macro to meso vughs and few (98/11) to rare mega (98/46) to meso planar voids. Voids are single to double-spaced and are generally oriented parallel to the long-axis of the large non-plastic inclusions. Voids usually remain free from calcification; a rare exception being 98/28. Inclusions are close to single-spaced and generally exhibit local long-axis parallel orientation varying between parallel to vessel margin (e.g. 97/1, 97/31, 97/47, 97/75, etc.) to almost perpendicular to vessel margin (e.g. 97/20, 98/66, 97/75). Sometimes inclusions are oriented in a curve (e.g. 98/66).

Groundmass

Groundmass is generally homogenous within single samples but may vary between samples: some samples are rich in sparite (e.g. 98/27), others are not (e.g. 98/59); some are rich in quartz (e.g. 97/70) others are not so rich (e.g. 98/19). Colour also varies from red-orange (PPL) (x40) and orange-red (XP) to dark brown (PPL) (x40) and very dark brown/black (XP). Several samples (e.g. 97/1, 97/69, 98/28) show strong colour differentiation either between core and outer or between interior and exterior. The micromass varies in optical activity from low (e.g. 97/1) to high (e.g. 98/19, 98/93). B-fabric is generally medium to thick porostriated/granostriated.

Inclusions

c:f:v_{10µm} c.25:72:3 to 30:63:7

Coarse fraction = 6.30mm to 0.25mm.

Fine fraction = 0.25mm or less.

Coarse Fraction

Dominant to frequent: **siltstone/pelite** (partially metamorphosed siltstone), sa-r, equant to elongate. Generally rock fragments display parallel extinction but within an intact well-sorted sedimentary structure varying from siltstone to a fine sandstone with a matrix-supported texture. Usually individual clasts of quartz, mica, calcite, feldspar, generally exhibiting high sphericity, are set within a clay-rich matrix with long-axis orientation parallel to the bedding lines. Sometimes clay-rich beds alternate with bands of chert (e.g. 98/30). More often these beds are interspersed with areas grading into a **fine sandstone/psammite** (e.g. 98/60), which are grain-supported and rich in larger (0.05mm to 0.25mm) clasts of quartz (both monocrystalline and polycrystalline metamorphosed quartz), biotite mica, chert, feldspar and rarely calcite (e.g. 97/20, 98/66, 97/75, 98/30); sometimes these areas appear to be metamorphosed (e.g. 98/8). Siltstone/pelite beds are also regularly interspersed with areas rich in calcite (sparite) (e.g. 98/66) and more rarely with chert (e.g. 98/30). Size = 6.30 to 0.25mm.

Rare (97/35) to absent: **fine sandstone**, sr, elongate; grain-supported, contains quartz, plagioclase, biotite. Size = 1.3 to 0.4mm.

Very few to absent: **calcareous siltstone**, sa, equant to elongate; contains predominantly a-rclasts of quartz, biotite and calcite in a calcareous matrix; varies in texture from grain-supported (e.g. 98/55) to matrix-supported (e.g. 98/30, 98/66). Sometimes found in association with siltstone/pelite and may therefore derive from the same source as the siltstone/pelite rocks discussed above. Size = 3.75mm (98/55) to 0.25mm

Few (98/27) to absent: **sparite**, sr, equant to elongate; usually fine-grained (c.0.05mm); sometimes sparite is very coarse-grained (c.0.2-0.3mm), more angular and resembles calcitic areas within the siltstone/pelite non-plastics; sometimes this more angular and coarse-grained sparite is in association with a siliceous matrix (e.g. 98/60) not unlike that of the siltstone/pelite non-plastics. This coarser sparite may therefore derive from this source. Size = 2.4 to 0.25mm. Rare to very rare: **monocrystalline calcite**, a-sa, equant to elongate. Size = 0.6 to 0.25mm.

Rare to very rare: **micrite with iron concentrations**, r; often contains rounded clasts of quartz, more rarely chert, plagioclase, foraminifera. Size = 5.6 to 0.25 mm.

Very rare to absent: **foraminifera**. Size = 0.4 to 0.25mm.

Rare to absent: **biomicrite**, sa-sr, equant to elongate (cf. 97/20, 98/28). Size = 0.6 to 0.25mm.

Rare: **monocrystalline quartz**, sa-r, equant to elongate. Size = 1.25 to 0.25mm.

Rare: **polycrystalline quartz**, a-r, sometimes with sutured contacts (e.g. 98/60, 98/66). Size = 1.25 to 0.25mm.

Rare to very rare: **chert**, sa-r; usually fine-grained but also in association with close-spaced clasts (0.35 to 0.01mm) of quartz, alkali and plagioclase feldspar (e.g. 98/66, 97/20, 97/75). Chert is occasionally found within fragments of siltstone/pelite (see above) (e.g. 98/30). Size = 1.5mm to 0.25mm.

Very rare to absent: **quartz-biotite schist**, r, equant to elongate; example in 97/20 exhibits crenulation cleavage (see 97/20, 97/55, 97/70, 97/94, 98/11). Size = 1.0 to 0.4mm.

Very rare (98/60) to absent: **igneous rock fragments**, sr-r. These vary in texture and composition. Sample 98/60 contains a fragment of a medium to fine-grained rock, containing plagioclase feldspar and pyroxene (dolerite?). One example in 97/75 contains laths of plagioclase (0.3mm to 0.05) in a yellow (biotite-rich) matrix (diorite?). An example in 98/46 contains plagioclase laths, alkali feldspar, quartz (diorite?). Size = 0.85mm to 0.25mm.

Very rare to absent: **plagioclase/alkali feldspar**, sa-sr. Size = 1.1 to 0.25mm.

Very rare to absent: **chlorite pseudomorph**, r. Size = 1.35mm to 0.25mm.

Fine Fraction

Dominant to frequent: **quartz**.

Few to rare: **calcite**.

Few to rare: **biotite**.

Rare: **siltstone/pelite rock fragments**.

Rare: **chert**.

Rare: **plagioclase**.

Very rare: **alkali feldspar**.

Rare: **opaques**.

Rare to absent: **epidote**.

Rare to absent: **quartz-biotite schist**.

Very rare to absent: **igneous rock frags**.

Very rare to absent: **pyroxene**

Very rare (98/46, 98/60) to absent: **foraminifera**.

Textural Concentration Features (Tcf)

Few to very rare: clay pellets, high sphericity, r, with clear to diffuse boundaries. Colour varies from yellow-brown or orange (PPL, XP) (x40) to very dark brown (PPL, XP) (x40). Size = 2.6mm (97/69) to 0.1mm. Two types are identifiable:

(1) Brown to very dark brown, rich in a-sa monocrystalline and polycrystalline quartz and biotite mica; contain also plagioclase, r chert, r quartz-biotite schist (see 97/69, 97/70, 98/27).

(2) Yellow/orange-brown, fine clay rare inclusions; rare discrete fine r quartz, biotite, opaques; example in 98/46 also contains biomicrite and appears to be calcareous (see 97/20, 98/19, 98/46, 98/27).

Amorphous Concentration Features (Acf)

Very few to rare: **partially burnt organics/darkened areas around voids**. Sometimes traces of opaque (organic?) material are preserved (e.g. 97/75, 98/28, 98/93) sometimes without any trace of burning (e.g. 98/46).

Comment

This fabric is characterised by a groundmass which is usually rich in quartz and also contains biotite, micrite, sparite, rare chert, quartz-biotite schist, r igneous rock fragments. This groundmass is homogenous within individual samples but varies between samples from those which are rich in quartz and biotite (e.g. 97/35, 97/70, 97/75) to those where quartz and biotite are more rare (e.g. 98/19, 98/28). All of these samples are linked by the large siltstone/pelite non plastic inclusions which dominate the groundmass and help to define the group. Consideration of size, distribution and angularity indicates that these siltstone/pelite inclusions were added as temper. Study of clay pellets strongly suggests the mixing of two clays (cf. 97/20, 98/27, 98/55): a red-firing clay rich in angular quartz, also containing biotite, chert, quartz-biotite schist, and a fine yellow/orange firing clay, which contains few inclusions, usually very fine discrete rounded clasts of quartz, some fine biotite, opaques and biomicrite. The latter clay is the likely source for the majority of the calcareous component of Fabric 8 (biomicrite, sparite, micrite with iron concentrations, foraminifera), although the angular coarse-grained sparite and the large individual calcite grains probably derive from the calcareous component of the siltstone/pelite temper. The mixing of these two clays, perhaps in varying proportions would help to explain the differences in groundmass noted above.

The siltstone/pelite in Fabric 8 shares some similarities with the siltstone/pelite in Fabric 26 although the pelite in these frequently contains opaque areas which are oriented the bedding plane. Moreover the groundmass of Fabric 26 is different: much finer quartz, more metamorphic rock fragments, more opaques and no calcareous component. Closer similarities exist with Fabric 9, which in general differs from Fabric 8 only in terms of texture and packing. Fabric 9 is therefore considered a technological variant of Fabric 8. Fabric 21 contains siltstone/pelite similar in composition and texture to Fabric 8, however the groundmass is different: generally larger more angular quartz, large shell and bioclastic limestone fragments.

Consideration of orientation of voids, inclusions and b-fabric and use of a lambda plate allowed the identification of probable coil-joins in 97/20, 97/94 and 98/66. Non-calcareous slip layers were noted on the exterior surfaces of 98/30, 98/46, 98/59 and 98/60. All of these samples come from polished vessels suggesting the use of slips may have been used only when a surface was to be

polished. At the surfaces of other samples areas of differential birefringence in several cases are suggestive of compaction due to burnishing (e.g. 97/19, 98/93, 98/59 [interior surface]). The wide variety in optical activity of samples of Fabric 8 suggests that these may have been fired to a variety of temperatures. Likewise variation in the colour of the groundmass from orange-red to very dark brown suggests variability in firing atmosphere (oxidising-reducing). A small number of samples show a steep gradient between oxidised exteriors and strongly reduced interiors. The presence of unburnt/partially burnt organics in combination with these other features would be compatible with fast firing in an open environment.

The majority of the components of Fabric 8 are inconsistent with a provenance within the immediate area of Knossos (<5km). The low-grade metamorphic component (siltstone/pelite rock fragments) would be consistent with an origin within the greenschist facies of the Phyllite-Quartzite Series of central-east Crete. Closest sources would be the north-western edge of the Herakleion Basin or possibly Iouktas (see Appendix III). The quartz-biotite schist fragments within the quartz-rich clay component may also derive from this source. However the other, quartz-poor and possibly calcareous clay component could be compatible with a source within the immediate area of Knossos as well as elsewhere in north-central Crete: the presence of bioclastic limestone, micrite with iron concentrations and foraminifera provide a link between this clay component of Fabric 8 and Fabrics 1a-i.

(9) Non-Calcareous, Quartz, Pelite/Phyllite

Sample: 97/34

Microstructure

Rare macro to meso planar voids, few to rare mega to meso vughs. Some voids contain opaque, possibly organic material. Voids and inclusions exhibit local long-axis orientation generally parallel to the vessel margins. Inclusions are close-spaced.

Groundmass

Colour is orange-red (PPL, XP) (x40). The micromass is optically active. B-fabric is thin to thick granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse fraction = 3.0mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **pelite/phyllite rock fragments**, a-sa, equant to elongate; usually retains bedding structure of a siltstone, but rich in fine mica which exhibit parallel orientation; matrix-supported, well-sorted; contains mica, quartz (mostly monocrystalline, although polycrystalline quartz also occurs), calcite, opaques; sometimes in association with areas rich in quartz, mica; grain-supported. Size = 3.0 to 0.2mm.

Very rare: **micrite with iron concentrations**, r, equant; contains isolated grains of quartz, mica. Size = 0.5 to 0.2mm.

Rare: **coarse-grained sparite**, sa-r, equant to elongate; grain-size varies from c.0.05 to 0.35mm. Size = 1.2 to 0.2mm

Very rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.25 to 0.2mm.

Very rare: **polycrystalline quartz**, r, equant to elongate. Size = 0.3 to 0.2mm.

Very rare: **chert**, r, equant to elongate; sometimes contains larger clasts of quartz. Size = 0.3mm to 0.2mm

Fine Fraction

Dominant to frequent: **monocrystalline quartz**.

Common: **pelite/phyllite**.

Few: **polycrystalline quartz**.

Rare: **calcite**.

Rare: **biotite**.

Rare: **opaques**

Very rare: **chert**.

Very rare: **quartz-biotite schist fragments**.

Very rare: **epidote**.

Very rare: **amphibole**.

Very rare: **plagioclase feldspar**.

Textural Concentration Features (Tcf)

Very few to rare: **clay pellets**, r, equant; sharp to diffuse boundaries. Size = 1.6 to 0.1mm, mode = 0.2mm. Two possible types are identifiable:

(1) Brown (XP, x40), a-sa quartz, biotite, chert;

(2) Orange/brown (XP, x40), fine clay very rare small r quartz, biotite.

Amorphous Concentration Features (Acf)

Rare to very rare: **burnt/partially burnt organic material**.

Comment

The fabric is characterised by a orange-red firing clay groundmass, which contains quartz, biotite, rare chert, plagioclase and epidote. This groundmass is dominated by large pelite/phyllite rock fragments, which were added as temper. In both its groundmass and large non-plastics Fabric 9 closely resembles Fabric 8, the main difference between the two being largely in texture and packing: in 97/35 the large non-plastics are very well packed. Like Fabric 8, Fabric 9 may have resulted from the mixing of two clays, however this is not certain. It is considered likely that Fabrics 8 and 9 are closely related and that Fabric 9 is a technological variant of Fabric 8. For provenance see Fabric 8.

(10) Non-Calcareous, Quartz-Rich, Serpentine, Siltstone/Sandstone, Mafic Rocks

Samples: 97/56, 97/71, 97/108, 98/40, 98/47, 98/48

Microstructure

Very few to rare macro to meso planar voids, rare mega to meso vughs, very rare (98/48) to absent channels. Some voids are surrounded by darker patches (e.g. 97/71, 98/48), some contain opaque, possibly organic material (e.g. 98/48). Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins sometimes across a single sample (e.g. 97/71). Inclusions are close to single-spaced.

Groundmass

Fabric is generally homogenous within individual samples but may vary between samples: some samples are rich in mafic rocks (e.g. 97/108) others contain very few (e.g. 97/56). Colour varies from orange-red to brown (PPL, XP) (x40). The micromass varies in optical activity from low (e.g. 97/108) to high (e.g. 98/40). B-fabric is thin to medium granostriated/porostriated (e.g. 98/47).

Inclusions

c:f:v_{10µm} c.25:70:5 to 30:65:5

Coarse fraction = 4.0mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant to frequent: **serpentinite**, a-sr, equant to elongate; often in association with biotite mica, more rarely intercalated with calcite. Size = 4.0mm to 0.2mm.

Very few (98/48) to absent: **chlorite pseudomorphs**, r, equant; one large example in 98/48 appears to be partially serpentinised. Size = 2.25mm to 0.2mm.

Rare to absent (97/56): **phyllite**, r, equant to elongate; quartz, mica, opaques; some examples retain structure of a siltstone (= pelite). Size = 1.0 to 0.2mm.

Rare: **coarse siltstone/fine sandstone**, r, equant to elongate; contains quartz (monocrystalline, polycrystalline), chert, mica, amphibole, opaques; grain-size varies from 0.02 to 0.4mm; usually well-sorted, grain-supported. Size = 1.0 to 0.2mm.

Few (97/108) to very rare (97/71): **igneous (mafic) rock frags.**, r, elongate; examples in 97/108 contain biotite, amphibole, pyroxene, quartz, feldspar and opaques; sometimes in association with larger (c.0.6mm) amphibole grains; one example in 97/71 is rich in biotite with some plagioclase in association with larger (0.2mm) alkali feldspar grains; some examples in 97/102 rich in pyroxene or plagioclase. Size = 1.25 to 0.2mm.

Rare to very rare: **calcite**, sa, equant to elongate; often in association with biotite mica or serpentinite. Size = 2.65mm to 0.2mm

Very few to rare: **biotite**, sr, elongate; usually lathlike. Size = 1.25 to 0.2mm.

Rare: **monocrystalline quartz**, sr-r, equant to elongate. Size = 0.7 to 0.2mm.

Rare: **polycrystalline quartz**, r, equant; often resembles meta-quartz. Size = 1.0 to 0.2mm.

Very rare: **quartz-biotite schist**, r, equant to elongate. Size = 1.1 to 0.2mm.

Rare to very rare: **chert**, r, equant. Size = 1.25mm to 0.2mm.

Rare: **opaques**, r, equant to elongate. Size = 0.8 to 0.2mm.

Rare (97/108) to absent: **amphibole**, sr, elongate. Size = 0.7mm.

Very rare (98/47) to absent: **pyroxene**, sr, elongate. Size = 0.75mm to 0.2mm.

Very rare: **plagioclase feldspar**, sa-sr, elongate. Size = 0.4 to 0.2mm.

Fine Fraction

Dominant to frequent: **quartz**.
 Common to rare: **serpentine**.
 Few to rare: **opaques**.
 Few to rare: **biotite**.
 Very few: **chert**.
 Rare to absent: **phyllite**.
 Rare: **siltstone/sandstone**.
 Rare: **igneous (mafic) rocks**.
 Rare: **plagioclase**.
 Rare: **alkali feldspar**.
 Rare: **amphibole**.
 Rare: **pyroxene**.

Textural Concentration Features (Tcf)

Rare: **clay pellets**, r, equant to elongate; colour varies from orange-red to dark brown (PPL, XP) (x40); contain fine quartz, mica, opaques, amphibole, r siltstone rock frags, r phyllite. Size = 1.2 to 0.1mm.

Amorphous Concentration Features (Acf)

Rare to absent (97/56, 98/40): **burnt/unburnt organics**; several samples contain voids surrounded by darkened patches (traces of burning of organic material), some of these voids (channels) preserve the shape of the organic material (e.g. 98/47, 98/48).

Comment

This fabric is characterised by a red-firing clay groundmass, rich in fine quartz, which also contains biotite, opaques, chert, siltstone/sandstone and mafic rocks. This groundmass is dominated by serpentine, which consideration of size, angularity and distribution would have been added as temper. Fabric 10 exhibits some variability in its groundmass between samples rich in mafic rocks (e.g. 97/108) and samples poor in mafic rocks (e.g. 97/56). In addition some samples contain more serpentine than others (cf. 97/56 and 97/71 with 98/48). Fabric 10 is distinctive and shares only superficial similarities with other fabrics. Fabric 6 contains altered igneous rocks, but has a groundmass that contains more chert and lacks mafic rocks. A section cut through the incised decoration on sample 97/108 would suggest the use of a blunt rounded tool. Colour would suggest that vessels in Fabric 10 were fired in a predominantly mixed oxidising-reducing atmosphere. The variation in optical activity exhibited between samples would suggest that vessels were exposed to a variety of firing temperatures. The presence of burnt or unburnt organic material may hint at the possibility that firing was short. Fabric 10 is characterised by a number of components (serpentine, mafic rocks), which are inconsistent with an origin within the immediate area of Knossos (<5km). The serpentine and mafic rocks would seem to link to rocks of the Ophiolite series, the nearest outcrops of which are to the south of Iouktas and to the west in the area of Tylissos.

(11) Non-Calcareous, Quartz-Rich, Fine-Grained Phyllite

Samples: 97/16, 97/18, 97/78, 97/102, 98/7, 98/17, 98/62, 98/67

Microstructure

Rare to very rare macro to meso planar voids, very few to rare mega to meso vughs. Some voids are surrounded by darker patches (e.g. 98/17), some contain opaque, possibly organic material (e.g. 97/16). Generally voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel (e.g. 97/16, 97/18) to perpendicular (e.g. 98/17) to vessel margins, sometimes across a single sample (e.g. 98/17) resulting in a structural discontinuity; in sample 97/78 the long-axis orientation of voids and inclusions follows a curve. Inclusions are close to single-spaced.

Groundmass

Colour varies from orange-red (PPL, XP) (x40) to brown (PPL, XP) (x40). The micromass varies in optical activity from medium (e.g. 98/17) to high (e.g. 97/16). B-fabric is thin to thick granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 3.0mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant to frequent: **quartz-biotite phyllite**, a-sa, equant to elongate; very fine-grained, contains quartz and biotite; sometimes in association with calcite (e.g. 97/18, 98/17) or chlorite (e.g. 97/16); sometimes in association with altered igneous rock frags. (see below). Size = 3.0 to 0.2mm.

Rare to absent: **biotite**, a-sa, elongate, lathlike. Size = 0.8mm to 0.2mm

Rare (97/18, 98/17) to absent: **altered igneous rock frags**, sa-sr, equant to elongate; fine-grained rock, rich in fine plagioclase; example in 97/18 altered to a green colour (XP) (x40) (chloritised?); example in 98/17 in association with calcite; examples in 98/17 in association with fine-grained phyllite. Size = 0.85mm to 0.7mm

Rare (97/102) to absent: **serpentinite**, sr, equant to elongate. Size = 0.5 to 0.2mm.

Very rare (97/18) to absent: **monocrystalline/polycrystalline calcite**, a-sa, equant to elongate. Size = 0.6 to 0.2mm.

Few (98/7) to very rare: **chert**, a-r, equant to elongate; one example in 97/102 contains larger clasts of plagioclase. Size = 0.8mm to 0.2mm.

Very few: **polycrystalline quartz**, a-sa, elongate; sometimes resembles meta-quartz, sometimes in association with mica. Size = 0.9 to 0.2mm

Rare: **monocrystalline quartz**, sr, equant to elongate. Size = 0.4 to 0.2mm

Common (97/102) to rare: **chlorite pseudomorphs**, r equant to elongate. Size = 2.25 to 0.2mm.

Very few (98/62) to absent: **micrite with iron concentrations**, r, equant; sometimes contains discrete clasts of quartz. Size = 0.7 to 0.2mm.

Few to rare: **coarse siltstone/fine sandstone**, sr-r, equant; grain-supported, well-sorted, contains sa-sr quartz, feldspar, biotite, chert, phyllite, calcite (max. grain-size varies from 0.1 to 0.35mm). Size = 2.6 to 0.6mm.

Rare: **plagioclase feldspar**, sr-r, equant. Size = 0.4 to 0.2mm.

Very rare to absent: **clinozoisite**, sr, equant. Size = 0.35mm to 0.2mm.

Very rare to absent: **foraminifera**.

Very few to rare: **opaques**, sa-sr, equant to elongate. Size = 1.1 to 0.2mm.

Fine Fraction

Dominant: **monocrystalline quartz**.

Common: **biotite**.

Very few to rare: **polycrystalline quartz**.

Very few to rare: **phyllite**.

Very few: **chert**.

Very few to rare: **chlorite pseudomorphs**.

Very few to rare: **plagioclase**.

Very few to rare: **calcite**.

Rare: **opaques**.

Rare: **clinozoisite**.

Very rare: **foraminifera**.

Textural Concentration Features (Tcf)

Rare: **clay pellets**, clear to diffuse boundaries, colour is varies from red-orange to dark brown (XP) (x100), contain quartz, mica, opaques, calcite, clinozoisite, rounded phyllite. Size = 0.6mm to 0.1mm.

Amorphous Concentration Feature (Acf)

Rare to absent: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a red-firing, quartz-rich clay groundmass, rich in biotite, which also contains rounded chlorite pseudomorphs, phyllite and siltstone/sandstone rocks. This groundmass is dominated by phyllite, which consideration of size, angularity and distribution would suggest was added as temper. The combination of phyllite in a quartz-rich micaceous groundmass generally serves to distinguish Fabric 11 from all others. Fabric 10 also contains chlorite pseudomorphs and phyllite, similar to that found in Fabric 11, albeit in smaller quantities. There are closer similarities with some of the finer phyllite in Fabric 14, although in general the low grade metamorphics in Fabric 14 resemble schists. The similarities, which Fabric 11 shares with Fabric 14 are not sufficiently close as to argue for a common provenance, although they might indicate a common geological origin (Phyllite-Quartzite series). The low grade metamorphic rocks in Fabric 11 make it incompatible with a provenance within the immediate area of Knossos (<5km). The closest compatible sources are at the eastern and western edges of the Herakleion basin or to the south of Knossos in the areas of Iouktas.

(12) Non-Calcareous, Feldspars, Quartz, Biotite, Altered Igneous Rocks, Phyllite

Samples: 97/27, 97/41, 97/137, 97/138

Microstructure

Very few macro to meso planar voids, rare macro to meso vughs. Some voids have calcite linings (e.g. 97/27, 97/137, 97/138). Some voids are surrounded by

darker patches, others contain opaque, possibly organic material (e.g. 97/41). Assessment of orientation of voids and inclusions is difficult because inclusions and voids are predominantly equant; however, when inclusions and voids are more elongated, local long-axis parallel orientation can be observed; the angle of this orientation varies from parallel to almost perpendicular to vessel margins; both extremes may be observed within a single sample (e.g. 97/41). Inclusions are close to single-spaced.

Groundmass

The fabric is generally homogeneous, however 97/41 differs slightly: larger non-plastics, absence of calcite. Colour varies from red-orange (PPL, XP) (x40) to very dark brown (PPL, XP) (x40). The micromass varies in optical activity from low (e.g. 97/138) to high (e.g. 97/41). B-fabric is thin to medium granostriated/porostriated.

Inclusions

c:fv_{10µm} c.30:65:5

Coarse fraction = 1.5mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction:

Dominant: **feldspars**, a-sa, equant to elongate; both alkali and plagioclase; often have a cloudy appearance due to saussuritisation. Size = 0.75mm to 0.2mm.

Common: **monocrystalline/polycrystalline quartz**, a-sa, equant to elongate; sometimes in association with biotite. Size = 1.25 to 0.2mm.

Few: **intermediate igneous rock (granodiorite)**, a-sa, equant; holocrystalline granular texture; contains alkali and plagioclase feldspar with some quartz, biotite and amphibole; one example in 97/27 rich in lath-like biotite. Size = 1.4 to 0.3mm.

Very few to rare: **fine-grained basic igneous rock frags.**, sr-r, elongate; highly altered; mostly plagioclase, biotite. Size = 0.75mm to 0.3mm.

Very few to rare: **chert**, sr-r, equant to elongate; sometimes contains larger clasts of quartz; sometimes contains biotite, opaques. Size = 0.9 to 0.2mm.

Few to rare: **siltstone/fine sandstone**, sr-r, equant to elongate; contains quartz, feldspar, mica, chert, opaques; grain-size varies between 0.05 and 0.2mm; well-sorted, grain-supported. Size = 1.4 to 0.2mm.

Rare: **biotite mica**, sa, elongate. Size = 0.35 to 0.2mm.

Rare to very rare: **amphibole**, sa, equant to elongate. Size = 0.25 to 0.2mm.

Rare to absent: **phyllite**, r, equant; quartz-mica. Size = 0.6 to 0.2mm.

Very rare to absent: **opaques**, r, equant. Size = 0.3 to 0.2mm.

Rare to absent: **calcite**, sa-sr, equant to elongate. Size = 0.5 to 0.2mm.

Rare to absent: **micrite**, r, equant to elongate; contains isolated clasts of quartz and feldspar. Size = 1.0 to 0.2mm.

Fine Fraction:

Dominant: **plagioclase and alkali feldspar**.

Frequent: **quartz**.

Few: **biotite**.

Very few to rare: **amphibole**.

Rare: **chert**.

Rare: **altered igneous rocks**.
Rare: **phyllite**.
Rare: **opaques**.
Very rare to absent: **calcite/micrite**.

Textural Concentration Features (Tcf)

Rare to very rare: **clay pellets**, sr-r, equant to elongate, diffuse to merging. Size = 0.5 to 0.2mm. Two types may possibly identified:

- (1) Red to dark brown (PPL, XP) (x40); contain fine grain-size (0.05-0.1mm) quartz, polycrystalline quartz, biotite, chert (e.g. 97/27, 97/41).
- (2) Fine yellow/brown clay, opaques, rare biotite; an example in 97/137 contains calcite (e.g. 97/137, 97/138)

Amorphous Concentration Feature (Acf)

Rare to very rare: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a red-firing groundmass containing feldspar (plagioclase and alkali), quartz, biotite, amphibole, chert, calcite/micrite with rounded altered igneous rocks. This groundmass is dominated by large grains of feldspar, quartz and granodioritic rock fragments. The groundmass is homogenous for samples 97/27, 98/137 and 98/138, however 97/41 has a slightly different texture and lacks calcite/micrite. Study of clay pellets suggests the possibility of the mixing of two clays: one red-firing containing quartz, biotite and chert, the other yellow/brown firing, containing calcite and opaques, but which otherwise was poor in inclusions (rare biotite). If so then the latter clay may be the origin of the calcareous component of Fabric 12, while the former clay could be the source of the phyllite and siltstone. Because of the small quantity and size of clay pellets available for comparison it is impossible to certain about this identification of mixing, however if correct it would suggest that the dominant granodiorite rock fragments did not derive from either clay and were therefore probably added as temper.

No slip layers were identified, however several samples (i.e. 97/27, 97/138) exhibited differentially oriented birefringence at the surface, which may suggest compaction due to burnishing. The presence of voids with calcite linings also proved to be a general feature of this fabric. The only sample which lacks such linings is 97/41. Since this is also the only sample to lack evidence for a calcareous component, then this may suggest that in general the secondary deposition of calcite has only a partially allochthonous origin, with a source in the original calcareous component of Fabric 12.

The various components of Fabric 12 are inconsistent with an origin in the area of Knossos. The presence of granodiorite rock fragments and altered basic igneous rocks in Fabric 12 compares closely to EM and later fabrics for which an origin has been established in the Isthmus of Ierapetra, East Crete. The granodiorite rocks in this area may belong stratigraphically to the upper tectonic melange or Asteroussia nappes, however similar rocks do not appear elsewhere on Crete (Fassoulas 2000:85; see Appendix III). Thus although granitic rocks in general occur elsewhere on Crete, most notably on the southern edge of the Mesara, the combination of granodiorite with phyllite and altered basic rocks in Fabric 12 is diagnostic of a source in the Isthmus. Moreover, comparison of

examples of Fabric 12 with Neolithic material from the site of Kavousi, situated on the northern coast of the Isthmus (Bay of Mirabello), suggested that the two were so close as to be indistinguishable (cf. Kavousi 93/69). This would serve to support a provenance for Fabric 12 in the Mirabello Bay area of East Crete.

(13) Non-Calcareous(?), Fine Quartz, Chlorite, Calcite, Phyllite

Samples: 97/12, 98/4

Microstructure

Very few to rare macro to meso planar voids, rare macro to meso vughs. Some voids are surrounded by darker patches, some contain opaque, possibly organic material. Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins; in sample 97/12 the long-axis orientation of voids and inclusions follows a curve. Inclusions are close to single-spaced.

Groundmass

Colour varies from red-orange to brown (PPL, XP) (x40). The micromass is highly optically active. B-fabric is thin to thick granostriated/porostriated.

Inclusions

c:fv_{10µm} c.20:75:5

Coarse fraction = 2.6mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **chlorite**, a-sa, equant to elongate; sometimes in association with polycrystalline calcite. Size = 2.0 to 0.2mm

Very few to rare: **monocrystalline/polycrystalline calcite**, a-sa, equant to elongate; some examples consist of large (max. size = 0.5mm) calcite grains. Size = 1.1 to 0.2mm

Very few to rare: **phyllite**, r, elongate; very fine-grained, opaques. Size = 1.0mm to 0.2mm.

Rare to very rare: **monocrystalline quartz**, sr, equant. Size = 0.3 to 0.2mm.

Very rare to absent: **plagioclase feldspar**, sr-r, equant to elongate. Size = 0.25 to 0.2mm.

Rare to absent: **chert**, r, equant to elongate. Size = 0.3 to 0.2mm

Very rare to absent: **polycrystalline quartz**, r, equant. Size = 0.25mm

Very rare to absent: **opaques**, r, elongate. Size = 0.5mm

Fine Fraction

Dominant: **monocrystalline quartz**

Very few: **chlorite**

Very few: **calcite**

Rare: **opaques**

Rare: **mica**

Rare: **polycrystalline quartz**

Rare: **phyllite**

Very rare: **epidote**

Textural Concentration Features (Tcf)

Few to very few: **clay pellets**, r, equant; sharp to clear/diffuse boundaries; colour varies from red to very dark brown (XP) (x40); contains fine quartz, rare larger quartz, mica, opaques, clay pellets, r igneous rock frag (alkali feldspar, some mica), calcite. Size = 2.6 to 0.1mm.

Amorphous Concentration Feature (Acf)

Rare to very rare: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a red-firing (non-calcareous?) clay groundmass rich in fine quartz with some mica, containing rounded phyllite. This groundmass is dominated by large chlorite and calcite non-plastics. Study of these large non-plastics would seem to indicate that the chlorite and the calcite are the intercalated component of a single rock and that this rock was added as temper. Comparison of groundmass and clay pellets does not indicate mixing. Consideration of void, inclusion and b-fabric orientation in conjunction with study using a lambda plate allowed the identification of a coil-join in sample 97/12. No evidence for the use of slips was observed, but both samples exhibit areas of differential birefringence at the surface, which is suggestive of compaction due to burnishing. The high optical activity of both samples suggests that they were low-fired.

Fabric 13 is distinctive and has no close parallels amongst other EN fabrics. Chlorite is also found in Fabric 10, however while the chlorite in fabric 13 is dominant and angular and probably added as temper, that in fabric 10 is rare and rounded. Nevertheless some geological link may exist between these fabrics, since the chlorite would in general be compatible with a serpentiferous geology. The closest potential source for the chlorite in Fabric 13 would be to the west of Herakleion in the area of Tylissos.

(14) Non-Calcareous, Quartz-Rich, Biotite, Quartz-Biotite Phyllite/Schist

Samples: 97/10, 97/28, 97/32, 98/65, 98/94

Microstructure

Rare to very rare meso to micro planar voids, rare to very rare macro to meso vughs. Sample 98/94 contains a void with a calcite lining. Some voids are surrounded by darker patches, some contain opaque, possibly organic material (e.g. 98/65). Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins (e.g. 98/65, 98/94). Inclusions are close to single-spaced.

Groundmass

Fabric is generally homogeneous, although 97/32 has a slightly different texture (finer) from other examples. Colour varies from orange-red or red (PPL, XP) (x40) to dark brown (PPL, XP) (x40). Sample 98/94 is predominantly dark brown with red margins. The micromass varies in optical activity from medium (e.g. 97/32) to high (e.g. 97/10). B-fabric is thin to medium granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.28:70:2

Coarse fraction = 2.25mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **quartz-biotite phyllite-schist**, a-sr, equant to elongate; predominantly lath-like biotite mica and quartz; sometimes biotite shows crenulation cleavage (e.g. 97/10, 97/32); sometimes also contain opaque material (e.g. 98/65, 98/94). Size = 2.0 to 0.2mm.

Few to very few: **polycrystalline quartz**, a-r, equant to elongate; usually grain-size is c.0.05 to 0.1mm, but occasionally larger grains occur (c.0.6mm); often meta-quartz, sometimes sutured contacts (e.g. 97/10, 97/28). Size = 2.25 to 0.2mm.

Very few to rare: **monocrystalline quartz**, sa-sr, equant to elongate. Size = 1.5mm to 0.2mm.

Rare: **opaques**, sr-r, equant to elongate; some examples resemble biotite in form (=black mica?). Size = 1.25 to 0.2mm.

Rare to very rare: **chert**, a-sr, equant to elongate. Size = 0.5mm to 0.2mm.

Rare (97/32) to absent: **siltstone**, sr-r, elongate; contains quartz, mica; matrix-supported (max. grain size c. 0.05mm). Size = 1.25mm.

Rare (97/32) to absent: **chlorite**, r, equant. Size = 0.6mm

Rare (97/28) to absent: **plagioclase feldspar**, sa-sr, equant to elongate. Size = 0.7 to 0.2mm

Fine Fraction

Dominant: **quartz**.

Frequent: **mica**.

Common: **phyllite**.

Rare: **opaques**.

Rare: **chert**.

Textural Concentration Features (Tcf)

Rare to very rare: **clay pellets**, sr-r, equant to elongate; colour is orange-red to dark brown (XP) (x40); sharp to clear boundaries; rich in a-sa quartz, also contain biotite, quartz-biotite phyllite. Size = 1.1mm to 0.1mm

Amorphous Concentration Features (Acf)

Rare to very rare: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a red-firing groundmass, which contains quartz, biotite, opaques and rounded phyllite. This groundmass is dominated by angular quartz-biotite phyllite-schist rock fragments. Consideration of size, angularity, distribution as well as comparison with clay pellets suggests that the large quartz-biotite phyllite rock fragments were added as temper. Texture and packing varies between samples from the very coarse (e.g. 97/28) to the fine (97/32). Samples 97/10, 97/32 and 98/65 appear to have thin fine non-calcareous clay layers at their surface, however it is not clear whether these are the natural result of the

burnishing process or result from the application of a slip. Other samples (e.g. 97/28, 98/94) exhibit areas of differential birefringence at their surfaces which may indicate compaction due to burnishing. The incidence of clay (slip?) layers appears to be confined to polished vessels, while those which exhibit possible signs of compaction are all burnished. Colour and optical activity suggests that samples were relatively low fired in an atmosphere which could vary from oxidising to reducing.

Fabric 14 shares some similarities with other fabrics. The closest to the quartz-biotite schist in Fabric 14 is the quartz-biotite schist in some samples (e.g. 97/52) of Fabric 5a and the phyllite in Fabric 11. Such similarities are not so great as to suggest a close relationship between these fabrics. Closer links are possible with an EM fabric from Knossos: cf. EMII Cooking Pot Ware, Red Wares (i.e. Group 4, Wilson & Day 1999:38-9, 50-2). The raw materials in Fabric 14 are not compatible with a source in the immediate area (<5km) of Knossos. They would seem to originate in low grade metamorphic deposits, such as those which characterise the Phyllite-Quartzite series, the nearest outcrops of which are to the east or west of the Herakleion basin or possibly around Iouktas (see Appendix III).

(15) Low/Non Calcareous, Fine Quartz, Organics, Foraminifera

Samples: 97/57, 97/88

Microstructure

Common macro to meso vughs., the majority of which are smooth-sided and elongate, sometimes curved, often tapering to a point (burnt out organics). Many in sample 97/88 contain opaque material. Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies in relation to vessel margins in different areas of a single section; often this orientation forms a curve; in sample 97/88 voids and inclusions curve round in a circle. Inclusions are close to single-spaced.

Groundmass

Fabric is homogeneous: colour varies from orange-red in PPL (x40) and red (XP) to dark brown (PPL) (x40) and brown (XP). The micromass is optically active. B-fabric is medium and granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse/fine fraction = 2.25mm. or less.

Coarse/Fine Fraction

Common: **marl**, r, equant; resembles micrite in form; sometimes contains clasts of quartz or more rarely shell frags. and foraminifera; sometimes has iron concentrations. Size = 1.0mm to 0.02mm.

Rare: **foraminifera**.

Few: **monocrystalline quartz**, sr-r, equant. Size = 0.5mm to 0.02mm, mode = 0.05mm

Very few to very rare: **chert**, r, equant; sometimes contains mica (cf. mica-rich example in 97/88) and larger clasts of mc/pc quartz. Size = 0.7 to 2mm.

Very rare to absent: **polycrystalline quartz**, sa-r. Size = 0.35mm
 Rare: **biotite**, r, lathlike. Size = 0.1 to 0.02mm.
 Very rare: **plagioclase feldspar**, r, elongate. Size = 0.35 to 0.1mm
 Very rare: **alkali feldspar**, r, equant. Size = 0.2 to 0.1mm
 Very rare to absent: **altered igneous rocks**, r. equant to elongate; one in 97/88 is v. fine-grained, contains quartz, feldspar, mica. Size = 0.75mm & 0.4mm.
 Very rare: **epidote**, r, equant. mode = 0.1mm
 Very rare (97/57) to absent: **sandstone frag.**, r, equant; contains quartz (max. size 0.3mm). Size = 0.3mm
 Very few to very rare: **opaques**, r, equant. Size = 0.05 to 0.1mm

Textural Concentration Features (Tcf)

Rare: **clay pellets**, r, equant, merging boundaries; contain quartz, some biotite, chert, feldspar, opaques; colour varies from orange-red in PPL (x40) and red (XP) to dark brown (PPL) (x40) and brown (XP). Size = 2.25mm to 0.2mm

Amorphous Concentration Features (Acf)

Very few (97/88) to rare: **unburnt** and **partially unburnt** organic material.

Comment

This fabric is characterised by red-firing groundmass, which contains quartz, some biotite, chert, foraminifera and marl and rare altered igneous and sandstone rock fragments. This groundmass is dominated by the traces of organic tempering material (chaff?): burnt out voids preserving form of organics as well as partially burnt and unburnt organic material. Comparison of groundmass and clay pellets suggests that a red-firing clay containing quartz and some biotite and chert was mixed with a bioclastic calcareous component (foraminifera, marl). Variation in colour and optical activity suggest that samples of fabric 15 were low-fired in a mixed oxidising-reducing atmosphere.

The fabric is highly distinctive: only one other organic-tempered fabric was identified in the EN assemblage at Knossos (see Fabric 27); however this is otherwise entirely different in technology (grog and organics) and composition (calcareous, low in quartz). The groundmass of Fabric 15 shares many similarities with that of Fabrics 2a-e: the same red-firing, quartz-rich, groundmass, which also contains some biotite, chert, microfossils and more rarely rounded sandstone and altered igneous rock fragments. The presence of micrite with iron concentrations would also link Fabric 15 more generally to Fabrics 1a-i and 2a-e. Such similarities suggest a close connection between these fabrics and it is quite likely that Fabric 15 is a technological variant of Fabric 2.

(16) Non-Calcareous, Quartz-Rich, Crushed Euhedral Calcite

Samples: 97/91, 97/100

Microstructure

Very few to rare meso planar voids, very few to rare macro to meso vughs. Small planar voids are often in-filled with calcite (e.g. 97/91). Voids generally exhibit local long-axis parallel orientation with inclusions, however this relationship may be at any angle with the vessel margins and different local arrangements may exist within a single section (e.g. 97/91). Some voids contain opaque, possibly organic material. Inclusions are close to single-spaced.

Groundmass

Homogenous in colour, texture, inclusion size and packing. Colour is orange-red (PPL) (x40) and red-brown (XP). Groundmass is mildly optically active. B-fabric is thin porostriated.

Inclusions

c:fv_{10µm} c.30:65:5

Coarse fraction = 1.6mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant to frequent: **monocrystalline euhedral calcite**, a, equant to elongate. Size = 1.2 to 0.2mm, mode = c.0.5mm

Rare: **polycrystalline euhedral calcite (coarse-grained sparite)**, a, elongate; calcite grains are well-formed, generally large (c.0.6mm) and elongate. Size = 1.6mm to 0.6mm.

Frequent to rare: **monocrystalline quartz**, a-r, equant to elongate. Size = 0.6 to 0.2mm.

Rare to absent: **polycrystalline quartz**, sa-r, equant to elongate. Size = 1.0 to 0.2mm.

Rare to absent: **quartz-biotite schist**, sa-sr, equant to elongate. Size = 1.0 to 0.2mm.

Very few to very rare: **chert**, r, equant to elongate; sometimes contains larger clasts of quartz. Size = 0.9 to 0.2mm

Very rare: **opaques**, r, equant. Size = 0.3 to 0.2mm

Fine Fraction

Dominant: **monocrystalline quartz**.

Few to very few: **monocrystalline calcite**.

Very few: **chert**.

Rare: **biotite**.

Rare: **opaques**.

Rare: **epidote**.

Textural Concentration Features (Tcf)

Rare to absent: **clay pellets**, r, equant to elongate; colour varies from red (PPL, XP) (x40) to dark brown (PPL, XP) (x40); sharp to clear boundaries; contain a-sa quartz, biotite, opaques, quartz-biotite schist. Size = 0.85 to 0.15mm

Amorphous Concentration Features (Acf)

Rare: **burnt/unburnt organics**, r, equant.

Comment

This fabric is characterised by a red-firing (non-calcareous?) groundmass, which is rich in quartz and also contains chert, rare biotite and quartz-biotite schist. This groundmass is dominated by angular euhedral calcite. Consideration of size and angularity as well as comparison with clay pellets suggests that the calcite was added as temper. Comparison of clay pellets and groundmass indicates that the groundmass is significantly richer in quartz than the clay pellets; moreover the quartz in the clay pellets is invariably small and angular or subangular, while the quartz of the groundmass varies considerably in size and angularity from angular to rounded. The differences between clay pellets and groundmass therefore largely concerns the additional presence in the groundmass of rounded quartz grains. These have no obvious origin and may have been also added as temper in the form of sand. Sample 97/91 has what appears to be a non-calcareous slip layer.

Fabric 16 is distinctive with no clear links to other fabrics. The euhedral calcite resembles that found in Fabric 1e, but there is otherwise nothing to link these groups. Unfortunately Fabric 16 contains no material indicative of a specific provenance, although it would be compatible with a provenance in north-central Crete.

(17) Non Calcareous(?), Quartz-Rich, Calcareous Siltstone

Samples: 98/77, 98/99

Microstructure

Rare mega to meso vughs, rare meso planar voids. Inclusions are close to single-spaced.

Groundmass

Fabric is generally homogeneous. Colour varies from red to dark brown (PPL, XP) (x40). Groundmass is mildly optically active.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse fraction = 2.0mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **calcareous siltstone**, a-sa, equant to elongate; some examples (e.g. 98/99) resemble a calcimudstone with rare discrete clasts of fine quartz and opaques, others (e.g. 97/77) contain larger clasts of quartz, plagioclase, calcite, opaques, shell fragments and foraminifera in calcareous matrix (matrix-supported). Size = 2.0 to 0.2mm.

Rare: **micrite with iron concentrations**, r, equant to elongate; sometimes contains discrete clasts of quartz.

Very rare to absent: **monocrystalline calcite**, sr, equant. Size = 0.4mm.

Rare: **monocrystalline quartz**, sr, equant. Size = 0.25 to 0.2mm.

Rare: **polycrystalline quartz**, sr, equant to elongate. Size = 1.4 to 0.2mm.

Rare to very rare: **chert**, sr, equant. Size = 0.3 to 0.2mm.

Rare to absent: **phyllite**, r, elongate; also in association with biotite. Size = 0.7mm.

Fine Fraction

Dominant: **quartz**.

Common: **biotite**, lathlike.

Very few to rare: **epidote**.

Very few: **micrite/calcareous siltstone**

Rare: **quartz-biotite phyllite**.

Very few: **chert**.

Very rare: **plagioclase**.

Very rare: **foraminifera**.

Very rare: **opaques**.

Comment

This fabric is characterised by a red-firing groundmass, which is very rich in quartz and which also contains chert, biotite, quartz-biotite phyllite. This groundmass is dominated by large calcareous siltstone non-plastics. Some of the calcareous siltstones in 98/99 are similar in form and composition to calcimudstones in Fabric 5a. Fabric 17 otherwise has a quite different groundmass from Fabric 5a, very rich in quartz, no clay pellets, phyllite. The presence of micrite with iron concentrations links Fabric 17 in general to Fabrics 1a-i, etc. Fabric 17 contains nothing indicative of a specific provenance, although it would be compatible with a broad origin in north-central Crete.

(18) Low Calcareous, Fine Quartz, Micrite, Biomicrite, Shell, Sand

Samples: 97/11, 97/89, 97/90

Microstructure

Few to rare macro to meso planar voids, rare mega to meso vughs. Some larger voids are surrounded by darker patches, some contain opaque, possibly organic material (e.g. 97/11, 97/89). Some voids (e.g. 97/90) contain remains of calcitic material at margins. Generally voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel (e.g. 97/89) to almost perpendicular (e.g. 97/11) to vessel margins. Inclusions are close to single-spaced.

Groundmass

Generally homogenous, however the groundmass of 97/90 is poor in fine quartz. Colour varies from orange (PPL, XP) (x40) to red-orange (PPL) (x40) and orange-brown (XP) (x40). Micromass varies in optical activity from low to high (e.g. 97/11).

Inclusions

c:f:v_{10µm} c. 25:70:5

Coarse fraction = 2.75mm. to 0.1mm.

Fine fraction = 0.1mm. or less.

Coarse Fraction

Dominant to frequent: **micrite/biomicrite**, r, equant to elongate; some well-rounded grains appear to be ooids or peloids; micrite contains foraminifera and discrete clasts of quartz, chert, quartz-biotite schist; sometimes contains iron concentrations. Size = 1.6 to 0.1mm.

Frequent: **sand**, r, equant to elongate, low to high sphericity; appears water worn; predominantly quartz (monocrystalline, polycrystalline), but also contains siltstone/sandstone (grain-supported, quartz, biotite, plagioclase), chert, quartz-biotite schist, igneous (doleritic?) rock. Size = 0.7 to 0.1mm.

Very few: **shell fragments**. Size = 1.25 to 0.25mm.

Very few: **foraminifera**. Size = 0.45 to 0.1mm.

Rare to absent: **fine-grained sparite**, sa-sr. Size = 2.7 to 0.1mm.

Rare to very rare: **opaques**, r, equant to elongate. Size = 0.8 to 0.1mm.

Very rare to absent: **epidote**, r, equant. Size = 0.2mm

Fine Fraction
Dominant to frequent: **monocrystalline quartz**.
Few: **polycrystalline quartz**.
Few: **calcite/micrite**.
Very few: **foraminifera**.
Rare: **biotite**.
Rare: **chert**.
Rare: **plagioclase feldspar**.
Rare: **opaques**.
Very rare: **epidote**.

Textural Concentration Features

Rare to very rare: **clay pellets**, sr-r, equant to elongate, clear boundaries, colour is orange to brown in XP (x40); contain fine monocrystalline quartz, biotite. Size = 0.5 to 0.1mm.

Amorphous Concentration Features (Acf)

Few: **unburnt organics/burnt organics**, r equant to elongate; always found in voids.

Comment

This fabric is characterised by orange to orange-brown firing groundmass, which contains fine quartz and rounded grains of quartz, chert, siltstone and phyllite. This groundmass is dominated by predominantly bioclastic calcareous non-plastics. Comparison of groundmass, large non-plastics and clay pellets would suggest that the main clay component was a red-firing clay rich in fine quartz. The predominantly quartz sand would appear then to be a second component, leaving the fossiliferous limestone as a third. This calcareous material could derive from a second clay or alternatively could have been added as temper with the sand. Fabric 18 is distinctive and lacks close parallels amongst other EN fabrics at Knossos. It contains no material distinctive of a specific origin, although it would nevertheless be compatible with an origin in north-central Crete.

(19) Calcareous, Quartz-Rich, Microfossils, Pelite/Phyllite

Samples: 97/30, 97/72, 97/92

Microstructure

Very rare to absent meso planar voids, very few to rare mega to meso vughs, very rare to absent channels. Some voids are surrounded by darker patches, some contain opaque, possibly organic material (e.g. 97/30). Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Generally homogenous throughout the section. Colour varies from yellow to yellow-brown (PPL, XP) (x40). The micromass is optically active.

Inclusions

c:f:v_{10µm} c.25:70:5 to c.30:65:5

Coarse fraction = 3.5 to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **pelite/phyllite**, a-sr, equant to elongate; grading from calcareous phyllites/meta-siltstones (e.g. 97/30) into mica-rich phyllites (e.g. 97/72); contain quartz, mica, often rich in calcite (sparite and micrite); well to moderately sorted; usually retain sedimentary bedding structure, but mica exhibits parallel extinction. Size = 2.75 to 0.2mm.

Few to very few: **micrite with iron concentrations**, sr-r, equant; well-sorted; sometimes contains isolated clasts of quartz, foraminifera. Size = 1.1 to 0.2mm.

Very few to rare: **foraminifera and ostracods**; sample 97/72 contains doughnut-shaped calcareous microstructure. Size = 0.65 to 0.2mm.

Rare to very rare: **monocrystalline/polycrystalline calcite (coarse-grained sparite)**, sa, elongate; max. single grain-size = 0.85mm. Size = 1.4 to 0.2mm.

Rare to very rare: **monocrystalline quartz**, sa-r, equant to elongate. Size = 0.4 to 0.2mm.

Very rare to absent: **polycrystalline quartz**, sa, equant, size = 0.3 to 0.2mm.

Very rare: **chert**, r, equant. Size = 0.35 to 0.2mm.

Rare to absent: **alkali feldspar**, sr-r, equant; sometimes in association with plagioclase feldspar (e.g. 97/30). Size = 0.3 to 0.2mm.

Very rare to absent: **plagioclase feldspar**, a, elongate. Size = 0.5 to 0.2mm.

Very rare (97/72) to absent: **chlorite pseudomorph(?)**, sr, equant; yellow (XP) (x40) intersecting laths. Size = 0.2mm.

Very rare (97/30, 97/92) to absent: **clinozoisite rock fragments**, sr, equant, granular, subhedral clinozoisite. Size = 0.25 to 0.2mm.

Rare (97/72) to absent: **igneous rock (volcanic?)**, r, equant; contains plagioclase laths and some mica in isotropic groundmass. Size = 0.6 to 0.2mm.

Fine fraction

Frequent: **quartz**.

Frequent: **micrite**.

Common to few: **foraminifera**.

Few to rare: **monocrystalline calcite**.

Few to very few: **phyllite frags**.

Very few to rare: **chert**.

Rare to very rare: **plagioclase feldspar**.

Rare to very rare: **biotite**.

Rare: **epidote**.

Rare to very rare: **clinozoisite**.

Rare to very rare: **epidote**.

Very rare (97/72) to absent: **igneous rock**.

Rare: **opaques**.

Textural Concentration Features (Tcf)

Rare to very rare: **clay pellets**, sr-r, equant to elongate; clear boundaries; red to dark brown (XP) (x40) (non-calcareous?); contain predominantly sa-sr, equant

quartz, but also chert, biotite, feldspar, clinozoisite, polycrystalline quartz, r quartz-biotite phyllite (cf. 97/30, 97/92). Size = 3.5 to 0.1mm.

Rare (97/92) to absent: **clay streaks**, clear boundaries, colour is red (XP) (x40); predominantly quartz, chert, feldspar, biotite, igneous rock frags. Length = 3.25mm.

Amorphous Concentration Feature (Acf)

Rare to very rare: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a yellow-brown, calcareous(?), clay groundmass which is rich in quartz, foraminifera, ostracods and micrite, and which also contains rounded phyllite and rarely igneous rock fragments. This groundmass is dominated by pelite/phyllite rock fragments, whose size, distribution and angularity would suggest were added as temper. Comparison of groundmass and tcfs (clay pellets, clay streak) strongly suggests the mixing of two clays: all tcfs are red-brown, rich in quartz, chert and rounded phyllite and, importantly, contain no calcareous material. Therefore the source for the foraminifera, ostracods and micrite must lie elsewhere (a calcareous marl?). There are traces of a non-calcareous slip layer in 97/30. The degree of optical activity suggests that vessels were generally low-fired.

Fabric 19 is distinctive and shares little more than superficial similarities with other fabrics. At a very general level the siltstone-pelites may be compared to pelite/phyllites in fabrics 8, 9, 20 and 21, while the calcareous component rich in micrite and microfossils closely resembles the calcareous component in Fabric 23 and sample 97/38 (non-ceramic clay lump - see description below). The pelite-phyllite temper and red clay rich in quartz and phyllite would appear to be mineralogically related. The pelite-phyllites would link to the Phyllite-Quartzite series, the close sources of which are to the east and west of Herakleion or possibly Iouktas. The provenance of this fabric remains open, although it seems unlikely that it was produced within the immediate environs of Knossos (<5km).

(20) Calcareous, Rare Quartz, Siltstone/Pelite/Phyllite

Sample: 98/33

Microstructure

Rare macro to meso planar voids, very few mega to meso vughs. Several contain opaque, possibly organic material. Voids and inclusions exhibit local long-axis orientation varying in orientation to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour is yellow-orange (PPL, XP) (x40). The micromass is highly optically active. B-fabric is thin to thick granostriated/porostriated.

Inclusions

c:f:v_{10μm} c.25:70:5

Coarse fraction = 3.1mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **siltstone/pelite/phyllite**, a-sr, equant to elongate; consists of beds of fine-grained matrix-supported, metamorphosed fine siltstone (=phyllite), rich in mica with very fine quartz, which alternate with coarser, grain-supported coarse siltstone (max. grain-size c. 0.05mm). The latter predominantly contain mica, quartz, calcite with some opaques; in many cases the micas exhibit parallel orientation suggesting metamorphism; sometimes the phyllite is in association with calcite, which often resembles meta-calcite. Size = 3.1 to 0.2mm.

Few: **monocrystalline/polycrystalline calcite**, a-sa, equant to elongate; resembles a coarse-grained sparite (grain-size varies from c.0.02 to 0.5mm). Size = 1.0mm to 0.2mm

Few: **micrite**, sr-r, equant to elongate. Size = 1.7 to 0.2mm

Very few **opaques**, sa-r, equant to elongate; sometimes contain fine quartz. Size = 0.7 to 0.2mm.

Rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.5 to 0.2mm.

Fine Fraction

Frequent: **quartz**.

Frequent: **calcite**.

Very few: **chert**.

Very few: **opaques**.

Very rare: **plagioclase feldspar**.

Rare: **biotite**.

Very rare: **epidote**.

Very rare: **igneous rock frag**.

Textural Concentration Features (Tcf)

Very few: **clay pellets**, high sphericity, r, with clear to diffuse boundaries; colour varies from yellow to red-brown (PPL, XP) (x40); contain almost no inclusions: some very fine quartz, calcite, very rare mica. Size = 0.7mm to 0.1mm.

Amorphous Concentration Features (Acf)

Very few to rare: **partially burnt organics**.

Comment

This fabric is characterised by a yellow-firing (calcareous ?) clay groundmass, which contains rare quartz, calcite and opaques. This groundmass is dominated siltstone/pelite rock fragments, whose size, angularity and distribution would suggest were added as temper. Comparison with clay pellets suggests that the main clay component was fine and relatively free from large non-plastics. The fabric is distinctive: at a very general level the siltstone-pelites may be compared to pelite/phyllites in Fabrics 8, 9, 19 and 21, while the fine calcareous clay component may be compared to Fabrics 1a-i. The colour and high optical activity suggest that sample 98/33 was low-fired in a predominantly oxidising atmosphere. Provenance remains open: the presence of low grade metamorphic (pelite-phyllite) rock fragments would link to rocks of the Phyllite-Quartzite series.

(21) Non-Calcareous, Quartz-Rich, Bioclastic Limestone/Marl, Chert, Phyllite, Biotite

Samples: 97/33, 98/20, 98/35

Microstructure

Rare meso planar voids, very few to rare mega to meso vughs. Some voids contain opaque, possibly organic, material (e.g. 97/33). Assessment of orientation of voids and inclusions is difficult because inclusions and voids are predominantly equant; however, when inclusions and voids are more elongated, local long-axis parallel orientation can be observed (e.g. 97/33); the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour is brown to dark brown (PPL, XP) (x40). The micromass exhibits low to no optical activity.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse fraction = 3.75mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Frequent to common: **bioclastic limestone/marl**, sr-r, equant to elongate; varies from micrite to sparite; some shell fragments are very large (e.g. c.3.75mm 97/33) others resemble foraminifera; large shell fragment in association with area of clay which is yellow/brown with rare quartz. Size = 3.75 to 0.2mm.

Frequent (98/20) to rare: **siltstone/pelite**, r, equant to elongate; usually retains the form of a siltstone (parallel bedding structure), but biotite and matrix frequently exhibit parallel extinction. Size = 3.15mm to 0.2mm.

Rare to very rare: **foraminifera**. Size = 0.3 to 0.2mm.

Rare (98/35): **sparite**, sa, elongate; varies in grain-size (c.0.4-0.1mm); examples in 97/33 and 98/35 exhibit only a relict primary structure. Size = 2.1 to 0.2mm.

Very rare to absent: **monocrystalline calcite**, r, equant to elongate. Size = 0.8 to 0.2mm.

Rare: **chert**, r, equant to elongate. Size = 0.4 to 0.2mm.

Rare: **polycrystalline quartz**, r, equant to elongate. Size = 0.3 to 0.2mm.

Rare: **monocrystalline quartz**, sr-r, equant to elongate. Size = 0.8 to 0.2mm

Very rare to absent: **igneous rock fragments**, r, equant to elongate; fine-grained, contain alkali and plagioclase feldspar with some quartz. Size = 0.9mm to 0.4mm

Rare to very rare: **opaques**, sr-r, equant. Size = 0.3 to 0.2mm.

Fine Fraction

Dominant: **monocrystalline quartz**.

Common: **chert**.

Few: **micrite**.

Few to rare: **phyllite**.

Few: **biotite**.

Few: **plagioclase feldspar**.
Few to very few: **alkali feldspar**.
Rare: **epidote**.
Rare: **calcite**.
Rare: **igneous rock fragments**.
Rare: **opaques**.
Very rare: **foraminifera**.

Textural Concentration Features (Tcf)

Rare to very rare: **clay pellets**, sr-r, equant, high sphericity, merging boundaries; contain sr monocrystalline quartz; colour is brown (PPL, XP) (x100). Size = 0.9 to 0.1mm.

Amorphous Concentration Feature (Acf)

Rare to very rare: **unburnt/partially burnt organics**; sample 97/33 contains a very large example of unburnt organic material (c.2.0mm).

Comment

This fabric is characterised by a groundmass rich in quartz and also containing chert, phyllite, opaques and biotite. This groundmass also contains a significant calcareous component in the form of shell fragments, foraminifera, micrite and sparite. The origin of the calcareous component is unclear. The area of yellow (calcareous?), quartz-poor clay adhering to the large shell fragment in 97/33 may indicate that the clay component originated in a calcareous marl which could have been added to a non-calcareous quartz rich clay. The calcite frequently exhibits traces of secondary calcite alteration (micritic clots, relict primary structures). In view of the low optical activity of the samples these features together may indicate a high firing temperature. There is a clear non-calcareous slip layer in 97/20.

Fabric 21 is most easily defined by its quartz-rich groundmass and its large fossiliferous limestone non-plastics. The presence of low-grade metamorphic rocks (pelite) links it to Fabrics 8, 9, 19 and 20 as well as more generally to rocks of the Phyllite-Quartzite of north-central Crete. Provenance remains open, although it would be consistent with a Cretan origin.

(22) Non-Calcareous(?), Fine Quartz, Marl, Sandstone, Phyllite, Igneous Rocks

Sample: 97/124

Microstructure

Very few to very rare mega to meso planar voids, rare macro to meso vughs. Some voids have calcite linings, some voids are surrounded by darker patches. Assessment of orientation of voids and inclusions is difficult because inclusions and voids are predominantly equant; however, when inclusions and voids are more elongated, local long-axis parallel orientation can be observed generally parallel to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour varies from orange (PPL, XP) (x40) to brown (PPL, XP) (x40). The micromass varies is highly optically active. B-fabric is thin to thick granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.1mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Frequent: **micrite**, r, equant to elongate; sometimes with iron concentrations; occasionally micrite is coarser in texture and resembles a very fine sparite; sometimes contains isolated clasts of quartz, chert, foraminifera/shell fragments. Size = 2.1 to 0.2mm.

Very few: **foraminifera/shell fragments**. Size = 1.7 to 0.2mm.

Very few: **quartz-biotite phyllite**, sr-r, equant to elongate. Size = 1.1 to 0.2mm.

Very few: **siltstone/sandstone rock frags.**, r, equant to elongate; varies in grain-size from fine matrix-supported siltstone to medium grain-supported sandstone; contains quartz, chert, biotite, calcite, feldspar, altered igneous rock frags. Size = 1.25 to 0.3mm.

Rare to very rare: **quartz**, r, equant to elongate. Size = 0.9 to 0.2mm

Rare to very rare: **chert**, r, equant to elongate. Size = 0.7 to 0.2mm.

Rare to very rare: **igneous rock frags.**, r, equant to elongate; several examples are rich in amphibole with some quartz and biotite. Size = 1.3 to 0.4mm.

Very rare: **opaques**, r, equant to elongate; sometimes contains isolated quartz. Size = 0.4 to 0.2mm.

Fine Fraction

Dominant to frequent: **quartz**.

Frequent: **calcite**.

Few: **foraminifera**.

Rare to very rare: **chert**.

Rare to absent: **amphibole**.

Rare: **biotite**.

Few: **opaques**.

Rare: **epidote**.

Textural Concentration Features (Tcf)

Rare: **clay pellets**, r, equant to elongate; yellow-brown (XP) (x40); calcite-rich, fine quartz, foraminifera. Size = 1.0 to 0.1mm.

Amorphous Concentration Feature (Acf)

Rare to very rare: **burnt organics**.

Comment

This fabric is characterised by yellow/brown-firing clay groundmass, which contains fine quartz, micrite, biotite, siltstone/sandstone, rounded phyllite and igneous rock fragments. Fabric 22 is distinctive and cannot easily be related to other fabrics. The presence of micrite with iron concentrations may indicate a general link to Fabrics 1a-i, 2a-e, 6 and 8. Provenance remains open.

(23) Calcareous(?), Quartz, Micrite, Foraminifera

Sample: 97/60, 97/61

Microstructure

Very few to very rare mega to meso planar voids, rare macro to meso vughs. Some voids contain opaque, possibly organic material, others are surrounded by darkened areas. Some voids and inclusions exhibit local long-axis orientation parallel to vessel margins (e.g. 97/60). Inclusions are close to single-spaced.

Groundmass

Colour is yellow/brown to dark brown (PPL, XP) (x40). The micromass is optically active.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse fraction = 0.8 to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Frequent: **micrite**, sa-sr, equant to elongate; sometimes contains iron concentrations; sometimes contains discrete clasts of quartz, foraminifera; sometimes grades into a fine sparite (e.g. 97/60). Size = 0.8 to 0.2mm.

Rare: **polycrystalline calcite (sparite)**, a, elongate. Size = 0.65 to 0.1mm.

Very few: **monocrystalline quartz**, sr-r, equant to elongate. Size = 0.8 to 0.2mm.

Rare: **chert**, sr-r, equant to elongate. Size = 0.65 to 0.2mm.

Rare: **polycrystalline quartz**, sr-r, equant to elongate. Size = 0.4 to 0.2mm.

Very few to rare: **foraminifera**. Size = 0.2mm.

Rare to very rare: **opaques**, r, equant; contain fine quartz and mica. Size = 0.5 to 0.25mm.

Fine Fraction

Frequent: **micrite/calcite**.

Frequent: **quartz**.

Few: **chert**.

Few: **polycrystalline quartz**.

Rare: **foraminifera**.

Rare: **plagioclase feldspar**.

Rare: **alkali feldspar**.

Rare: **biotite**.

Rare: **opaques**.

Very rare: **epidote**.

Textural Concentration Features (Tcf)

Rare to very rare: **clay pellets**, merging boundaries. Size = 0.8 to 0.1mm. Two types are possible:

(1) yellow/brown (XP, x40), rich in foraminifera and biotite;

(2) brown to dark brown (XP, x100); contains large rounded quartz, biotite.

Amorphous Concentration Features (Acf)

Very few to rare: **burnt/partially burnt/unburnt organics**, sr-r, equant to elongate; always found in voids.

Comment

This fabric is characterised by a groundmass rich in large rounded quartz, which also contains micrite, microfossils and biotite. Study of clay pellets suggests the possibility of clay mixing: the micrite and microfossils would appear to derive from a yellow firing (calcareous?) clay (marl?) which contains biotite but lacks large rounded quartz; the large rounded quartz would appear to derive from a brown-firing clay which also contains biotite. The fossiliferous components shares some similarity to the fossiliferous component of Fabrics 19 and 22 as well as to sample 97/38. Consideration of the orientation of voids, inclusions and b-fabric allowed the identification of a coil join in 97/60. There appears to be a non-calcareous (slip?) layer in 97/60. Colour suggests that both samples were fired in a predominantly reducing atmosphere. The frequent presence of unburnt organic material in 97/61 may suggest that the overall duration of firing was short. Provenance remains open, although Fabric 23 would be compatible with a provenance within the immediate area of Knossos.

(24) Low-Calcareous(?), Micrite, Phyllite, Opaques

Samples: 97/39, 98/29, 98/43, 98/44

Microstructure

Few to rare mega to meso vughs, rare macro to meso planar voids. Occasionally voids have calcite linings (e.g. 98/44). Some voids are surrounded by darker patches, many contain opaque, possibly organic material (e.g. 98/44). Assessment of orientation of voids and inclusions is difficult because inclusions and voids are predominantly equant; however, when inclusions and voids are more elongated, local long-axis parallel orientation can be observed (e.g. 98/29, 98/44); the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour varies from orange (PPL, XP) (x40) to brown (PPL, XP) (x40). The micromass is optically active.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.5mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **micrite with iron concentrations**, sr-r, equant to elongate; usually contains isolated sr-r clasts of quartz, calcite, opaques, more rarely fine lath-like biotite, chert, alkali feldspar; rarely bioclastic (e.g. 98/43, 98/44); size of clasts varies from 0.3 to <0.05mm. Sometimes contain a-sa argillaceous rock frags., red

to brown in colour (XP) (x40), 0.9 to 0.1mm in size, which resemble siltstone and contain quartz, calcite and some biotite (e.g. 97/39, 98/44). Sometimes contain larger sa-sr clasts of sparite, (0.6 to 0.1mm in size). Size = 2.5mm to 0.2mm, mode = c.0.6mm.

Rare to absent: **siltstone**, sa, equant; contains calcite and quartz (cf. above micrite). Size = 0.55mm to 0.2mm.

Few to absent: **calcareous siltstone/fine sandstone**, a-sa, equant to elongate; grain-size = 0.3 to 0.05mm, mode = 0.12mm, matrix-supported but point contacts; contains sa-r quartz, calcite, chert, phyllite rock frags., polycrystalline quartz and mica in a calcareous matrix (see above micrite). Size = 2.2 to 0.5mm.

Rare to absent: **sparite**, sa-sr, equant to elongate; grain-size c. 0.15 to 0.05mm (cf. above micrite). Size = 1.0 to 0.2mm.

Rare to absent: **calcite**, sa, equant to elongate. Size = 0.45 to 0.2mm.

Very few to absent: **chert**, sa-r, equant to elongate. Size = 0.6 to 0.2mm.

Few to absent: **phyllite rock frags.**, r, elongate; contain quartz, biotite (cf. above calcareous siltstone). Size = 1.7 to 0.3mm.

Very few: **monocrystalline quartz**, r, equant to elongate. Size = 1.75mm to 0.2mm, mode = c.0.3mm.

Rare: **polycrystalline quartz**, r, equant. Size = 0.35 to 0.2mm.

Rare: **alkali feldspar**, r, elongate. Size = 0.5 to 0.2mm.

Rare: **igneous rock frags.**, r, equant to elongate; contain plagioclase with alkali feldspar and some quartz. Size = 0.4 to 0.2mm.

Rare to absent: **opaques (iron oxide?)**, r, equant to elongate. Size = 0.7 to 0.2mm.

Very rare to absent: **pyroxene**, r, equant. Size = 0.25mm.

Fine Fraction

Dominant: **micrite**.

Frequent to common: **monocrystalline quartz**.

Few: **chert**.

Few: **alkali feldspar**.

Few: **polycrystalline quartz**.

Few to rare: **calcite**.

Rare: **epidote**.

Rare: **mica**.

Rare: **opaques**.

Rare: **quartz-biotite phyllite**.

Very rare: **igneous rocks**.

Very rare to absent: **pyroxene**.

Rare to absent: **foraminifera**.

Very rare: **plagioclase feldspar**.

Textural Concentration Features (Tcf)

Very few to rare: **clay pellets**, r, equant; red (PPL, XP) (x40) to dark brown (PPL, XP); contains fine quartz, alkali feldspar, epidote. Size = 0.5 to 0.1mm, mode = 0.15mm.

Amorphous Concentration Features (Acf)

Few: **unburnt organics/burnt organics**, r equant to elongate; always found in voids.

Comment

This fabric is characterised by an orange-firing (low calcareous?) clay groundmass, which contains fine quartz, chert, feldspar, phyllite and opaques. This groundmass is dominated by micrite/calcareous siltstone, which may have been added as temper. The presence of micrite with iron concentrations would appear to link Fabric 24 to Fabrics 1a-i, 2a-e and 8. However the micrite in Fabric 24 also occasionally contains a silty component which does not find good parallels. In addition the phyllite has no close comparanda in these fabrics (cf. Fabric 8), although parallels could be found in Fabrics 11 and 14. Provenance therefore remains open, although Fabric 24 would in general be compatible with an origin in north-central Crete.

(25) Non-Calcareous, Fine Quartz, White Mica, Phyllite/Coarse Siltstone

Sample: 98/92

Microstructure

Rare macro to meso vughs, very rare meso planar voids, very rare macro channels. Some voids are surrounded by darker patches, some contain opaque, possibly organic material. Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation may vary from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour is brown (PPL, XP) (x40). Where visible the micromass is optically active.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.5mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **phyllite/coarse siltstone**, a-sr, equant to elongate; phyllite is predominantly quartz and biotite; phyllite sometimes found in association with coarse siltstone (grain-supported; max. grain-size c.0.05mm). Size = 1.4 to 0.2mm.

Very rare: **white mica**, sr, lath-like. Size = 0.5mm

Rare: **polycrystalline quartz**, sr-r, equant to elongate. Size = 0.3 to 0.2mm.

Very rare: **alkali feldspar**, r, equant to elongate. Size = 0.25 to 0.2mm.

Fine Fraction

Dominant: **quartz**.

Frequent: **white mica**.

Common: **phyllite**.

Rare: **calcite**.

Very rare: **opaques**.

Textural Concentration Features (Tcf)

Very few: **clay pellets**, r, equant to elongate; merging to clear boundaries; dark brown in colour (XP) (x40); quartz-rich, white mica. Size = 0.75 to 0.1mm.
Rare: **clay streak**, clear, yellow in colour (PPL, XP) (x40); contains clay pellets, very rare quartz. Length = c. 2.5mm.

Amorphous Concentration Features (Acf)

Rare: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a groundmass, rich in quartz and white mica, which is dominated by large phyllite and siltstone non-plastics, which may have been added as temper. Comparison between clay groundmass and textural concentration features (clay pellets, clay streak) suggests the possibility that two clays were mixed: i.e. a non-calcareous, micaceous, quartz-rich clay and a calcareous clay rare in quartz. There is a possible calcareous slip layer on the exterior surface of sample 98/92. This overlies a thicker area, which exhibits differentially-oriented birefringence which may indicate compaction due to burnishing. Fabric 25 shares no close parallels with other fabrics. There is nothing diagnostic of specific provenance.

(26) Non-Calcareous, Fine Quartz, Siltstone/Pelite, Metamorphics, Opaques

Samples: 97/73, 97/76, 98/91

Microstructure

Very few to rare mega to meso vughs, very few to rare macro to meso planar voids. Occasionally voids have calcite linings (e.g. 97/76). Some voids are surrounded by darker patches, some contain opaque, possibly organic material (e.g. 98/91). Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour varies from orange-red (PPL, XP) (x40) to very dark brown (PPL, XP) (x40). The micromass varies in optical activity from low (e.g. 98/91) to medium (e.g. 97/141). B-fabric is thin to medium granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.25:75:5

Coarse fraction = 3.2mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **siltstone/pelite**, a-r, equant to elongate; generally matrix supported; contains quartz, biotite, feldspar, opaques, rare calcite; biotite often shows parallel extinction; pronounced dark bedding lines; sometimes grain-supported and larger grain-size (fine sandstone). Size = 3.2 to 0.2mm.

Very few to rare: **quartz-biotite schist**, r, equant to elongate. Size = 1.0 to 0.2mm.

Rare to very rare: **monocrystalline quartz**, sr, equant to elongate. Size = 0.9mm to 0.2mm.

Rare: **polycrystalline quartz**, sr-r, equant to elongate. Size = 0.6mm to 0.2mm.

Rare to very rare: **chert**, sr-r, equant to elongate; contains mica. Size = 0.55 to 0.2mm.

Rare: **opaques**, sa, equant to elongate. Size = 1.0 to 0.2mm

Fine Fraction

Frequent: **quartz**.

Common: **biotite**.

Few: **phylite**.

Very few: **opaques**.

Rare: **chert**.

Very rare: **plagioclase feldspar**.

Very rare: **alkali feldspar**.

Textural Concentration Features (Tcf)

Rare: **clay pellets**, r, clear to merging; colour is orange-red to dark brown (XP) (x40); contain fine quartz, mica, opaques, r phyllite. Size = 0.9 to 0.1mm

Amorphous Concentration Feature (Acf)

Rare: **burnt/partially burnt organics**

Comment

This fabric is characterised by a red-firing (non-calcareous ?) clay groundmass, which contains fine quartz, biotite, opaques and rounded phyllite rock fragments. This groundmass is dominated by siltstone/pelite rock fragments, which consideration of size, angularity and distribution would suggest were added as temper. There is a thick non-calcareous slip layer in 97/73, which in composition resembles the body (fine quartz, biotite). The siltstone/pelite in Fabric 26 shares some similarities with the siltstone/pelite in Fabric 8, although there is no parallel in the siltstone/pelite in Fabric 8 for the distinctive dark opaque bedding structures. The groundmasses of the two fabrics are also distinct: that of Fabric 26 is richer in metamorphic rock fragments and opaques and contains only fine quartz. Fabric 26 also lacks the calcareous component of Fabric 8. Provenance remains open.

(27) Calcareous, Rare Quartz, Grog, Organics, Rounded Phyllite

Sample: 98/26, 98/83

Microstructure

Very few (98/26) to absent macro to meso channels, very few (98/83) to rare mega to meso vughs, rare macro to meso planar voids. In sample 98/26 many channels surrounded by slightly darkened areas. Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins, forming a curve in several areas. Inclusions are close to single-spaced.

Groundmass

Colour varies from yellow (PPL, XP) (x40) in sample 98/26 to dark brown (PPL, XP) (x40) in sample 98/83. The micromass is very mildly optically active.

Inclusions

c:fv_{10µm} c.25:68:7

Coarse fraction = 1.8mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **grog** (see below).

Very few: **micrite**, r, equant to elongate; sometimes contains isolated quartz grains; sometimes with iron concentrations. Size = 1.3 to 0.2mm.

Rare to absent: **quartz-biotite phyllite**, sr, equant to elongate; contains quartz, mica. Size = 0.4 to 0.2mm.

Rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.35mm to 0.2mm.

Rare to very rare: **polycrystalline quartz**, r, elongate; sometimes in association with banded mica. Size = 0.65 to 0.2mm.

Rare to very rare: **chert**, sr, equant to elongate. Size = 0.3 to 0.2mm.

Rare: **opaques**, r, elongate. Size = 0.65 to 0.3mm.

Very rare to absent: **plagioclase feldspar**, r, equant. Size = 0.25mm.

Fine Fraction
Dominant: **calcite/micrite**
Frequent: **quartz**
Few: **foraminifera/shell frags.**
Rare: **phyllite frags.**
Rare: **chert**
Rare: **opaques**
Rare: **amphibole**
Rare: **mica**

Textural Concentration Features (Tcf)

Dominant: **grog**, a-sa, equant to elongate; sharp to merging boundaries. Size = 1.8 to 0.2mm. Three basic types are identifiable:

(1) yellow to dark brown (XP) (x40), calcareous, rare fine quartz, r micrite, r elongate chert, amphibole/quartz rock frags., opaques, epidote, biotite, grog, rounded voids (organics?); varying degrees of optical activity.

(2) dark brown (XP) (x40), non-calcareous, quartz rich (monocrystalline and polycrystalline), rare biotite.

(3) orange-brown (XP) (x40), rich in lath-like biotite, quartz, some calcite; large sa-r siltstone? rock frag., some quartz in association with lath-like biotite, rare foraminifera.

Rare: **clay pellets**, diffuse boundaries, orange (XP) (x40), contain fine calcite, biotite, some quartz. Size = 0.4 to 0.1mm.

Amorphous Concentration Features (Acf)

Few: **burnt organics**. Very many channel voids have darkened areas around them which may be connected with the burning out of organic material.

Comment

This fabric is characterised by a yellow-firing (calcareous?) clay groundmass, low in quartz, with rare rounded phyllites and chert. This groundmass is dominated by grog temper. In sample 98/26 organic material has also been added, probably also as temper. The fabric is distinctive with no close parallels amongst the other fabrics. Although the clay is calcareous and resembles calcareous clays in Fabrics 1a-i, the presence of rounded phyllite rock fragments mark it out as different and moreover suggest that Fabric 27 is inconsistent with a provenance within the immediate area (<5km) of Knossos. Provenance remains open.

(28) Non-Calcareous, Large Quartz, Grog, Quartz-Biotite Phyllite/Schist

Samples: 97/36, 97/79, 98/21, 98/22, 98/87, 98/89, 98/96

Microstructure

Very few to rare macro to meso planar voids, rare mega to meso vughs. Very rarely (i.e. 97/36) voids contain very small amounts of opaque, probably organic, material. Voids and inclusions generally exhibit local long-axis parallel orientation usually parallel to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour varies from orange (PPL, XP) (x40) to brown (PPL, XP) (x40) to black (97/79). The micromass varies in optical activity from low (e.g. 98/96) to high (e.g. 97/36). B-fabric is medium to thin granostriated/porostriated.

Inclusions

c:f:v_{10μm} c.25:70:5

Coarse fraction = 1.7 mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant to frequent: **grog** (see below)

Very few to rare: **monocrystalline quartz**, sa-sr, equant to elongate. Size = 1.1 to 0.2mm

Rare: **polycrystalline quartz/meta-quartz**, sa-sr, equant to elongate; often resembles meta-quartz (e.g. 98/21). Size = 0.95 to 0.2mm

Rare: **quartz-biotite phyllite/schist**, r, equant; also contains opaques. Size = 0.7 to 0.2mm.

Rare: **chert**, sa, elongate; sometimes contains larger grains of quartz (e.g. 98/21); sometimes contains calcite (e.g. 98/87). Size = 0.75mm to 0.2mm.

Very rare: **plagioclase feldspar**, sr, elongate. Size = 0.25mm

Very rare: **radiolarian test(?)**, sr, equant; infilled with chalcedonic quartz. Size = 0.25mm.

Rare to absent: **micrite**, r, elongate; contains isolated quartz. Size = 0.95mm to 0.2mm.

Very rare to absent: **opaques**, r, equant; sometimes contain isolated fine quartz. Size = 0.45 to 0.2mm.

Fine Fraction

Dominant: **quartz**.

Few: **chert**.

Few to rare: **biotite**.

Very few to rare: **plagioclase feldspar**.

Rare: **opaques**.

Rare to absent: **micrite**.

Textural Concentration Features (Tcf)

Dominant to frequent: **grog**, a-sa, equant to elongate, sharp to diffuse boundaries. Size = 1.7 to 0.2mm. Four fabrics can be identified:

- (1) orange to dark brown (XP) (x40), large sr-r quartz, chert, polycrystalline quartz, rare micrite, biotite. This resembles groundmass of Fabric 28.
- (2) dark brown (XP) (x40), rich in fine quartz, some micrite, biotite, chert, grog.
- (3) yellow/brown to dark brown (XP) (x40), rich in fine calcite/micrite, some fine quartz, rare biotite, grog? (see large example in 98/96).
- (4) brown (XP) (x40), fine quartz, large rounded phyllite.

Very few to rare: **clay pellets**, sr-r, equant to elongate, diffuse to merging boundaries, colour is orange (XP) (x40), contain quartz, opaques, biotite. Size = 0.7 to 0.1mm.

Rare to absent: **clay layer**, on exterior surface of 97/36, 98/87 and 98/89, red in colour (XP) (x40), clear to sharp boundaries, differentially oriented b-fabric; varies in thickness from 0.1mm to 0.85mm.; rich in fine quartz, biotite, chert, opaques, sparite. Possibly different clay from Fabric 28.

Amorphous Concentration Features (Acf)

Very rare (97/36) to absent: **opaque, possibly organic material**, consists of thin (c.0.05) elongate strands in planar voids. However, there are no darkened areas around the voids.

Comment

This fabric is characterised by an orange to brown firing clay groundmass, which contains large quartz grains, chert, some quartz-biotite schist. This groundmass is dominated by grog temper. The fabric is distinctive: the closest fabric is Fabric 29, which is richer in fine quartz. In comparison to the majority of fabrics from Knossos, Fabric 28 contains very little organic material. A number of samples have coarse non-calcareous slip layers (e.g. 97/36, 98/87 and 98/89), which are always in association with features added to the original surface of the vessel, either tubular lugs (97/36, 98/87) or plastic decoration (98/89). These slip layers contain fine quartz and biotite, but lack larger quartz. They therefore may derive from a different clay from the body. Provenance remains open.

(29) Low/Non Calcareous, Fine Quartz, Grog, Limestone, Phyllite

Sample: 97/86

Microstructure

Very few macro to meso planar voids, rare mega to meso vughs. Voids and inclusions generally exhibit local long-axis parallel orientation. Inclusions are close to single-spaced.

Groundmass

Colour varies from orange to brown (PPL, XP) (x40). The micromass is highly optically active. B-fabric is medium to thin granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.15 mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **grog** (see below).

Few: **micrite**, r, equant to elongate; sometimes contains isolated quartz. Size = 1.3 to 0.2mm.

Very few: **polycrystalline quartz**, sr-r, equant to elongate; sometimes resembles meta-quartz. Size = 0.5 to 0.2mm.

Very few: **quartz-biotite phyllite**. Size = 0.6 to 0.2mm.

Rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.3 to 0.2mm.

Rare: **opaques**, r, equant to elongate. Size = 0.5 to 0.2mm.

Very rare: **chert**, r, equant. Size = 0.25mm.

Fine Fraction

Dominant: **quartz**.

Common: **calcite/micrite**.

Few: **biotite**.

Few: **chert**.

Rare: **opaques**.

Very rare: **epidote**.

Very rare: **alkali/plagioclase feldspar**.

Textural Concentration Features (Tcf)

Dominant: **grog**, a-sa, equant to elongate, sharp to diffuse boundaries. Size = 2.15 to 0.2mm. A number of fabrics are identifiable:

(1) yellow (XP) (x100), calcareous?, some rounded quartz, some biotite, sparite/micrite, (max. c.0.5mm), rare rounded phyllite, small rounded highly spherical brown clay pellets.

(2) orange-red (XP) (x100), non calcareous?, large quartz.

(3) dark brown (XP) (x100), non-calcareous?, rich in fine quartz, biotite, chert, calcite, rounded phyllite rock frags., dark tcfs (clay pellets?).

(4) dark brown (XP) (x100), non-calcareous?, rich in meta-quartz, rich in biotite, some meta-calcite, opaques, rare large pyroxene (schist?).

(5) red (XP) (x100), rich in mica, some quartz, meta-quartz and metamorphic rock frags. (quartz-mica phyllite/schist).

Amorphous Concentration Features (Acf)

Very rare: **unburnt organic material**.

Comment

This fabric is characterised by a clay groundmass, rich in fine quartz and which also contains biotite, chert and quartz-biotite phyllite. This groundmass is dominated by grog temper. The fabric may be compared to fabrics 27 and 28, which also contain metamorphic rock fragments and grog. There is a possible non-calcareous slip layer in 97/86, which has been cut through by an angular tool (cf. combed/grooved surface of 97/86). Fabric 29 contains nothing distinctive of a specific source and provenance therefore remains open.

(30) Low/Non Calcareous, Fine Quartz, Biotite, Siltstone/Pelite

Sample: 98/90

Microstructure

Few mega to meso vughs, rare mega to meso planar voids. Voids and inclusions approximately oriented parallel to vessel margins. Inclusions are close to single-spaced.

Groundmass

Groundmass almost entirely obscured due to isotropic nature of fabric.

Inclusions

c:f:v₁₀µm c.25:65:10

Coarse fraction = 2.1mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

NB very obscured.

Dominant: **siltstone/pelite**, sa-r, equant to elongate; contains quartz and biotite. Size = 2.0 to 0.2mm.

Rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.65 to 0.2mm.

Rare: **altered igneous rock frags.**, sr, equant; one example consists of clasts of alkali feldspar in a glassy matrix. Size = 1.0 to 0.2mm.

Rare: **chert**, a-sa, elongate. Size = 0.75mm to 0.2mm.

Very rare: **micrite**, r, equant. Size = 0.25mm to 0.2mm.

Fine Fraction

NB almost entirely obscured.

Frequent: **quartz**.

Common?: **biotite**.

Few: **chert**.

Textural Concentration Features (Tcf)

Rare: **clay pellets**, r, equant to elongate; contains quartz, mica, grog. Size = 2.1mm to 0.2mm

Amorphous Concentration Features (Acf)

None identifiable.

Comment

This fabric is characterised by clay groundmass rich in biotite and quartz, which also contains altered igneous rocks. This is dominated by large siltstone/pelite non-plastics, which seem to have been added as temper. The isotropic nature of this sample may indicate that it is high-fired. There is little distinctive of a specific source and provenance therefore remains open.

(31) Non-Calcareous, Siltstones, Biotite

Samples: 97/101

Microstructure

Very few macro to meso vughs, rare meso planar voids. Some voids are surrounded by darker patches, some contain opaque, possibly organic material. Voids and inclusions exhibit local long-axis orientation parallel to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour varies from brown to orange-red at margins (PPL, XP) (x40). Where visible the micromass is optically active.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 1.9mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **siltstone**, sr-r, equant to elongate; matrix-supported; contain rare isolated quartz, mica, calcite (grain-size 0.1 to 0.01mm) and very rare foraminifera (c.0.25mm); sometimes matrix appears to be calcareous (e.g. 97/101); sometimes in association with coarser grain-supported siltstone (grain-size 0.1 to 0.01mm), which contains predominantly quartz, calcite, banded mica, chert in a non-calcareous/calcareous matrix. Size = 1.9 to 0.2mm.

Rare: **coarse siltstone/calcareous siltstone**, r, equant to elongate; grain-supported, contain quartz, calcite, banded mica, chert. Size = 1.0 to 0.5mm.

Few: **biotite**, sa-sr, lath-like. Size = 0.7mm to 0.2mm.

Rare: **igneous or metamorphic (?) rock fragments**, sr-r, equant to elongate; contain lath-like biotite, quartz and feldspar. Size = 0.7mm to 0.2mm.

Rare: **polycrystalline quartz**, sr-r, equant to elongate. Size = 0.6 to 0.2mm.

Rare: **monocrystalline quartz**, sr-r, equant to elongate. Size = 0.5 to 0.2mm.

Very rare: **plagioclase**, r, equant to elongate. Size = 0.25 to 0.2mm.

Very rare: **calcite/micrite**, r, equant. Size = 0.25 to 0.2mm.

Very rare: **foraminifera**. Size = 0.2mm.

Fine Fraction

Frequent: **quartz**.

Frequent: **biotite**.

Few: **siltstone**.

Rare: **plagioclase**.

Rare: **calcite/micrite**.

Rare: **opaques**.

Textural Concentration Features (Tcf)

Very rare: **clay pellets**, r, equant to elongate; merging boundaries; dark brown in colour (XP) (x40); contain quartz, mica. Size = 0.2 to 0.1mm.

Amorphous Concentration Features (Acf)

Rare: **burnt/partially burnt organics**.

Comment

This fabric is characterised by clay groundmass rich in lath-like biotite mica and also containing quartz, igneous or metamorphic rock fragments and foraminifera. This groundmass is dominated by large siltstone non-plastics, which appear to have been added as temper. Sample 97/101 has a non-calcareous slip layer. Fabric 31 is distinctive and shares no similarities with other fabrics. Clays sufficiently rich in biotite mica to produce Fabric 31 are rare on Crete (cf. area of the Isthmus of Ierapetra). Provenance therefore remains open.

(32) Non-Calcareous, Quartz-Epidote Phyllite/Schist

Sample: 98/78

Microstructure

Rare mega to meso vughs, very rare to absent meso planar voids. Some voids contain opaque, possibly organic material. Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to almost perpendicular to vessel margins across a single sample. Inclusions are close to single-spaced.

Groundmass

Colour is orange-red (PPL, XP) (x40). The micromass is optically active. B-fabric is thin to medium granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.20:75:5

Coarse fraction = 1.7mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **quartz-epidote phyllite/schist**, a-sr, equant to elongate; also contains some biotite (grain size varies from c.0.05 to c.0.6mm). Size = 1.7 to 0.2mm.

Rare: **polycrystalline quartz (meta-quartz)**, a, equant to elongate. Size = 0.75 to 0.2mm.

Rare: **white mica**, a, lath-like. Size = 0.4 to 0.2mm.

Rare: **epidote**, sr, elongate. Size = 0.25mm.

Rare: **alkali feldspar**, sa-sr, elongate. Size = 0.4mm.

Fine Fraction

Dominant: **quartz**

Few: **epidote**

Very few: **biotite**.

Rare: **white mica**.

Very few: **phyllite**.

Rare: **opaques**.

Rare: **plagioclase**.

Rare: **alkali feldspar**.

Textural Concentration Features (Tcf)

Very rare to absent: **clay pellets**, r, equant; colour is orange to red (XP) (x40); clear to diffuse boundaries; contain isolated fine quartz and mica. Size = 0.15 to 0.1mm.

Amorphous Concentration Features (Acf)

Very rare: **unburnt organics**.

Comment

This fabric is characterised by a red-firing (non-calcareous?), clay groundmass, containing quartz and white mica. This is dominated by quartz-epidote phyllite/schist rock fragments. Consideration of size, angularity and distribution would indicate that these were added as temper. The fabric is distinctive and shares no similarities with any other fabric. Provenance remains open, but cannot be within the immediate area (<5km) of Knossos.

(33) Non-Calcareous, Quartz-Rich, Amphibolite, Altered Igneous, Phyllite

Sample: 97/59

Microstructure

Rare macro to meso vughs, very rare macro channel. Some larger voids are surrounded by darker patches, some contain opaque, possibly organic material. Voids and inclusions exhibit local long-axis parallel orientation, parallel to vessel margins. Inclusions are close to single-spaced.

Groundmass

Colour varies from very dark brown/black to red at margins (PPL, XP) (x40): both samples are almost entirely very dark brown/black. Where visible the micromass is optically active.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 1.1mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Frequent: **amphibolite**, sa-r, equant to elongate; predominantly amphibole, some biotite, opaques, feldspar, quartz. Size = 1.0 to 0.2mm.

Few: **altered igneous rocks**, sr-r, equant to elongate; usually little internal structure can be seen, however one example rich in biotite with some pyroxene, another example contains plagioclase laths with mica and pyroxene (altered basalt?). Size = 1.1 to 0.2mm.

Very few: **quartz-biotite phyllite**, r, equant. Size = 0.5 to 0.2mm.

Rare: **amphibole**, a-sr, equant to elongate. Size = 0.7 to 0.2mm.

Rare: **biotite**, sa-sr, lath-like. Size = 0.25 to 0.2mm.

Rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.5 to 0.2mm.

Rare: **polycrystalline quartz**, sa-r, equant to elongate; sometimes sutured contacts. Size = 0.6 to 0.2mm.

Very rare: **plagioclase feldspar**, sr-r, equant to elongate. Size = 0.25 to 0.2mm.

Rare: **chert**, sr, equant to elongate. Size = 0.4 to 0.2mm.

Very rare: **radiolarian test(?)**, infilled with chalcedonic quartz.

Rare: **chlorite pseudomorph**, r, equant. Size = 0.6mm.

Very rare: **micrite**, r, elongate. Size = 0.4 to 0.2mm.

Rare: **opaques**, r, equant to elongate. Size = 0.4 to 0.2mm.

Fine Fraction

Dominant: **quartz**.

Common: **biotite**.

Few: **plagioclase feldspar**.

Very few: **pyroxene**.

Rare: **igneous rocks**.

Rare: **altered igneous rocks**.

Very few: **amphibole**

Rare: **phyllite**.

Rare to very rare: **chert**.

Rare to very rare: **opaques**.

Very rare: **micrite**.

Textural Concentration Features (Tcf)

Very few to rare: **clay pellets**, sr-r, equant to elongate; colour dark brown/black (PPL) (x40); merging boundaries; contains fine quartz, biotite, pyroxene, calcite, r altered igneous rock frags, chert. Size = 1.2 to 0.1mm

Amorphous Concentration Features (Acf)

Rare: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a red-firing (non-calcareous?) groundmass, which contains quartz, biotite, amphibole, phyllite and altered igneous rocks. This is dominated by amphibolite rock fragments. Angularity, grain-size and comparison with clay pellets fail to indicate obvious tempering. Fabric 33 is distinctive and shares no similarities with any other fabric. Provenance remains open.

(34) Non-Calcareous, Quartz-Rich, Dolerite, Altered Igneous, Phyllite/Schist

Samples: 98/80, 98/88

Microstructure

Rare meso planar voids, very few mega to meso vughs. Some voids contain opaque material. Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins, sometimes across a single sample (e.g. 98/80). Inclusions are close to single-spaced.

Groundmass

Colour varies from very dark brown/black to red at margins (PPL, XP) (x40): both samples are almost entirely very dark brown/black. Where visible the micromass is optically active.

Inclusions

c:f:v_{10µm} c.25:70:5

Coarse fraction = 2.0mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant to frequent: **dolerite**, a-sr, equant to elongate; fine-grained; contains laths of plagioclase and biotite, with phenocrysts of pyroxene in an opaque matrix; some examples appear altered (e.g. 98/88). Size = 2.05 to 0.25mm.

Very few to rare: **altered igneous (basaltic?) rock frags.**, r, equant to elongate; usually show little texture; one example in 98/88 contains plagioclase laths in a flow structure.. Size = 1.1mm to 0.2mm.

Common: **siltstone/pelite**, sa-r, equant to elongate; varies from meta-siltstone/phyllite to a well-sorted very fine sandstone/meta-sandstone (max. grain size 0.1mm); contain quartz, mica, opaques; retain bedding structure of a siltstone, but micas in parallel orientation; sometimes pronounced dark bedding lines. Size = 2.0 to 0.2mm.

Very few to rare: **quartz-biotite phyllite/schist**, r, equant to elongate. Size = 1.6 to 0.2mm.

Rare: **monocrystalline quartz**, r, equant to elongate. Size = 0.5 to 0.2mm.

Very few to rare: **polycrystalline quartz**, sa-r, equant to elongate; sometimes sutured contacts. Size = 1.1 to 0.2mm.

Rare: **plagioclase feldspar**, sr-r, equant to elongate. Size = 1.2 to 0.2mm.

Rare: **biotite**, sa-sr, elongate. Size = 0.25 to 0.2mm.

Rare: **opaques**, r, equant to elongate. Size = 0.3 to 0.2mm.

Rare: to absent: **chert**, sa-sr, equant to elongate. Size = 1.2 to 0.2mm.

Very rare to absent: **micrite**, r, equant to elongate. Size = 0.25mm.

Fine Fraction

Dominant: **quartz**.

Common: **biotite**.

Few: **plagioclase feldspar**.

Very few: **pyroxene**.

Very few: **igneous/altered igneous rocks**.

Rare: **phyllite/schist**.
Rare to very rare: **chert**.
Rare to very rare: **opaques**.
Very rare: **micrite**.

Textural Concentration Features (Tcf)

Very few to rare: **clay pellets**, sr-r, equant to elongate; colour dark brown/black (PPL) (x40); merging boundaries; contains fine quartz, mica, r meta-siltstone, r phyllite, r altered igneous rock frags, chert. Size = 1.2 to 0.1mm.

Amorphous Concentration Features (Acf)

Very rare to absent: **burnt/partially burnt organics**.

Comment

This fabric is characterised by a groundmass, rich in quartz and biotite and also containing quartz-biotite schist and siltstone/pelite. This groundmass is dominated by large igneous (dolerite) and altered igneous non-plastics. Consideration of angularity, size and comparison with clay pellets suggests that the latter was added as temper. Fabric 34 is distinctive: the presence of dolerites and altered igneous rocks encourages comparison with Fabric 6, however Fabric 34 also contain more metamorphic rocks of a different texture to Fabric 6 (quartz-biotite phyllite/schist). Provenance remains open.

(35) Non-Calcareous, Quartz and Biotite-Rich, Blueschist

Samples: 97/43, 98/10

Microstructure

Rare macro to meso planar voids, very few to rare mega to meso vughs. One void in 98/10 is surrounded by a darker area and contains some opaque, possibly organic material. Voids and inclusions exhibit local long-axis parallel orientation; the angle of this orientation varies from parallel to perpendicular to vessel margins, sometimes across a single sample (e.g. 97/43) leading to structural discontinuities where zones of different orientation meet; also the long-axis orientation of voids and inclusions sometimes follows a curve (e.g. 97/43). Inclusions are close to single-spaced.

Groundmass

Colour varies across the section, usually from red-orange at margins, to red-brown to brown in the core (PPL, XP) (x40). The micromass is highly optically active. B-fabric is thin to thick granostriated/porostriated.

Inclusions

c:f:v_{10µm} c.30:65:5

Coarse fraction = 6.2mm. to 0.2mm.

Fine fraction = 0.2mm. or less.

Coarse Fraction

Dominant: **glaucophane schist (blueschist)**, a-sa, equant to elongate; contains fine grains (c.0.05 - 0.15mm.) of quartz, mica, amphibole, pyroxene, glaucophane and opaques, often in association with porphyroblasts (max. size c.1.25mm.) of glaucophane, pyroxene, mica, plagioclase. Size = 2.75mm to 0.2mm.

Few: **monocrystalline glaucophane**, a-sa, equant to elongate, size = 1.25mm. to 0.2mm.

Very few to rare: **monocrystalline quartz**, sr, equant to elongate. Size = 0.5mm to 0.2mm

Rare: **polycrystalline quartz**, sa-sr, equant to elongate; sometimes resembles meta-quartz; sometimes sutured contacts; often in association with mica. Size = 2.5 to 1.0mm.

Very few to rare: **opaques**, sr-r, equant to elongate; sometimes contain fine quartz and mica. Size = 0.5mm to 0.2mm.

Fine Fraction

Dominant: **quartz**.

Frequent: **biotite**.

Few: **glaucophane**.

Few: **opaques**.

Rare: **chert**.

Rare: **amphibole**.

Rare: **pyroxene**.

Textural Concentration Features (Tcf)

Few to very few: **clay pellets**, r, equant to elongate; clear to diffuse boundaries; colour is red to dark brown (XP) (x40); rich in fine quartz and biotite, some opaques, with sr-r metamorphic rock fragments containing quartz and biotite. Size = 6.2mm to 0.1mm.

Amorphous Concentration Features (Acf)

Very rare (97/43) to absent: **burnt/partially burnt organic**.

Comment

This fabric is characterised by a red-firing (non-calcareous?) clay groundmass, which is rich in quartz and biotite and also contains rounded quartz-biotite schist rock fragments. This groundmass is dominated by large glaucophane schist (blueschist) non-plastics. Consideration of angularity, grain-size and comparison with clay pellets suggests that the latter was added as temper. There is a possible non-calcareous slip layer in 98/10. Fabric 35 is distinctive and shares no similarities with any other fabric. Although blueschists do occur on Crete (e.g. Preveli, West Crete), they are far more common in the Cyclades and also occur in coastal Anatolia (e.g. Knidian peninsula). Provenance remains open.

Untempered Clay Lump: Calcareous, Quartz-rich, Foraminifera, Micrite

Sample: 97/38

Microstructure

Rare meso planar voids, very few macro to meso vughs. Local long-axis orientation of planar voids. Inclusions are close to single-spaced.

Groundmass

Colour varies from yellow (PPL, XP) (x40) to orange (PPL, XP) (x40). Micromass is very mildly optically active.

Inclusions

c:fv_{10μm} c.26:70:4

Coarse/fine fraction = 1.75mm. to 0.05mm.

Coarse/Fine Fraction

Frequent: **micrite**, r, equant; sometimes contain isolated clasts of quartz, foraminifera, calcite. Size = 1.75 to 0.05mm.

Common: **monocrystalline quartz**, sa-r, equant to elongate. Size = 0.4 to 0.05mm.

Few: **foraminifera**. Size = 0.35mm to 0.05mm.

Rare: **quartz-biotite schist**, r, equant to elongate. Size = 0.25 to 0.1mm.

Very few: **biotite**. Size = 0.1 to 0.05mm.

Rare: **opaques (iron oxide?)**, r, equant. Size = 0.7 to 0.05mm.

Rare: **chert**, r, equant. Size = 0.2mm to 0.05mm.

Rare: **plagioclase feldspar**, r, elongate. Size = 0.25mm .

Textural Concentration Feature Tcf)

clay pellets, r, equant to elongate; clear boundaries; colour is brown (PPL, XP) (x40), contains fine quartz and biotite. Size = 0.35 to 0.05mm.

clay streak: presence of a ptygmatic texture (suggestive of the folding together of two different clays) and clay striations within sample. These are red (PPL, XP) (x40), rich in quartz, with chert, feldspar, biotite, rounded volcanic rock frags. (rich in plagioclase). Grain size varies from 0.25 to 0.05mm.

Amorphous Concentration Features (Acf)

None visible; no sooted areas around voids.

Comment

This sample is characterised by a yellow-firing (calcareous?) groundmass, which contains quartz, foraminifera and micrite. Study of tcfs suggests the mixing of two clays: yellow firing (calcareous?) clay, rich in microfossils and micrite; a red firing (non-calcareous?) clay, rich in quartz with biotite, feldspar and rounded altered igneous rock frags. The former clay could be compared to clays used to produce Fabrics 1a-i, while the latter resembles the red quartz-rich clay component of Fabrics 2a-e. Sample 97/38 lacks obvious evidence for an added temper and here it is worth noting that the sample comes from an amorphous clay lump and not from a finished ceramic vessel.

APPENDIX VI

A REVISED TYPOLOGY OF EARLY NEOLITHIC CERAMIC FORMS

In the following series of tables the existing Furness-Evans shape typology is presented alongside a new typology of shape. This comparison is intended to demonstrate the extent to which forms may vary within the existing typology. For further discussion of this see Section 7.3. The new proposed typology will form the basis of all discussion of form in this thesis (see Chapter 7 and Appendix VII).

Coarse Burnished EN

Furness-Evans Typology	Range of Forms (Furness) ²⁰⁷	Range of Forms (Evans) ²⁰⁸	New Typology
Type 1: open bowls w. rounded profile			curved bowl
			deep curved bowl
			shallow curved bowl
			shallow straight-sided bowl
Type 1A: open bowls w. beaded/ offset rim (Evans 1964:198)			deep curved bowl with beaded rim

²⁰⁷ Forms taken from Furness 1953: figs. 4-8.

²⁰⁸ Forms taken from Evans 1964: figs. 22-32.

Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 2: open bowls w. straight/ splayed sides			straight-sided bowl
			flared bowl
			flared carinated bowl
			carinated bowl

Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 3: carinated bowls			deep curved bowl with offset rim
			curved bowl w. offset rim
			carinated bowl
			carinated bowl with flared offset rim

Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 4: carinated bowls with offset rim			high carinated bowl with offset rim
			curved bowl with flared offset rim
Type 5: bowls with incurved rim			incurved bowl

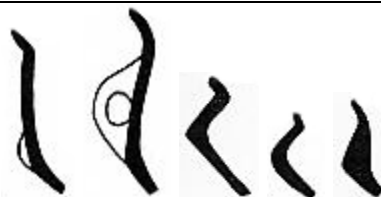
Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 6: deep jars			incurved bowl
			incurved bowl
			curved jar with offset rim

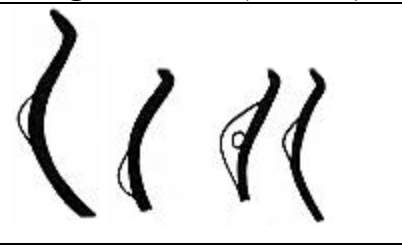
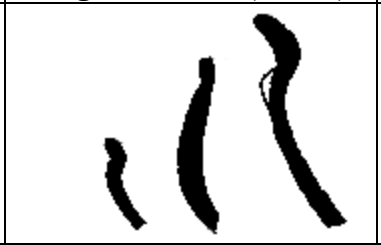
Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 7: narrow-necked jars			's' profile bowls/jars
Type 8: funnel-necked jars			jar with flared offset rim
			's' profile bowls/jars

Fine Burnished

Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 1: open bowls w. rounded profile			curved bowls
			shallow curved bowls
Type 1A: open bowls w. offset rim			straight-sided bowls with offset rim
			curved/carinated bowls with tiny offset rim

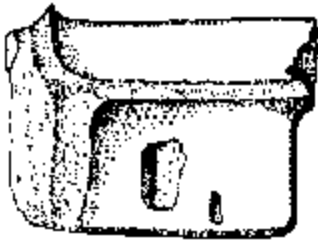
Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 2: open bowls w. straight/splayed profile			flared bowls
			shallow straight-sided bowls
			straight-sided bowls
			straight-sided bowls with offset rim
			flared carinated bowls

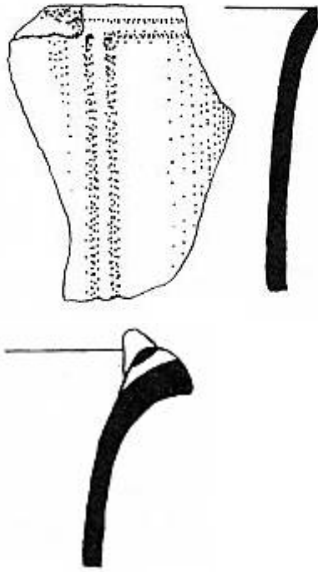
Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 3A: simple carinated bowls			carinated bowls
Type 3B: profiled carinated bowls			high carinated bowls with offset rim
			weakly carinated bowl with offset rim
			flared carinated bowls (see above)
Type 4A: carinated bowls with offset rim			high carinated bowls with offset rim (see above)
			carinated bowls with offset rim

Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 4B: bowls with offset rim			curved bowls with offset rim
			straight-sided bowls with offset rim
			curved jars with offset rim
Type 5: bowls with incurved rim			incurved bowls

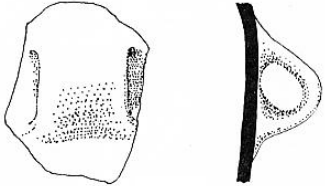
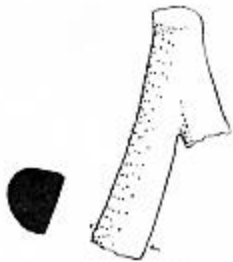
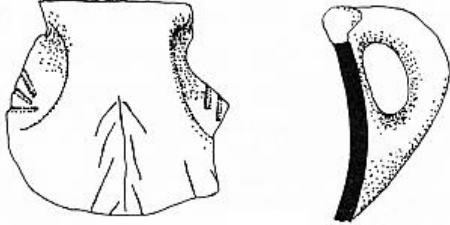
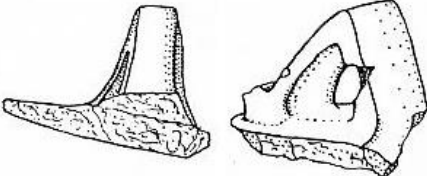
Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 6: deep narrow-mouthed bowls/jars			incurved bowls
			straight-sided incurved bowl/jar
			straight-sided incurved bowl/jar with offset rim
Type 7: narrow-necked jars			's' profile bowl/jar
			collared jar

Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Type 8: funnel-necked jars	no fine equivalent noted by Furness		collared jar
			curved jar with offset rim (see above)
Flat-based dishes or mugs: (Evans 1964:198, 200)			flat-based mug
			flat-based mug with offset rim
Oval Dishes with pairs of ears: (Furness 1953: fig. 9.13; Evans 1964:200; fig. 39.4)			curved bowl (see above)

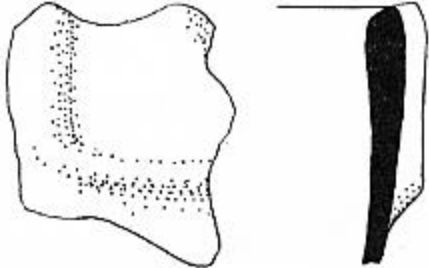
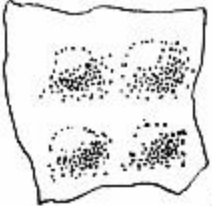
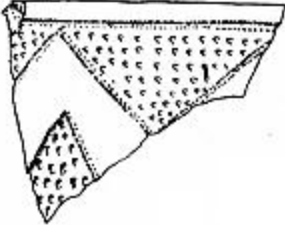
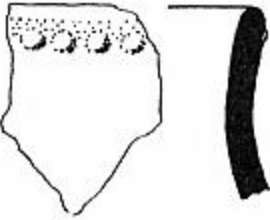
Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
Shallow Rectangular Vessels: (Evans 1964:200-1; fig. 27.26)			rectangular trays
Pedastalled Bowls: (Evans 1964:201; fig. 24.17, fig. 27.14)			pedestalled stand/ shallow bowl
'Legged Receptacles': (Furness 1953: fig. 13b.10; Evans 1964: fig. 31.3-5)			 house model(?)

Furness-Evans Typology	Range of Forms (Furness)	Range of Forms (Evans)	New Typology
			flared cup
Flat base			flat base
			steep-sided base
Concave base			concave base

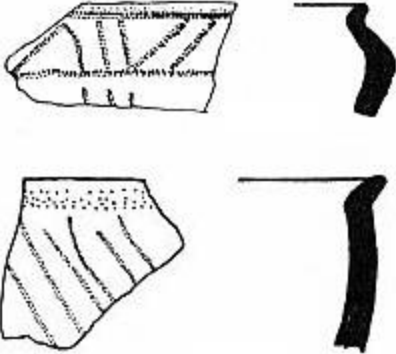
Main Handle Types

Strap handle		Wishbone	
Flared strap		Tubular lug	
Rim Strap			
Squared handle			

Main ENI Decoration Types

Plastic cordon		Barbotine	
Incised Pointillé		Incised Lattice	
Pellet (rim)		Incised 'Ladder'	
Pellet (body)		Incised Cordon/'Rope'	

Main ENII Decoration Types

Incised Diagonals or Chevrons		'Branch'	
'Barbed Wire'		Barbotine	

APPENDIX VII

FORM AND FINISH PER FABRIC

In the following series of tables the incidence of specific features of form and finish are presented for each fabric and for each ceramic phase (i.e. ENIa, ENIb, ENIc, ENII; see Appendix I). When a fabric is not listed this means either that it was not identified in contexts belonging to that phase or that such sherds that were identified were not diagnostic of a specific form or finish.

	1a	1a	1b	1d	1e	1f	2a	2c	4	5a	5a	5b	5c	6	7	8	9
	C	F	/c				/b			C	F						
no offset rim																	
deep curved	•	•									•			•		•	•
curved	•	•					•				•			•		•	
shallow (curved)		•									•					•	
shallow (straight)	•	•					•							•			
incurved bowl	•	•					•				•			•	•	•	
/hole-mouth jar									•	•	•		•			•	•
hole-mouth jar (straight-sided)																	
carinated							•										
flared										•	•			•		•	
's' profile	•	•					•			•				•			
flat-based mug							•				•						
palette							•										
with offset rim																	
deep curved							•										
curved	•	•					•				•			•		•	
carinated		•															
shallow (curved)							•				•						
curved jar	•	•									•						
carinated jar		•					•										
collared jar							•			•	•			•			
flared offset rim																	
strap	•	•					•		•	•	•		•	•		•	•
flared strap							•							•		•	
false flared strap														•			
rim strap																	
squared strap																	
wishbone	•	•					•							•		•	
tubular rim loop (vertical)											•				•		
tubular loop (horizontal)							•							•		•	
tubular lug																	
oval pierced lug																	
flat base	•	•					•				•			•		•	•
rounded base																	

ENIa Forms Per Fabric

	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
no offset rim															
deep curved															
curved		•			•										
shallow curved)															
shallow (straight)															
incurved bowl												•			•
/hole-mouth jar															
hole-mouth jar												•			
(straight-sided)															
carinated															
flared					•										
's' profile															
flat-based mug															
palette															
with offset rim															
deep curved															
curved															
shallow (curved)			•												
curved jar															
carinated jar															
collared jar		•													
carinated															
curved high offset															
flared rim jar															
flared offset rim															
strap									•						•
flared strap	•														
false flared strap			•												
rim strap		•													
squared strap															
wishbone				•											
tubular rim loop															
(vertical)															
tubular loop												•			
(horizontal)															
tubular lug															
oval pierced lug															•
flat base										•	•	•			•
rounded base															

ENIa Forms Per Fabric (Continued)

	25	26	27	28	29	30	31	32	33	34	35	36
no offset rim												
deep curved												
curved					•							
shallow curved)												
shallow (straight)												
incurved bowl					•							
/hole-mouth jar												
hole-mouth jar												
(straight-sided)												
carinated												
flared												
's' profile												
flat-based mug												
palette												
with offset rim												
deep curved												
curved												
shallow (curved)												
curved jar												
carinated jar												
collared jar												
carinated												
curved high												
offset												
flared rim jar												
flared offset rim											•	
strap											•	
flared strap												
false flared strap												
rim strap												
squared strap				•								
wishbone												
tubular rim loop												
(vertical)												
tubular loop												
(horizontal)												
tubular lug				•								
oval pierced lug												
flat base												
rounded base											•	

EN1a Forms Per Fabric (Continued)

	1a C	1a F	1b /c	1d	1e	1f	2a /b	2c	4	5a C	5a F	5b	5c	6	7
no offset rim															
deep curved	•						•			•		•		•	
curved	•						•			•	•			•	
shallow (curved)		•					•				•			•	
shallow (straight)		•												•	
incurved bowl	•	•					•			•	•			•	
/hole-mouth jar															
hole-mouth jar	•	•							•		•				
(straight-sided)															
carinated							•				•				
flared							•				•		•	•	
's' profile	•	•								•	•			•	
flat-based mug							•				•			•	
straight-sided	•	•									•			•	
bowl															
flared cup				•											
tray							•							•	
pedestal							•								
with offset rim															
deep curved		•					•							•	
curved	•	•					•			•	•			•	
shallow (curved)											•				
curved jar	•	•			•						•			•	
carinated jar							•								
collared jar										•	•			•	
carinated		•					•							•	
high carinated															
flared rim jar											•			•	
flared offset rim															
strap	•	•		•			•		•	•	•	•	•	•	
flared strap	•	•								•	•			•	
false flared strap	•						•				•			•	
rim strap							•			•	•		•	•	
mini rim strap							•								
squared handle							•								
wishbone	•			•			•				•			•	
tubular rim loop															
(vertical)															
tubular loop											•			•	
(horizontal)															
tubular lug															
oval pierced lug															
flat base	•	•		•			•			•	•			•	
rounded base				•			•		•						

EN1b Forms Per Fabric

	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
no offset rim															
deep curved	•		•					•				•			
curved	•								•						
shallow (curved)	•														
shallow (straight)															
incurved bowl											•				
/hole-mouth jar															
hole-mouth jar	•													•	
(straight-sided)															
carinated											•			•	
flared	•	•													
's' profile			•												
flat-based mug	•														
straight-sided											•			•	
bowl															
flared cup			•												
tray															
pedestal				•											
with offset rim															
deep curved									•						
curved	•		•		•										
shallow (curved)															
curved jar	•														
carinated jar															
collared jar															
carinated															
high carinated														•	
flared rim jar															
flared offset rim															
strap	•	•				•	•				•	•		•	
flared strap															
false flared strap															
rim strap															
mini rim strap															
squared handle									•						
wishbone	•	•			•									•	
tubular rim loop															
(vertical)															
tubular loop															
(horizontal)															
tubular lug															
oval pierced lug															
flat base	•										•			•	
rounded base															
ring base															

ENIb Forms Per Fabric (Continued)

	23	24	25	26	27	28	29	30	31	32	33	34	35
no offset rim													
deep curved													
curved									•		•		
shallow (curved)													
shallow (straight)													
incurved bowl		•											
/hole-mouth jar													
hole-mouth jar (straight-sided)													
carinated													
flared													
's' profile													
flat-based mug	•												
straight-sided bowl													
flared cup													
tray													
pedestal													
with offset rim													
deep curved													
curved													
shallow (curved)													
curved jar													
carinated jar													
collared jar													
carinated													
high carinated													
flared rim jar													
flared offset rim													
strap													
flared strap													
false flared strap													
rim strap													
mini rim strap													
squared handle						•							
wishbone													
tubular rim loop (vertical)													
tubular loop (horizontal)													
tubular lug				•		•							
oval pierced lug													
flat base		•											
rounded base													
ring base		•											

EN1b Forms Per Fabric (Continued)

	1b C	1b F	1d C	1d F	1e C	1e F	1e B/S	1f C	1f F	2a/b C	2a/b F	2c	4	5a C	5a F
no offset rim															
deep curved	•		•	•					•	•					•
curved		•		•	•	•			•		•		•		•
curved with thickened rim									•		•				
straight-sided		•					•						•		•
shallow (curved)				•	•										•
shallow (straight)	•		•			•			•	•	•				
incurved bowl		•		•	•					•	•				
/hole-mouth jar															
hole-mouth jar (straight-sided)															
vertical carinated		•							•						•
vertical curved		•													
carinated															
carinated shallow									•						
flared		•		•	•				•		•				•
's' profile	•			•									•		
flat-based mug									•		•				
flared cup		•		•											•
with offset rim															
deep curved			•	•					•		•				
curved		•		•	•	•		•	•	•	•				•
shallow									•		•				
curved jar										•					
carinated jar															
collared jar	•	•	•	•	•	•		•	•	•	•			•	
carinated				•	•	•				•			•		•
high carinated		•							•						
flared rim jar											•				
funnel-necked jar															•
flared offset rim															
strap	•		•	•	•		•	•		•	•		•		
flared strap			•				•			•	•		•	•	•
false flared strap		•													
rim strap							•				•				
mini rim strap															
squared handle									•	•					
wishbone		•		•		•			•						•
loop handle															
mini fold-over handle															
tubular lug															
oval pierced lug															
flat base	•	•	•	•			•		•	•	•		•		
rounded base													•		
steep-sided				•							•				

ENic Forms Per Fabric

	6	8	8	9	10	11	12	18	34
	C	F	F						
no offset rim									
deep curved	•	•	•						
curved		•	•						•
curved with thickened rim									
straight-sided	•								
shallow (curved)	•		•						
shallow (straight)									
incurved bowl	•	•	•						
/hole-mouth jar									
hole-mouth jar (straight-sided)	•								
vertical carinated	•								
vertical curved							•		
carinated									
carinated shallow									
flared	•	•	•						
's' profile									
flat-based mug									
flared cup									
with offset rim									
deep curved									
curved	•		•						
shallow									
curved jar	•								
carinated jar							•		
collared jar	•	•	•						
carinated	•								
high carinated									
flared rim jar									
funnel-necked jar									
flared offset rim									•
strap	•	•	•					•	
flared strap	•		•						
false flared strap									
rim strap									
mini rim strap									
squared handle	•								
wishbone	•		•						
loop handle									
mini fold-over handle			•						
tubular lug									
oval pierced lug									
flat base	•		•						
rounded base									
steep-sided						•			

ENIc Forms Per Fabric (Continued)

	1b C	1b F	1d C	1d F	1e C	1e F	1e B/S	1f C	1f F	1f B/S	2a/b C	2a/b F	4
no offset rim													
deep curved			•		•	•		•			•		•
curved	•	•		•		•	•	•	•	•		•	•
curved with thickened rim					•	•			•				
straight-sided		•			•		•		•	•			
shallow (curved)													
shallow (straight)	•	•		•		•			•			•	
incurved bowl					•	•						•	
/hole-mouth jar													
hole-mouth jar (straight-sided)					•		•						
vertical carinated		•				•	•		•	•		•	
vertical curved						•			•				
carinated													
carinated shallow				•		•			•				
flared	•	•		•		•	•		•	•	•	•	
's' profile													
flat-based mug													
flared cup													
house model						•			•				
spoon/scoop		•				•							
with offset rim													
deep curved		•		•					•			•	
curved	•	•			•	•	•		•	•		•	•
shallow						•							
curved jar		•		•	•	•	•				•	•	
carinated jar									•				
collared jar	•					•	•	•	•				
carinated									•			•	
high carinated		•				•	•		•				
funnel-necked jar									•				
strap	•	•	•	•	•	•	•	•	•	•	•	•	•
flared strap							•						
false flared strap						•			•				
rim strap	•	•		•		•			•				
mini rim strap													
squared handle						•			•			•	
horizontal strap						•							
wishbone		•		•		•			•			•	
loop handle									•				
tubular lug													
flat base	•	•			•	•			•		•		
concave base	•	•	•	•	•	•	•		•			•	
rounded base						•							•
steep-sided									•			•	
pedestal						•	•						

ENII Forms Per Fabric

	5a C	5a F	6	8	9	10	11	12	13	14	15	16	18	22
no offset rim														
deep curved	•		•											
curved	•	•	•	•										
curved with thickened rim														
straight-sided		•	•	•										
shallow (curved)											•			
shallow (straight)														
incurved bowl			•			•								
/hole-mouth jar														
hole-mouth jar (straight-sided)				•										
vertical carinated				•		•		•			•			
vertical curved														
carinated														
carinated shallow		•		•										
flared		•	•	•				•						•
's' profile														
flat-based mug														
flared cup														
house model														
spoon/scoop														
with offset rim														
deep curved		•	•											
curved		•		•				•						
shallow		•												
curved jar		•		•										
carinated jar														
collared jar				•										
carinated														
high carinated		•		•										
funnel-necked jar		•												
strap	•	•	•	•				•						•
flared strap														
false flared strap														
rim strap		•												
mini rim strap														
squared handle				•										
horizontal strap				•										
wishbone		•		•										
loop handle														•
horizontal tub. lug		•												
flat base		•		•										
concave base		•	•	•									•	
rounded base														
steep-sided		•		•										
pedestal								•						

ENII Forms Per Fabric (Continued)

	1a C	1a F	1b /c	1d	1e	1f	2a /b	2c	4	5a	5b	5c	6	7	8	9
U/V cordon:																
curved/deep bowl	•						•						•		•	
incurved bowl	•															
lump (↑ rim):																
curved/deep bowl	•															
incurved bowl	•						•			•				•	•	
lump (↓ rim):																
curved/deep bowl	•						•						•			•
pierced ears:																
curved bowl							•								•	
flat-based mug										•						
pellet (↓ rim):																
's' profile jar							•									
pellets (body):																
single							•									
∴ carinated [o]		•														
jar																
mini false strap:																
curved [o] bowl													•			
rim of curved [o]		•														
bowl																
unpierced tub																
lug																
incised/							•									
pointillé:																
fb [o] mug							•			•						
curved [o] bowl							•									
lattice in triangle																
lattice																
'ladder'																
incised offset															•	
rim																
oblique/V																
punched:																
straight-sided															•	•
hole-mouth jar																
wiped/combed							•									
scribble burnish							•						•		•	
piercing																
(pre-firing):																
shallow (ss)		•														
flared															•	
high carinated [o]															•	

ENIa Decoration Per Fabric

	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
U/V cordon:															
curved/deep bowl															
incurved bowl															
lump (↑ rim):															
curved/deep bowl															
incurved bowl															
lump (↓ rim):															
curved/deep bowl															
pierced ears:															
curved bowl															
flat-based mug															
pellet (↓ rim):															
's' profile jar															
pellets (body):															
single															
∴ carinated [o]															
jar															
mini false strap:															
curved [o] bowl			•												
rim of curved [o]															
bowl															
unpierced tub															
lug															
incised/pointillé:															
flat-based [o]															
mug															
curved [o] bowl															
lattice in triangle															
lattice															
'ladder'															
incised offset															
rim															
oblique/V															
punched:															
straight-sided															
hole-mouth jar															
wiped/combed															
scribble burnish															
piercing															
(pre-firing)															

ENIa Decoration Per Fabric (Continued)

	25	26	27	28	29	30	31	32	33	34	35	unsampled
U/V cordon:												
curved/deep bowl												
incurved bowl												
lump (↑ rim):												
curved/deep bowl												
incurved bowl												
lump (↓ rim):												
curved/deep bowl												
pierced ears:												
curved bowl												
flat-based mug												
pellet (↓ rim):												
's' profile jar												
pellets (body):												
single												
∴ carinated [o]												
jar												
mini false strap:												
curved [o] bowl												
rim of curved [o]												
bowl												
unpierced tub												
lug												
incised/pointillé:												
flat-based [o]												
mug												
curved [o] bowl												
lattice in triangle												
lattice												
'ladder'												
incised offset												
rim												
oblique/V												
punched:												
straight-sided												
hole-mouth jar												
wiped/combed												
scribble burnish												
piercing												
(pre-firing)												

ENIa Decoration Per Fabric (Continued)

	1a C	1a F	1b/c	1d	1e	1f	2a/ b	2c	4	5a	5b	5c	6	7	8	9
U/V cordon																
curved/deep bowl	•			•			•						•		•	•
incurved bowl																
flared															•	•
curved [o] bowl							•			•					•	
flared cup																
slashed cordon/rope:																
curved/deep curved							•									
lump (↑ rim):																
curved/deep bowl	•			•			•						•		•	
incurved bowl	•						•									
flared bowl															•	
lump (below rim)																
[un]pierced ear																
curved bowl							•			•			•			
flat-based mug																
pellet (↓ rim):																
's' profile jar																
curved/deep curved	•														•	•
incurved	•						•						•			
collared jar				•			•								•	
curved [o] bowl							•			•					•	
pellets (body):																
single							•			•						
row				•			•									
barbotine				•						•						
mini false strap:																
curved [o] bowl										•						
rim of curved [o] bowl																
unpierced tub lug																
ripple decoration:																
curved [o] bowl																
carinated [o]															•	

EN1b Decoration Per Fabric

	1a C	1a F	1b /c	1d	1e	1f	2a /b	2c	4	5a	5b	5c	6	7	8	9
incised/pointillé:							•			•			•			
flat-based [o] mug							•						•			
flared										•						
pedestal bowl							•									
rim strap							•									
dotted													•			
lattice																
flat-based mug										•						
'ladder'																
curved							•									
flat-based mug							•			•			•			
incised offset rim															•	
unique incised decoration																
oblique/V																
punched:																
straight-sided hole- mouth jar																
curved [o] bowl															•	
combed																
wiped/scored							•						•			
scribble burnish																
d-on-l painted:																
crosshatching																
oblique																
dribble				•												
dots					•											
red & white paint																
piercing (pre-fire)																
flared cup				•												

EN1b Decoration Per Fabric (Continued)

	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Plastic															
Decoration															
U/V cordon									•						
curved/deep bowl															
flared cup		•													
slashed cordon/ 'rope':															
curved/deep curved	•														
's' profile	•														
lump (↑ rim)															
lump (↓ rim):															
deep curved						•				•					
[un]pierced ear															
pellet (↓ rim):															
's' profile jar															
curved/deep curved						•									
incurved														•	
pellets (body)															
barbotine															
mini false strap															
unpierced tub lug															
ripple decoration		•													
incised/pointillé															
pedestal bowl		•													
flat-based [o] mug														•	
grooved/pointillé					•										
dotted															
lattice in triangle															
lattice															
'ladder'															
incised offset rim							•								
unique incised															
decoration															
oblique/V punched															
combed															
wiped/scored															
scribble burnish															
d-on-l painted:															
crosshatching															
oblique															
dribble								•							
red & white paint															
piercing (pre-fire)															

EN1b Decoration Per Fabric (Continued)

	25	26	27	28	29	30	31	32	33	34	35
Plastic											
Decoration											
U/V cordon											
curved/deep bowl											
flared cup											
slashed cordon/ 'rope':											
curved/deep curved											
's' profile											
lump (↑ rim)											
lump (↓ rim):											
deep curved											
[un]pierced ear											
pellet (↓ rim):											
's' profile jar				•							
curved/deep curved											
incurved											
pellets (body)											
barbotine											
mini false strap											
unpierced tub lug											
ripple decoration											
incised/pointillé											
pedestal bowl											
flat-based [o] mug											
grooved/pointillé											
dotted											
lattice in triangle											
lattice											
'ladder'											
incised offset rim											
unique incised			•	•							
decoration											
oblique/V punched											
combed					•						
wiped/scored											
scribble burnish											
d-on-l painted:											
crosshatching	•										
oblique										•	
dribble											
red & white paint								•			
piercing (pre-fire)											

EN1b Decoration Per Fabric (Continued)

	1b C	1b F	1d C	1d F	1e C	1e F	1f C	1f F	2a/b C	2a/b F	2c	4	5a C	5a F	6	8 F	34
U/V cordon																	
curved/deep bowl			•						•	•						•	
slashed																	
cordon/rope																	
curved/deep															•		
lump (↑ rim)																	
lump (↓ rim)																	
[un]pierced																	
ear																	
pellet (↓ rim)																	
collared jar			•														
pellets (body)																	
single		•											•	•			
row																	
double on								•		•							•
high carinated bowl																	
barbotine			•														
mini false																	
strap																	
curved [o]		•															
bowl																	
rim of curved [o] bowl																	
unpierced																	
tubular lug																	
ripple																	
curved [o]						•											
bowl																	
carinated [o]				•											•		
carinated																•	
body				•													
incised/																	
pointillé:																	
flat-based [o]								•		•					•		
mug																	
curved [o]																	
bowl																	
flared																•	
rim strap																	
body		•	•					•		•					•		

ENlc Decoration Per Fabric

	1b C	1b F	1d C	1d F	1e C	1e F	1f C	1f F	2a/b C	2a/b F	2c	4	5a C	5a F	6	8 F	34
dotted																	
lattice																	
flat-based mug															•		
'ladder'																	
curved										•							
curved [o]		•															
flat-based mug										•							
incised offset						•											
rim																	
vertical notch								•									
high carin. [o]																	
notched rim																	•
incised																	
diagonals																	
vertical								•									
carinated								•									
curved [o]								•									
'barbed wire'						•		•								•	
deep bowl [o]			•														
vertical						•		•									
carinated [o] w.																	
rim strap																	
high carin. [o]								•									
V punched																	
combed																	
wiped									•		•						
scribble		•	•		•												•
burnish																	
deep bowl						•											
carinated [o]						•											
flared strap						•											
brushed				•			•										
vertical						•											
carinated [o] w.																	
rim strap																	
d-on-l painted																	
crosshatching																	
oblique/linear																	
dribble				•													
brushed/painted			•	•													
dots																	

ENIc Decoration Per Fabric (Continued)

	1b C	1b F	1d C	1d F	1e C	1e F	1f C	1f F	2a/b C	2a/b F	4	5a C	5a F	6 F	8 C	8 F	12 F	?
U/V cordon																		
curved/deep				•	•	•	•			•								
slashed cordon																		
curved/deep													•					
lump (↑ rim)																		
lump (↓ rim)																		
[un]pierced ear																		
pellet (↓ rim)																		
curved/deep																•		
pellets (body)																		
single	•																	
double on high							•		•									
carinated bowl																		
barbotine					•								•					
curved [o] bowl								•										
ripple								•								•		
curved [o] bowl								•									•	
carinated [o]								•					•					
carinated																•		
's' profile						•										•		
(flat-topped)																		
flared															•			
wishbone								•										
incised/pointillé					•	•									•			
f-based [o] mug						•				•								
lattice																		
'ladder'																•		
incised				•	•	•		•		•			•			•		
diagonals																		
vertical								•		•								
carinated																		
curved/carinated				•		•		•		•								
[o] (rim strap)																		
'barbed wire'						•	•	•		•								
deep bowl [o]																		
curved/carinated						•		•										
[o] (rim strap)																		
incurved						•				•								
V punched																		
curved [o] bowl																•		
scribble burn.	•					•		•		•	•							
brushed						•		•										
d-on-l painted																		
oblique/linear																		•
dribble																		
brushed/paint						•												
dots						•												

ENII Decoration Per Fabric

APPENDIX VIII

SELECTED SAMPLES

All samples selected for further analysis by thin section petrography are listed below in Figure VIII.1. Illustrations of those samples that preserve specific features of form or finish can be found after Figure VIII.1 or in Plates 30-71.

Sample No.	Fabric	Finish	Context	Comments	Illustration
97/1	8	B	ENIA	body	-
97/2	2b	B	ENIA	body	-
97/3	2b	B	ENIA	body	-
97/4	1a	P	ENIA	body w. strap handle	VIII.2
97/5	2b	B	ENIA	straight-sided shallow bowl	VIII.14
97/6	7	P	ENIA	body	-
97/7	1a	P	ENIA	carinated bowl w. offset rim	VIII.8
97/8	6	B	ENIA	handle	-
97/9	5a	B	ENIA	straight-sided hole-mouth jar	VIII.17
97/10	14	P	ENIA	body	-
97/11	18	B	ENIA	body	-
97/12	13	B	ENIA	body	-
97/13	6	B	ENIA	body	-
97/14	7	P	ENIA	incurved bowl w. rim lump	VIII.20
97/15	5a	P	ENIA	flared	VIII.17
97/16	11	P	ENIA	thin body sherd	-
97/17	7	P	ENIA	incurved bowl	VIII.20
97/18	11	B	ENIA	flat-base	VIII.24
97/19	8	B	ENIA	body	-
97/20	8	B/P	ENIA	's' profile	VIII.21
97/21	6	P	ENIA	carinated bowl w. offset	-
97/22	1a	P	ENIA	carinated bowl w. offset rim	VIII.2
97/23	5a	P	ENIA	incurved bowl	VIII.16
97/24	2a	B	ENIA	body	-
97/25	4	B	ENIA	round base burnt interior	-
97/26	7	B	ENIA	body	-
97/27	12	P	ENIA	curved bowl w. offset	Plate 34
97/28	14	B	ENIA	curved bowl	VIII.25
97/29	5a	P	ENIA	body	-
97/30	19	P	ENIA	body	-
97/31	8	B	ENIA	body	-
97/32	14	P	ENIA	body	-
97/33	21	B	ENIA	flat-base	Plate 65
97/34	9	B	ENIA	strap handle	VIII.23
97/35	8	B	ENIA	body	-
97/36	28	B	ENIA	tubular lug	Plate 67
97/37	2a	B	ENIA	body	-
97/38	-	-	ENIA	clay lump	-

97/39	24	B	ENIA	miniature bowl	VIII.16
97/40	1i	B	ENIA	straight-sided bowl	VIII.10
97/41	12	B	ENIA	round base	-
97/42	2c	B	ENIA?	deep bowl	VIII.15
97/43	35	B	ENIA	body	-
97/44	2b	P	ENIA	body	-
97/45	6	B	ENIA	rounded base	-
97/46	2e	B	ENIA	flat-base	VIII.15
97/47	8	B	ENIA	body	-
97/48	5a	P	ENIA?	body	-
97/49	1a	B	ENIA?	carinated	VIII.2
97/50	1e	P	ENIA?	body	-
97/51	1a	P	ENIA	curved bowl with offset rim	VIII.2
97/52	5a		ENIA	body	-
97/53	1b	P	ENIA?	wishbone	VIII.4
97/54	2b	I	ENIA	deep bowl w. offset rim	VIII.12
97/55	1b	P	ENIA	bowl	VIII.4
97/56	10	B	ENIA	body?	-
97/57	15	B	ENIA	deep bowl	Plate 45
97/58	2c	P	ENIA	body.	-
97/59	33	P	ENIA	body	-
97/60	23	IP	ENIA?	flat-based mug	Plate 59
97/61	23	P	ENIA	carinated	Plate 59
97/62	1a	P	ENIB	shallow bowl	VIII.2
97/63	2b	P	ENIB	shallow bowl	VIII.14
97/64	2a	B/W	ENIB	deep bowl	VIII.11
97/65	1c	P	ENIB	deep bowl	VIII.3
97/66	2b	B	ENIB	carinated	VIII.14
97/67	6	B/W	ENIB	curved bowl w. offset rim	VIII.19
97/68	6	B	ENIB	body	Plate 63
97/69	8	B	ENIB	body	-
97/70	8	B	ENIB	rounded base burnt.	Plate 47
97/71	10	SC/R	ENIB	's' profile	VIII.22; Plate 64
97/72	19	B	ENIB	body	-
97/73	26	B	ENIB	body	-
97/74	6	B	ENIB	body	-
97/75	8	B/W	ENIB	body	-
97/76	26	B	ENIB	horiz. tubular lug	Plate 66
97/77	17	B	ENIB	body	-
97/78	11	B	ENIB	pedestalled stand/bowl.	VIII.24
97/79	28	B	ENIB	body	-
97/80	6	B	ENIB	body	-
97/81	1b	P	ENIB?	straight-sided bowl	VIII.3
97/82	2b	B	ENIB	handle	-
97/83	1b	P	ENIB	curved bowl w. offset rim	VIII.4
97/84	1d	B	ENIB	deep bowl	VIII.5
97/85	2a	P	ENIB	deep bowl w. offset rim.	VIII.12
97/86	29	C	ENIB	bowl	Plate 66
97/87	5a	B	ENIB	flat-base	VIII.16

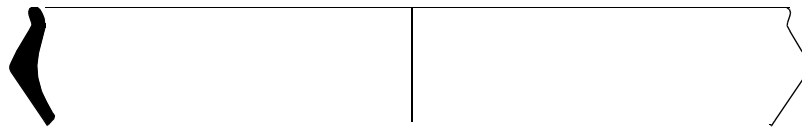
97/88	15	B	ENIB	deep bowl	Plate 45
97/89	18	B	ENIB	body	-
97/90	18	B	ENIB	carinated bowl	-
97/91	16	P	ENIB	curved bowl	VIII.25
97/92	19	B	ENIB	body	-
97/93	5a	P	ENIB	curved	VIII.17
97/94	8	B	ENIB	flat base	VIII.21
97/95	5a	P	ENIB	curved bowl w. offset rim	VIII.16
97/96	6	B	ENIB	straight-sided hole-mouth jar	VIII.18
97/97	6	B	ENIB	body	-
97/98	5a	W	ENIB	straight-sided bowl	VIII.17
97/99	5a	IL	ENIB	flat-based mug	VIII.18
97/100	16	B	ENIB	deep bowl w. offset rim	VIII.25
97/101	31	P	ENIB	bowl!	VIII.26
97/102	11	R	ENIB	curved bowl w. offset rim	VIII.24
97/103	1c	P	ENIB	carin. bowl w. mini offset	VIII.3
97/104	2b	B	ENIB	flat-base.	VIII.13
97/105	1d	B	ENIC	deep bowl	VIII.5
97/106	2b	B	ENIC	collared rim.	VIII.14
97/107	1a	P	ENIC	bowl	VIII.2
97/108	10	IP	ENIC	carinated	Plate 64
97/109	1d	P	ENIC	deep bowl	VIII.5
97/110	2b	B	ENIC	's' profile	VIII.14
97/111	1d	P	ENIC	bowl	VIII.5
97/112	5a	B	ENIC	strap	VIII.16
97/113	5a	P	ENIC	curved bowl	VIII.16
97/114	5a	P	ENIC	flared	VIII.17
97/115	1d	B	ENIC	handle	-
97/116	1b	P	ENIC	shallow bowl	VIII.3
97/117	1b	P	ENIC	curved bowl w. offset rim	VIII.4
97/118	1a	B	ENIC	strap handle	VIII.2
97/119	1c	B	ENIC	incurved/'s' profile	VIII.4
97/120	1c	B	ENIC	deep bowl	VIII.4
97/121	1e	paintd	ENIC?	deep bowl	VIII.6
97/122	1h	B	ENIC	body.	VIII.10
97/123	5a	B	ENIC	bowl	VIII.17
97/124	22	B	ENIC	bowl	VIII.26
97/125	1f	P	ENIC	bowl	VIII.7
97/126	1e	P	ENIC	bowl	VIII.6
97/127	1e	P	ENIC	flat-base	VIII.6
97/128	5a	P	ENIC	strap handle	VIII.16
97/129	5a	P	ENIC	carinated bowl 3b	VIII.17
97/130	1b	P	ENIC	bowl; darker b	VIII.3
97/131	1f	P	ENIC	high carinated	VIII.7
97/132	1e	I	ENIC	bowl	VIII.6
97/133	1g	B	ENIC	strap handle	VIII.10
97/134	1f	P	ENIC	carinated	VIII.7
97/135	1b	I	ENIC	body	VIII.4
97/136	1b	P	ENIC	body	-
97/137	12	B	ENII	body	-

97/138	12	B	ENII	body	-
97/139	22	B	ENII	body	-
97/140	3	P	ENII	body	VIII.10
98/1	1a	P	ENIA	curved bowl	VIII.2
98/2	2a	SB	ENIA	incurved	VIII.11
98/3	2b	P	ENIA	deep curved w. offset rim	VIII.13
98/4	13	P	ENIA	wishbone	VIII.25; Plate 53
98/5	2a	B/SB	ENIA	incurved bowl	VIII.11
98/6	2b	B	ENIa	large strap handle	VIII.15
98/7	14	P	ENIA	collared jar w. flared strap	VIII.24
98/8	8	PB	ENIA	body	-
98/9	5b	B	ENIA	body	VIII.20
98/10	35	B	ENIA	flared rim bowl	Plate 71
98/11	8	B	ENIa	deep bowl	VIII.21
98/12	6	B	ENIA	curved bowl	VIII.19
98/13	6	B	ENIA	body	-
98/14	6	B	ENIa	incurved jar	VIII.19
98/15	6	P	ENIA	deep bowl	VIII.18
98/16	6	P	ENIA	curved bowl w. offset rim	Plate 63
98/17	11	P	ENIA	squared strap	VIII.24
98/18	6	P	ENIA	collared jar	VIII.19
98/19	8	B	ENIA	straight-sided hole-mouth jar	VIII.21
98/20	21	B	ENIA	horizontal loop handle	Plate 29
98/21	28	B	ENIA	body	-
98/22	28	B	ENIB	unpierced tubular lug	Plate 67
98/23	6	SB	ENIA	strap handle	Plate 63
98/24	2a	P	ENIB	deep bowl w. offset rim	VIII.12
98/25	4	B	ENIB	body	-
98/26	27	B	ENIB	body	-
98/27	8	B	ENIB	deep bowl	VIII.21
98/28	8	B	ENIB	curved bowl, pierced ear	VIII.22
98/29	24	B	ENIB	large strap handle	Plate 68
98/30	8	P	ENIB	curved bowl w. offset rim	VIII.23
98/31	6	SB	ENIBa	body	-
98/32		SB	ENIBa	body	-
98/33	20	B	ENIBa	flat-base	Plate 69
98/34	2a	B	ENIB	collared rim	VIII.12
98/35	21	B	ENIBa	jar w.offset rim high carin.;	Plate 29
98/36	2b	B	ENIB	strap handle	VIII.13
98/37	2a	B	ENIB	curved bowl	VIII.8
98/38	2b	B	ENIB	deep bowl; rim strap	VIII.13
98/39	5a	B	ENIB	deep bowl; rim strap	VIII.16
98/40	10	P	ENIB	flared strap handle shallow carinated bowl	Plate 64
98/41	5a	P	ENIB	body plastic dec.	VIII.16
98/42	2a	IP	ENIB	deep bowl w. offset rim	VIII.8
98/43	24	B	ENIB	pierced oval lug	Plate 68

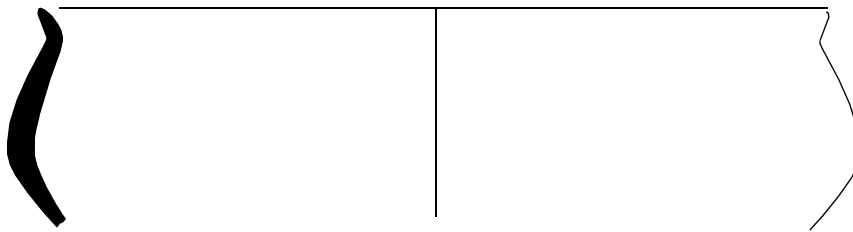
98/44	24	B	ENIB	incurved bowl w. lump	Plate 68
98/45	8	SB	ENIB	body	-
98/46	8	P	ENIB	collared jar	VIII.23
98/47	10	P	ENIB	flared strap handle	Plate 64
98/48	10	P	ENIB	curved bowl w. offset rim	Plate 64
98/49	2b	IP	ENIB	deep bowl w. offset rim	VIII.13
98/50	2a	IP	ENIB	deep bowl w. offset rim	VIII.12
98/51	1d	B	ENIB	flared cup w. pierced rim	VIII.5
98/52	5a	B	ENIB	body; barbotine	-
98/53	1d	B	ENIB	body; single line of knobs	-
98/54	1d	B	ENIB	body; barbotine	VIII.5
98/55	8	B	ENIB	straight-sided hole mouth jar	VIII.21
98/56	2b	S	ENIB	body	-
98/57	5c	B	ENIB	flared bowl; rim strap	VIII.20
98/58	2c	P	ENIB	wishbone	VIII.15
98/59	8	B	ENIB	's' profile; pellets below rim	VIII.22
98/60	8	P	ENIB	curved bowl w. offset rim	VIII.23
98/61	6	B	ENIB	deep bowl; below rim pellets	VIII.18
98/62	11	P	ENIB	flared cup plastic decoration	VIII.22
98/63	5a	P	ENIB	wishbone	VIII.16
98/64	6		ENIB	deep bowl	VIII.18
98/65	14	P	ENIB	grooved incised body	VIII.25
98/66	8	P	ENIB	body w. flared strap	VIII.23
98/67	11	B	ENIB	strap handle	-
98/68	1i	B	ENIB	rounded base	VIII.10
98/69	1i	B	ENIB	strap	VIII.10
98/70	1d	B	ENIB	drilled body	-
98/71		B	ENIB	strap	VIII.4
98/72	2c	P	ENIB	body	-
98/73	4	B	ENIB	strap handle	-
98/74	2d	P	ENIC	rim	-
98/75	1i	P	ENIC	curved offset rim	VIII.10
98/76	1f	PB	ENIC	body	-
98/77	2b	B	ENIC	incurved bowl	VIII.14
98/78	32	Painted	ENIB	body; red and white lines	Plate 70
98/79	1e	Painted	ENIB	curved jar w. offset rim black dots	Plate 70
98/80	34	B	ENIC	flared rim jar	VIII.26
98/81	1f	I	ENII	curved bowl w. offset rim	VIII.7
98/82	1e	B	ENII	straight-sided bowl	VIII.8
98/83	27	I	ENIb	body	-
98/84	2b	IP	ENIB	incised strap handle	VIII.13
98/85	1d	P	ENIB	body	-
98/86	1e	I	ENIB/C	collared jar	VIII.6
98/87	28	B	ENIB	pierced horiz. tubular lug	Plate 67
98/88	34	painted	ENIB	straight-sided bowl	VIII.26
98/89	28	B	ENIB	's' profile; joining lumps	Plate 67
98/90	30	B	ENIB	body	Plate 69
98/91	26	B	ENIB	unpierced horiz. lug	Plate 66
98/92	25	painted	ENIB	d-on-d lattice painted; body	-
98/93	8	R	ENIB	body	VIII.21

98/94	14	W	ENIA?	bowl	VIII.25
98/95	1e	B	ENII	house model	VIII.9
98/96	28	I	ENIB	narrow cup	Plate 67
98/97	1a	B	ENIB	body	-
98/98	1d	Painted	ENIC	body; l-on-d dribble	VIII.5
98/99	17	Painted	ENIB/C	body; d-on-d dribble	VIII.25
98/100	6	B	ENII	dark rough sb	VIII.19

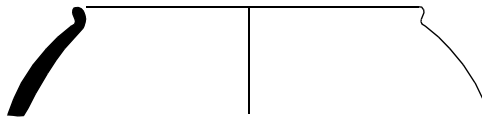
Figure VIII.1 List of Selected Samples



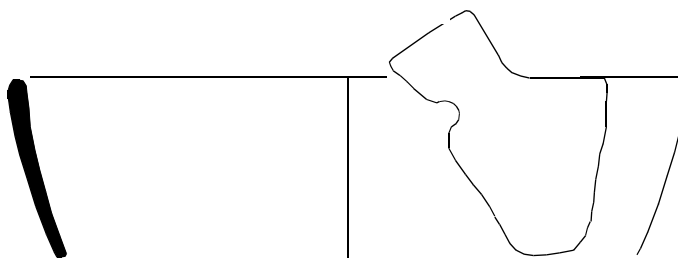
97/22



97/51



97/107



98/1



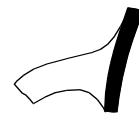
97/4



97/62



97/49



97/118

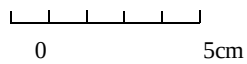
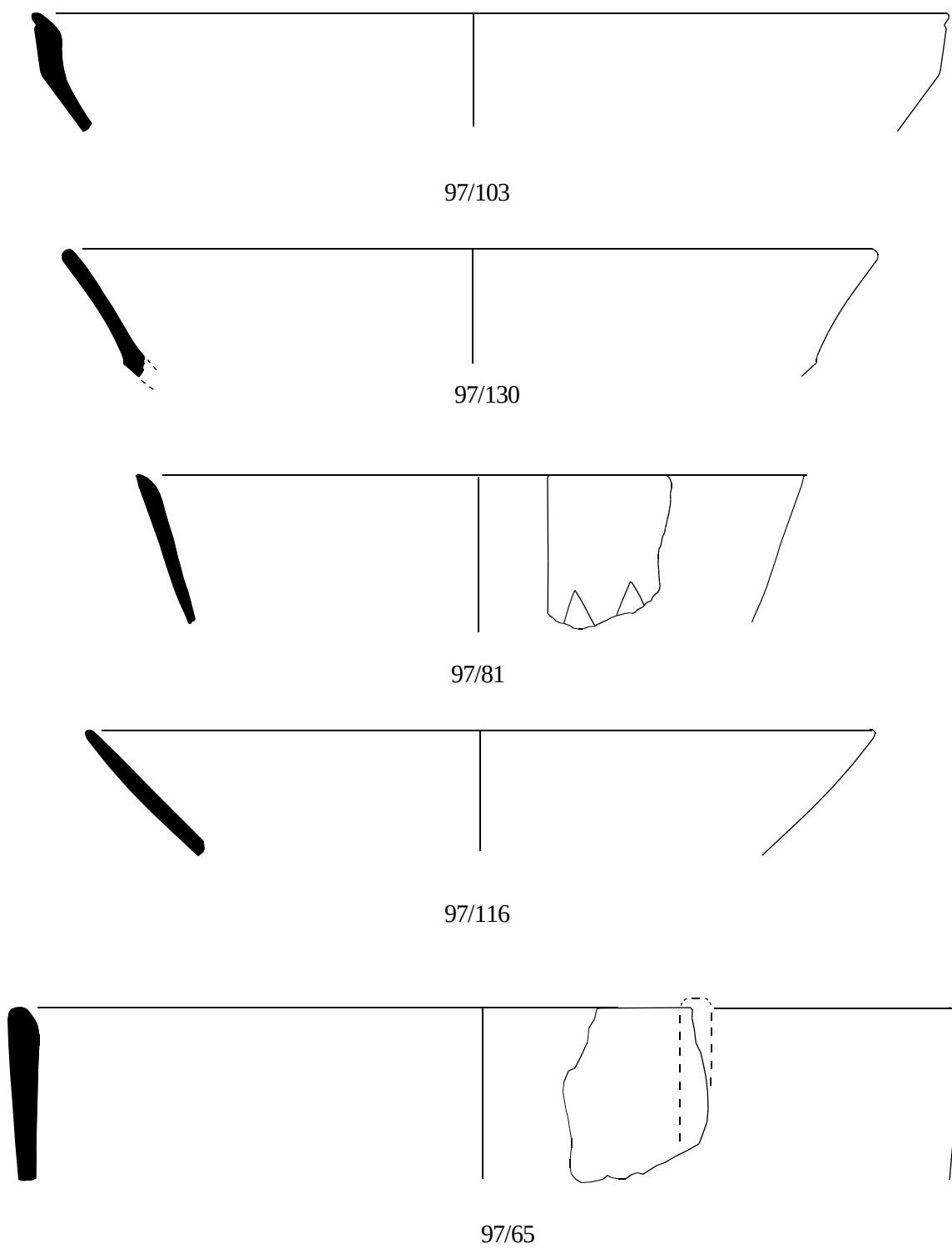
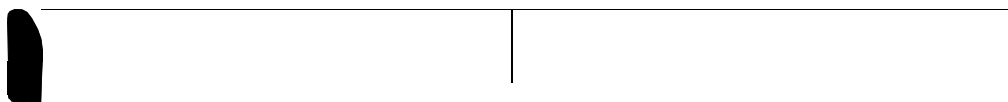


Figure VIII.2. Fabric 1a



0 5cm

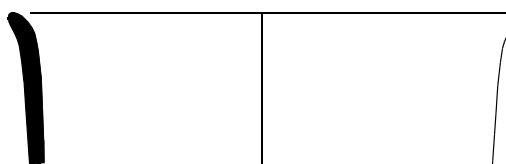
Figure VIII.3. Fabrics 1b/c



97/120



97/117



97/55



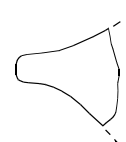
97/83



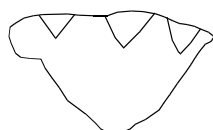
97/119



98/71



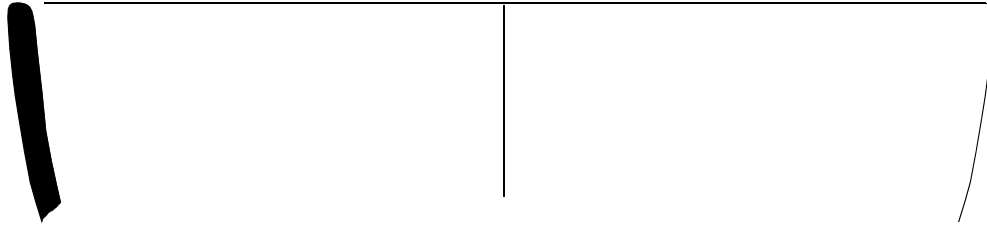
97/53



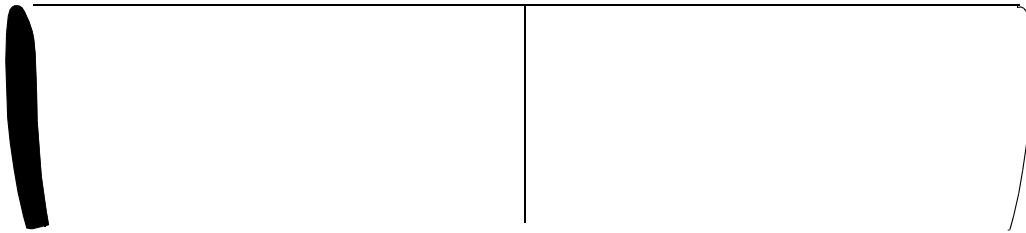
97/135



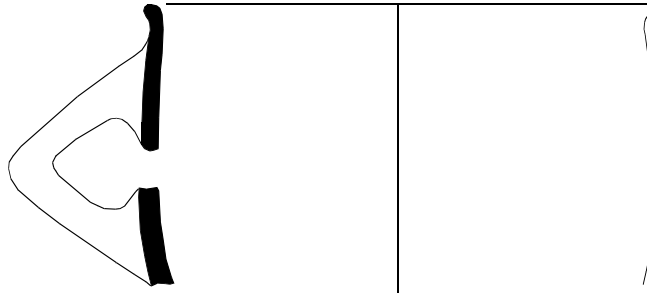
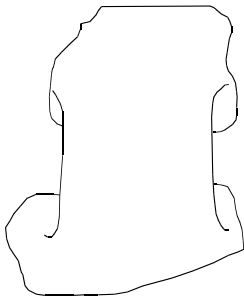
Figure VIII.4.



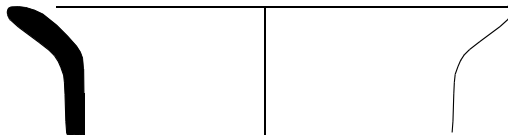
97/105



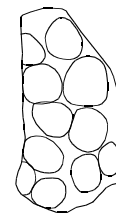
97/84



97/109



98/51



98/54



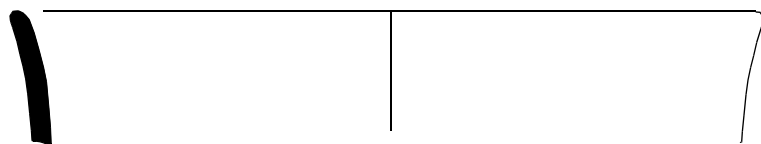
98/98



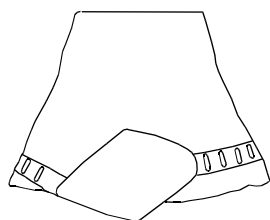
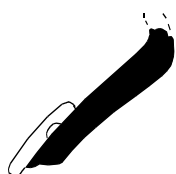
97/111



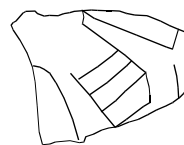
Figure



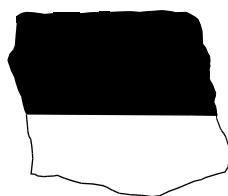
97/126



98/86



97/132



97/121

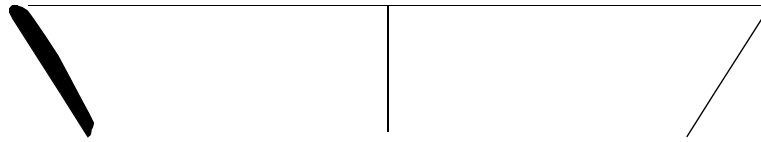


97/127

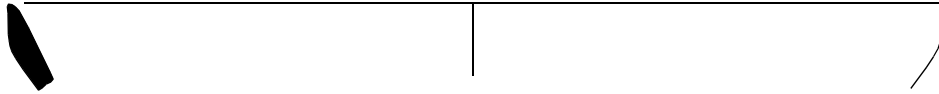
0 5cm



Figure VIII.6. Fabric 1e



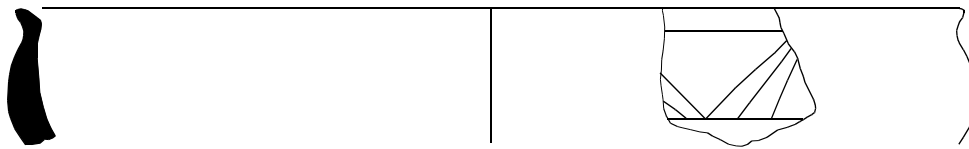
97/125



97/134



97/131



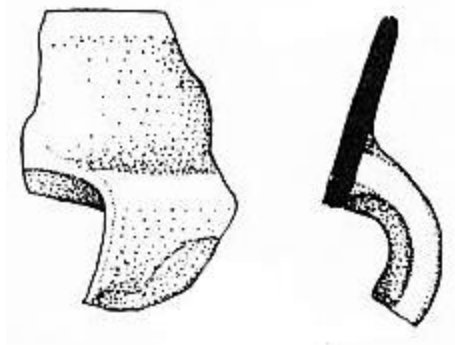
98/81



0

5cm

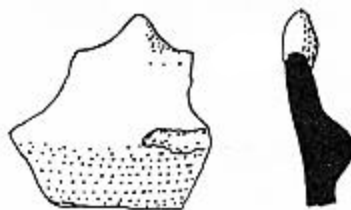
Figure



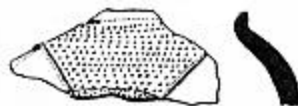
Fabric 1e: sample 98/82 – not to scale
(Evans 1964: fig. 31.20)



Fabric 1a: sample 97/7; – not to scale
(Evans 1964: fig. 23.32)

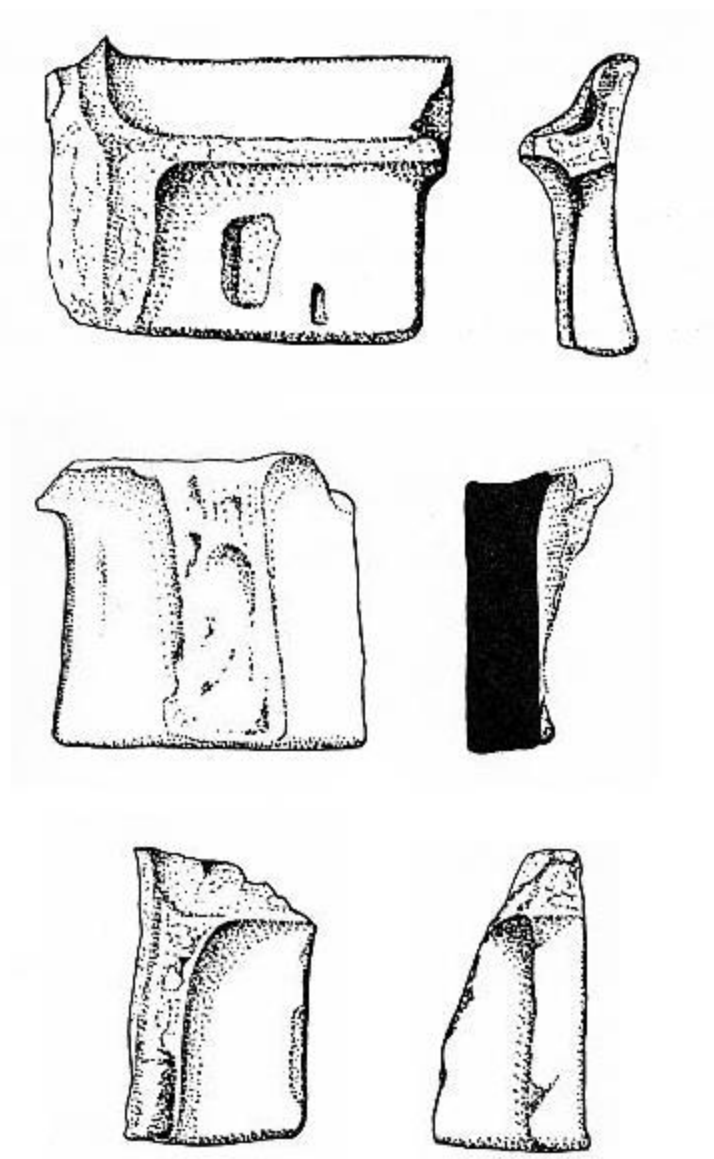


Fabric 2a; sample 98/37; not to scale
(Evans 1964: fig. 26.3)



Fabric 2a; sample 98/42; not to scale
(Evans 1964: fig. 27.10)

Figure VIII.8. Fabrics 1a and 2a



Fragments of a House Model (ENII)
 Fabric 1d; sample 98/95; not to scale
 (Evans 1964: 31.3-5)

Figure VIII.9. Fabric 1e

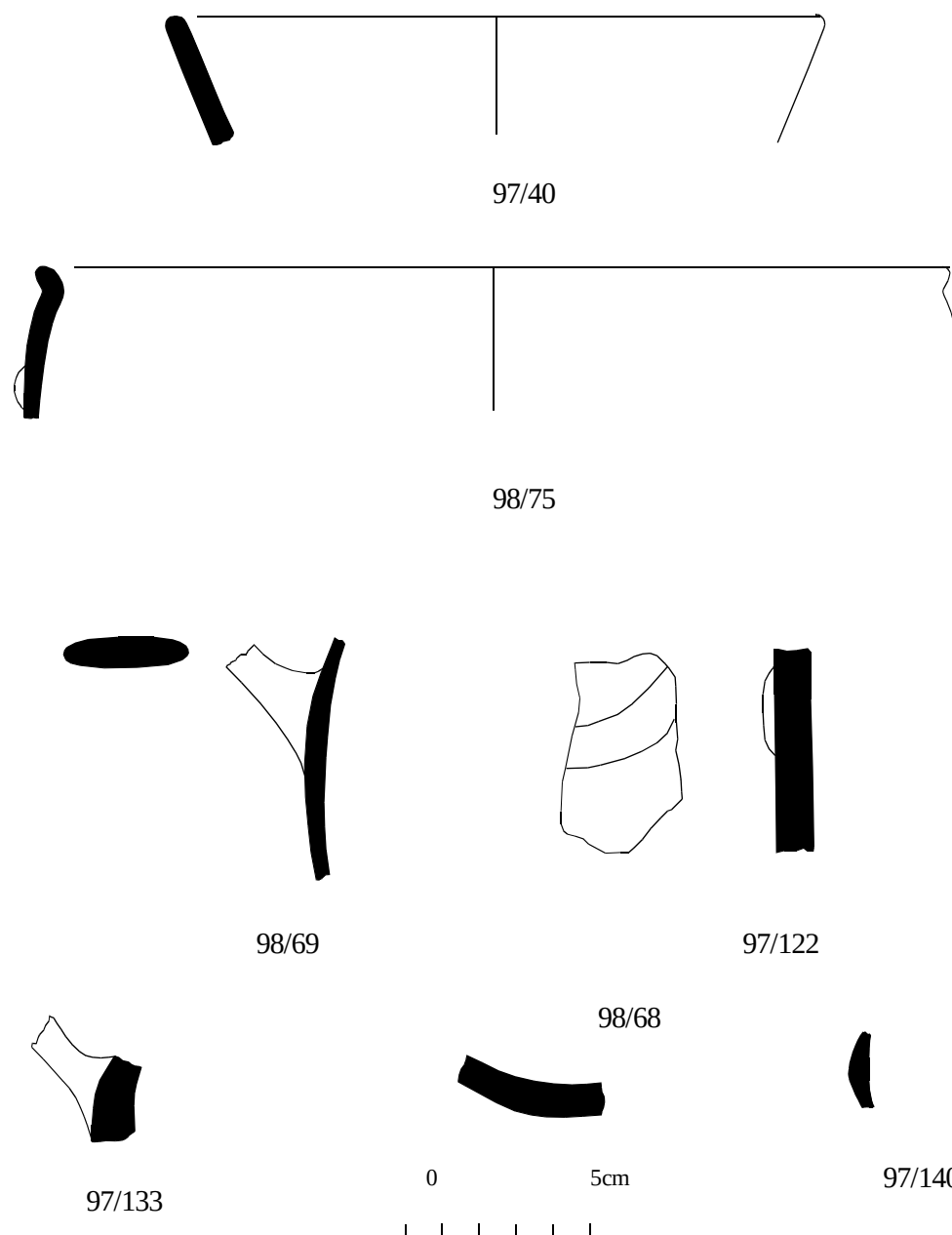


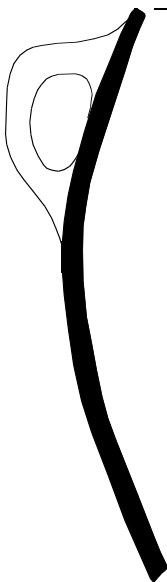
Figure VIII.10. Fabrics



98/2



97/64

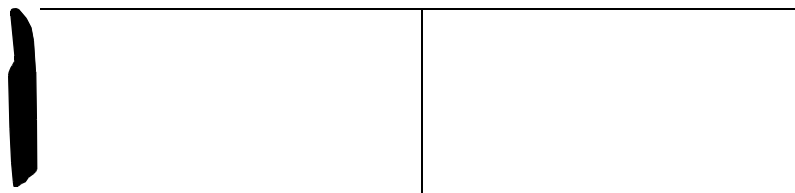


98/5

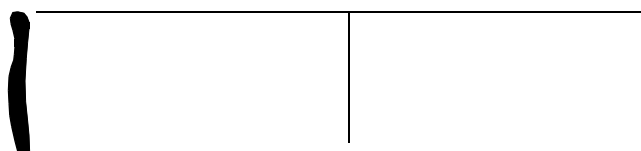
0 5cm



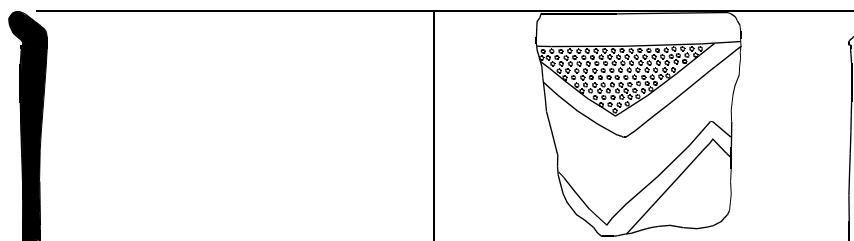
Figure VIII.11. Fabric 2a



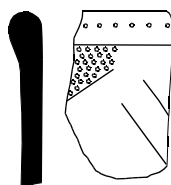
98/24



97/85



98/50



97/54



98/34

0

5cm



Figure VIII.12. Fabric 2a

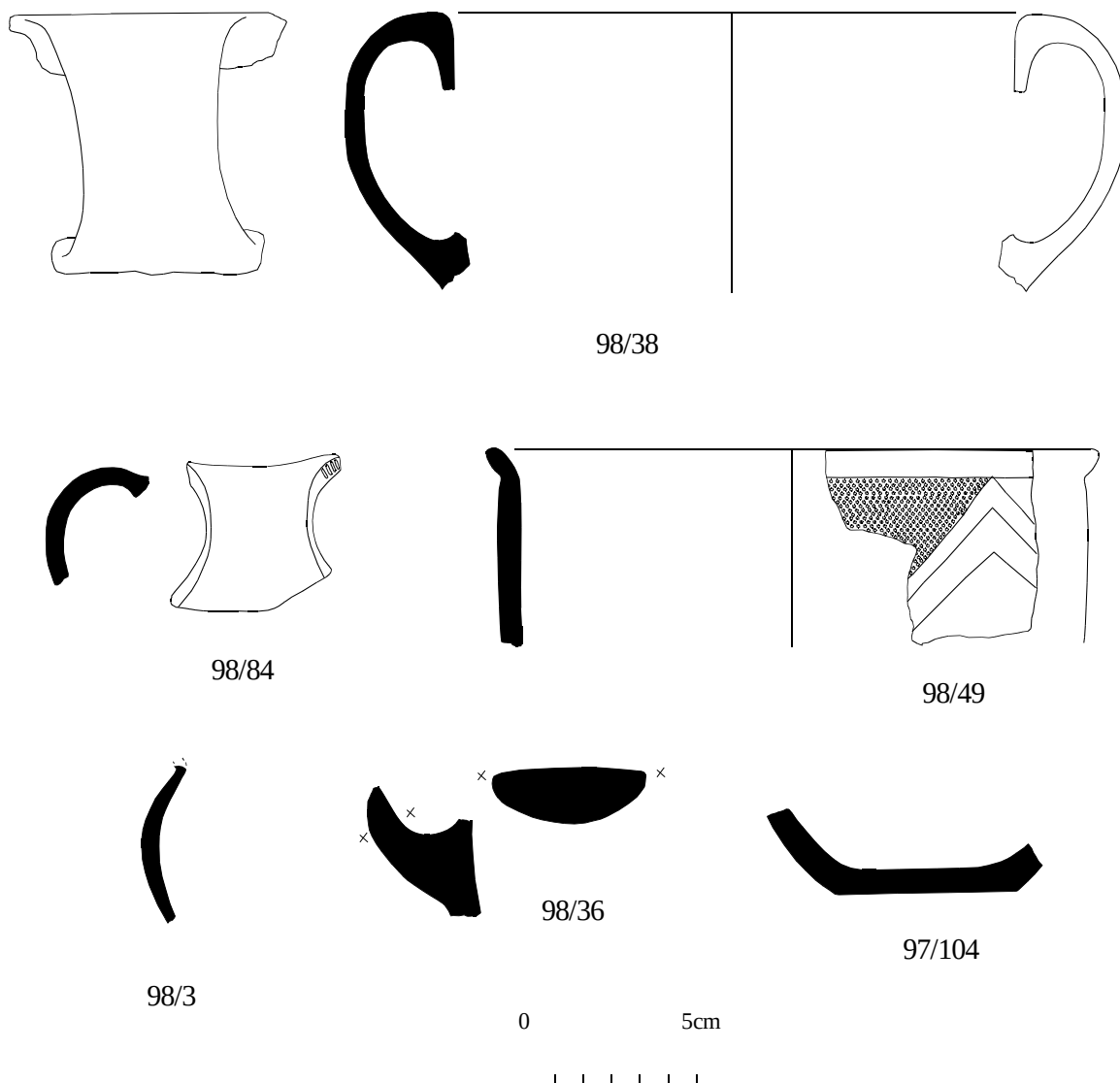


Figure VIII.13. Fabric 2b

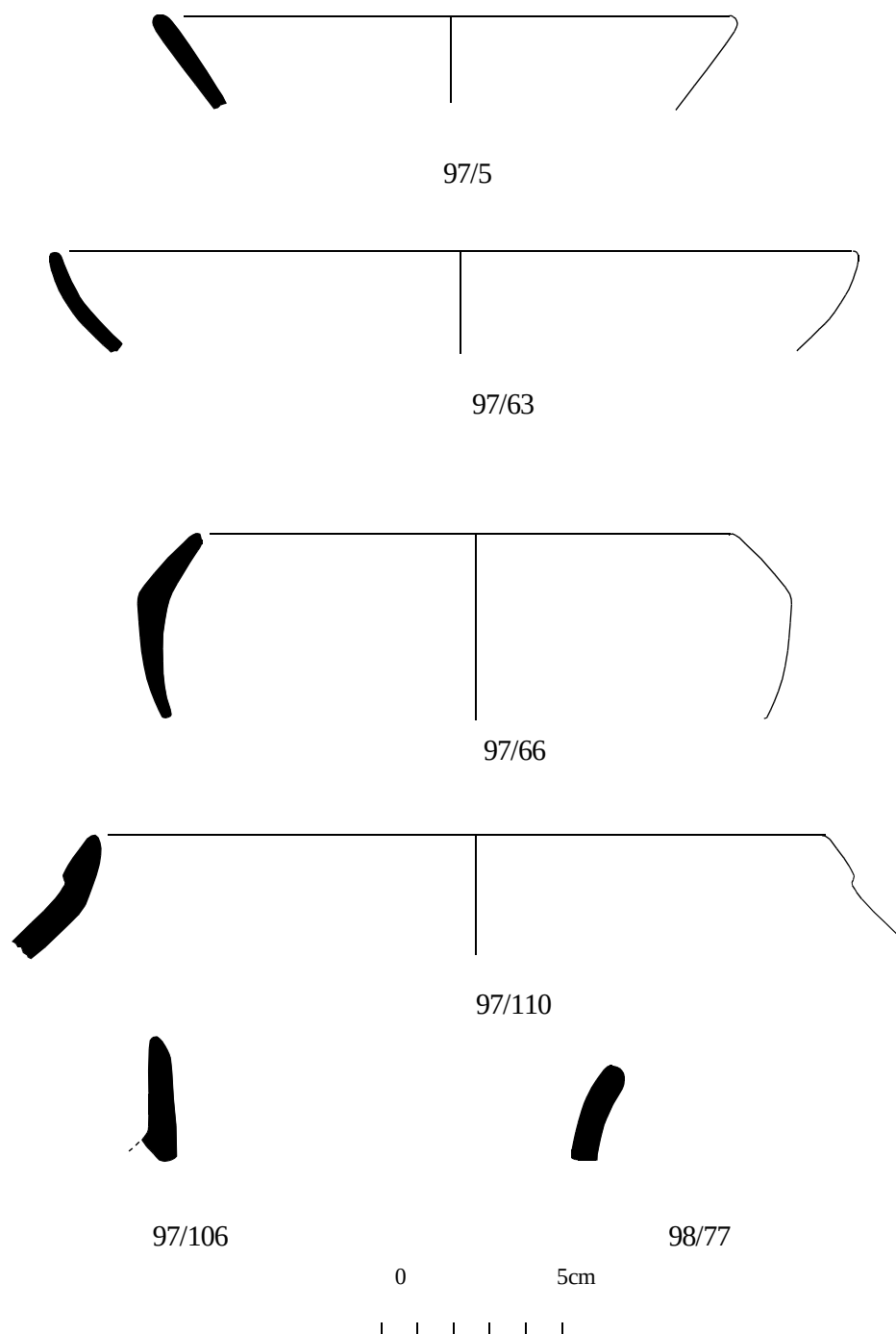
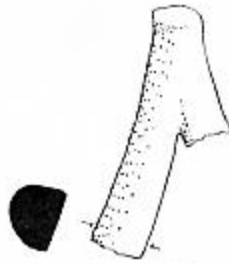
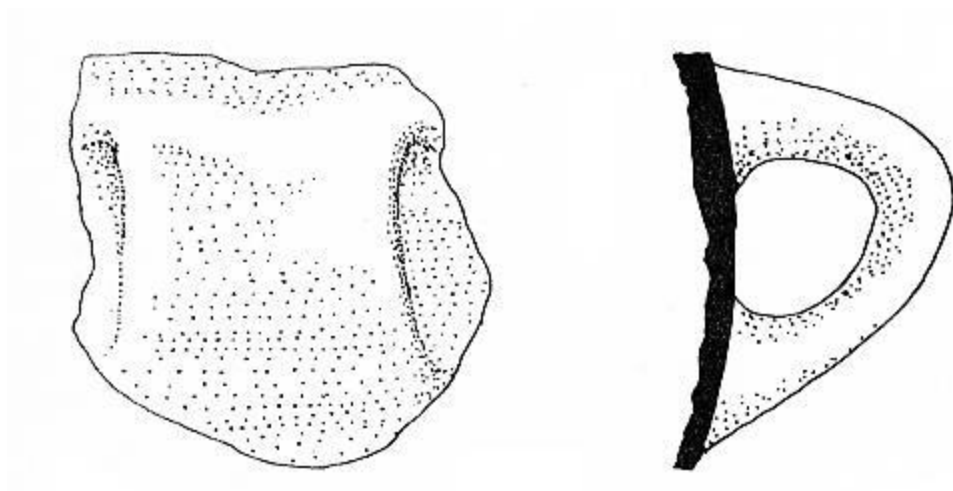


Figure VIII.14. Fabric 2b



Fabric 2c; sample 98/58; not to scale

(Evans 1964: fig. 25.20)



Fabric 2b; sample 98/6; not to scale

(Evans 1964: fig. 24.19)

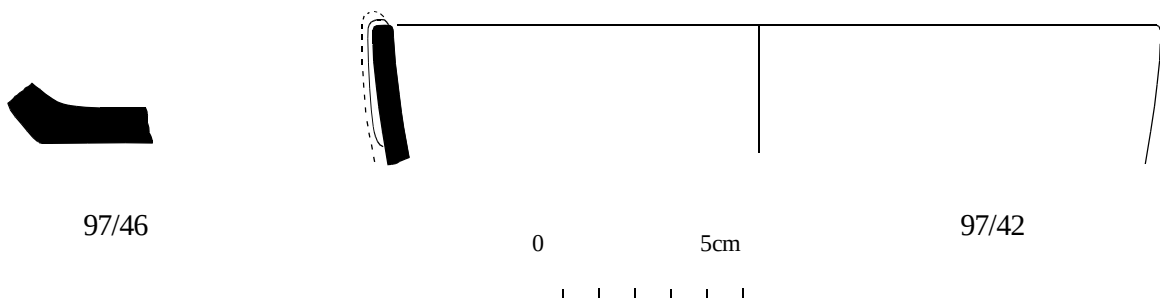
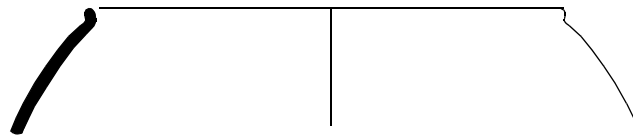
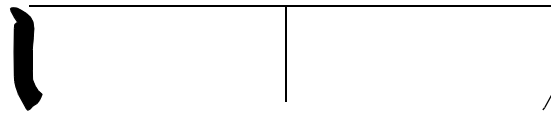


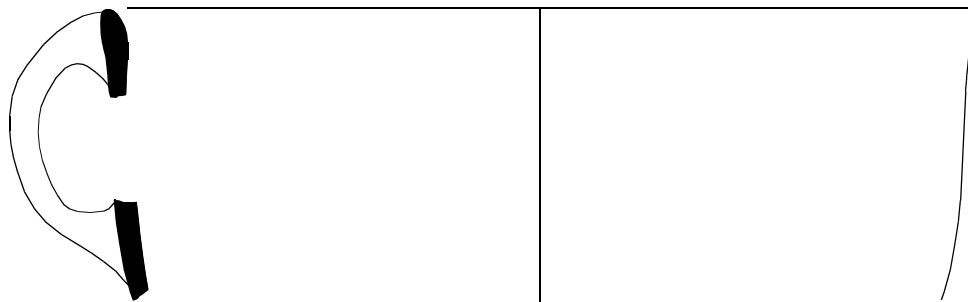
Figure VIII.15. Fabrics 1c and 1e



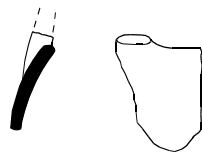
97/128



97/95



98/39



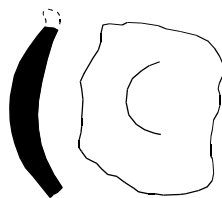
97/23



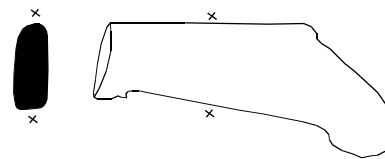
97/113



97/112



98/41



98/63



97/39
Fabric 24



97/87

0 5cm



Figure VIII.16. Fabric 5a

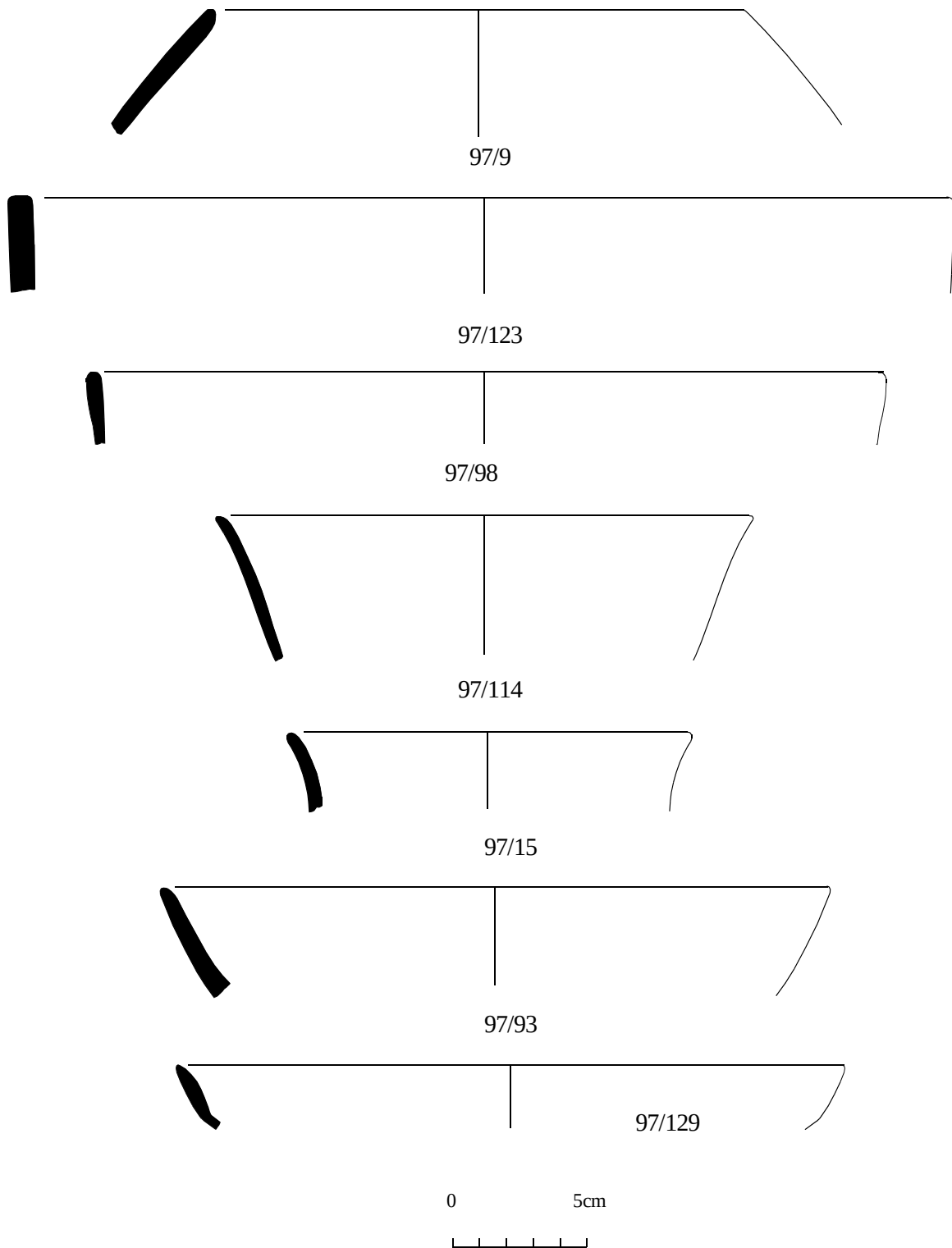
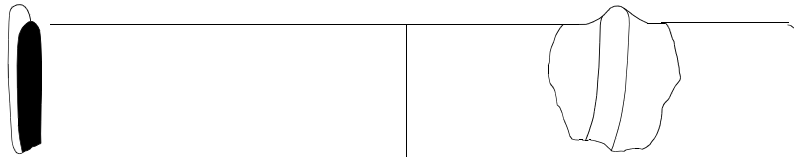


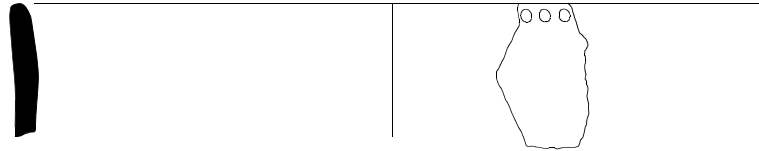
Figure VIII.17. Fabric 5a



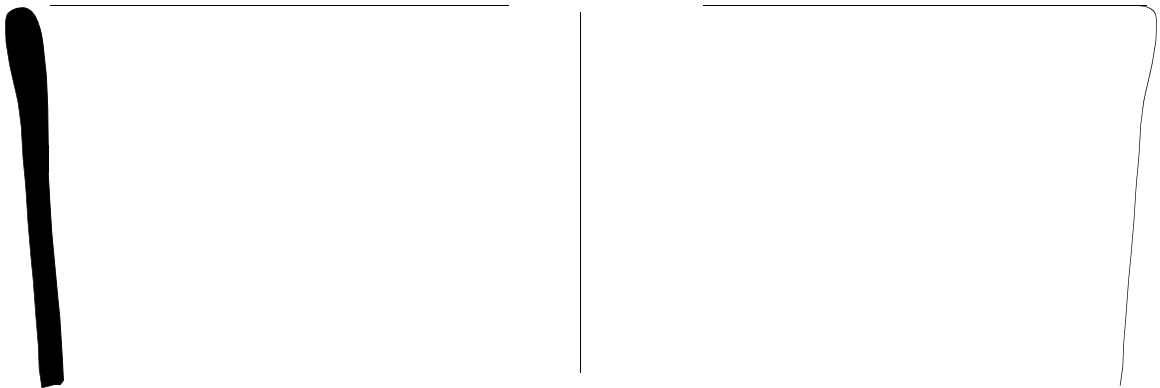
Fabric 5a; sample 97/99; not to scale
(Evans 1964: fig.28.11)



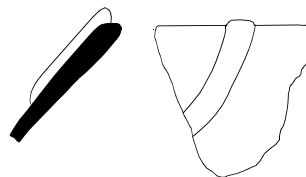
98/15



98/61



98/64



97/96

0 5cm

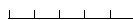
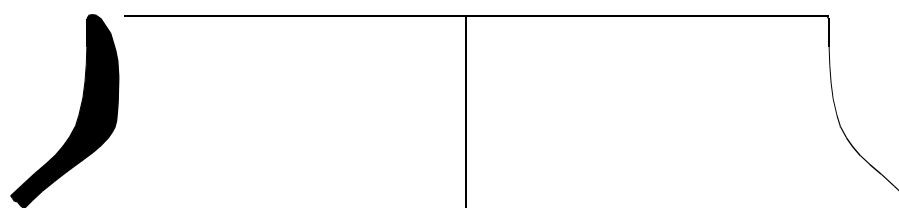
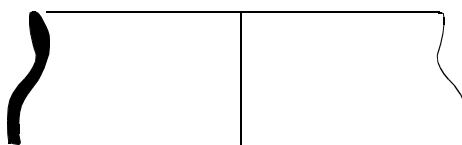


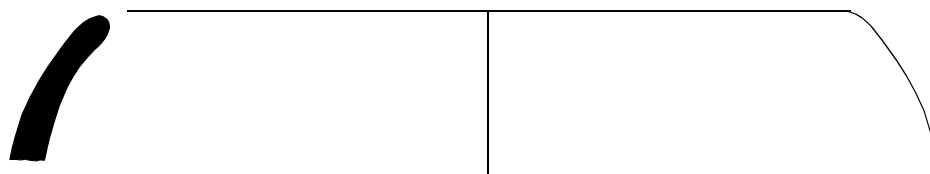
Figure VIII.18. Fabrics 5a and 6



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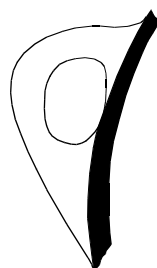
97/67



98/14



98/12



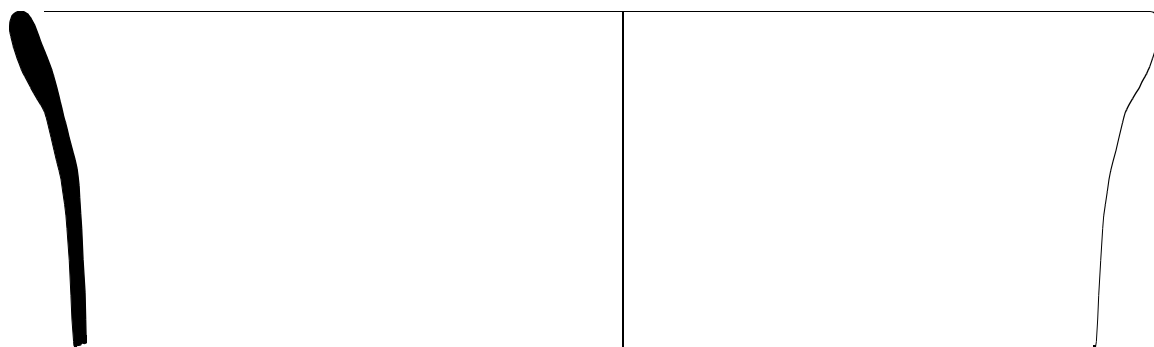
98/100

0

5cm



Figure VIII.19. Fabric 6



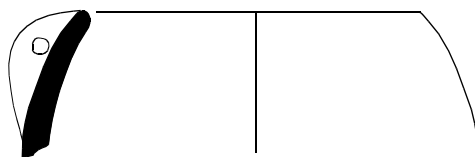
98/57



98/9



97/14



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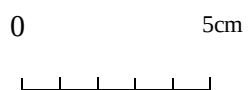
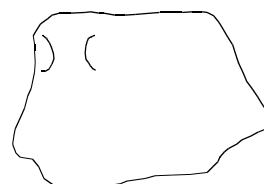
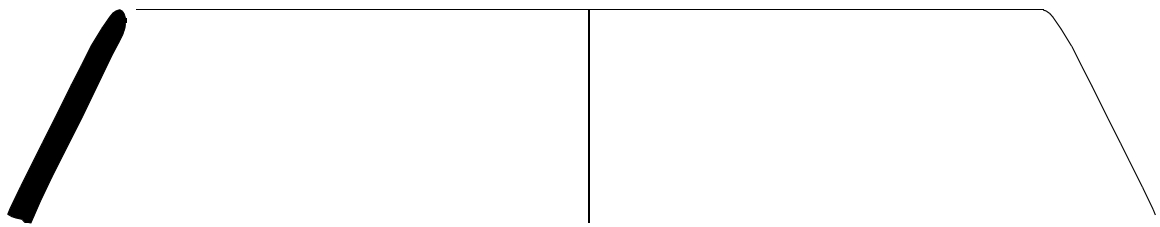
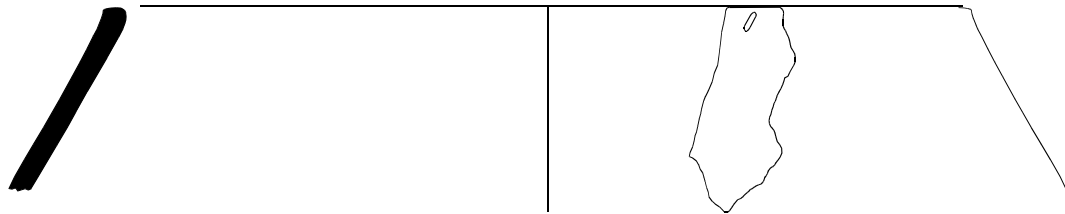


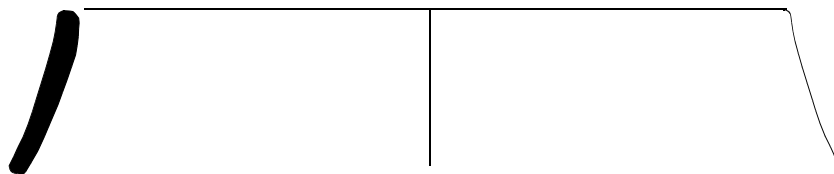
Figure VIII.20. Fabrics 5b, 5c and 7



98/55



98/19



97/20



98/27



98/11



97/94



98/93

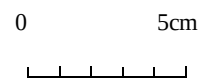
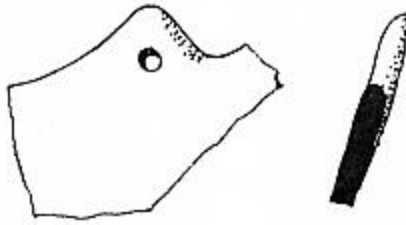
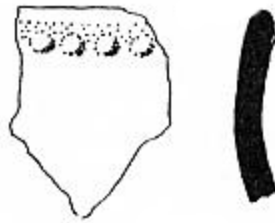


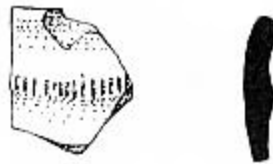
Figure VIII.21. Fabric 8



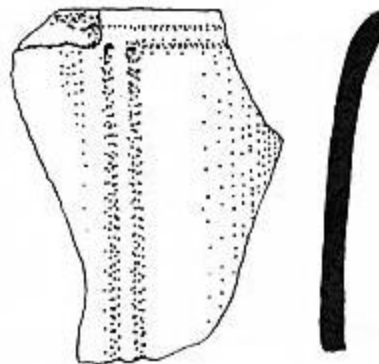
Fabric 8; sample 98/28; not to scale
(Evans 1964: fig.26.6)



Fabric 8; sample 98/59; not to scale
(Evans 1964: fig. 26.17)



Fabric 10; sample 97/71; not to scale
(Evans 1964: fig.28.16)



Fabric 11; sample 98/62; not to scale
(Evans 1964: fig.28.18)

Figure VIII.22. Fabrics 8, 10, 11

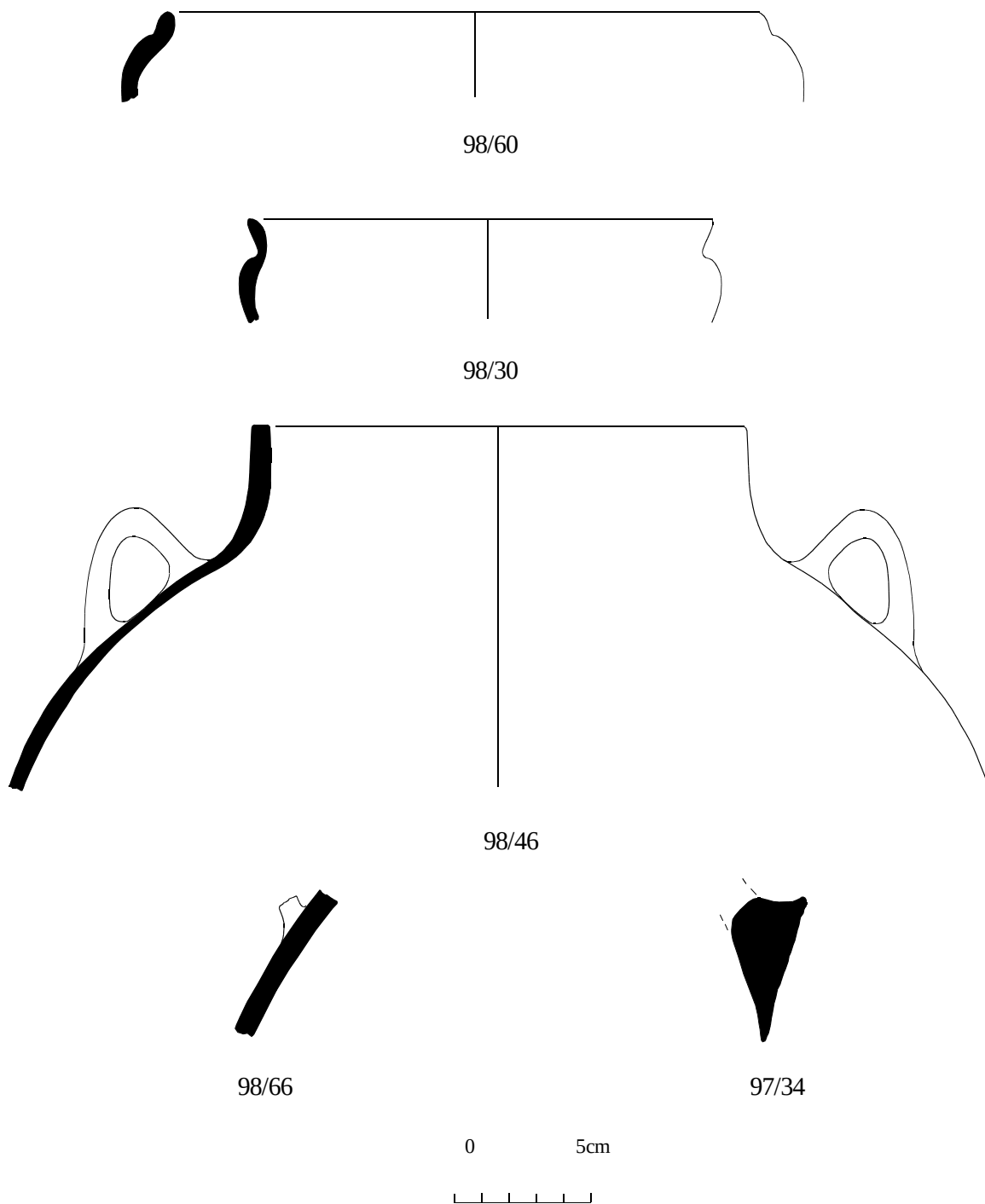
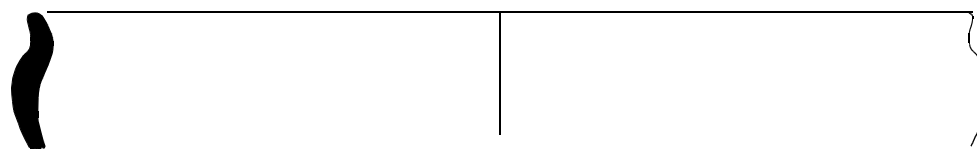


Figure VIII.23. Fabrics 8 and 9



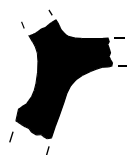
97/102



98/7



98/17



97/78



97/18



Figure VIII.24. Fabric 11

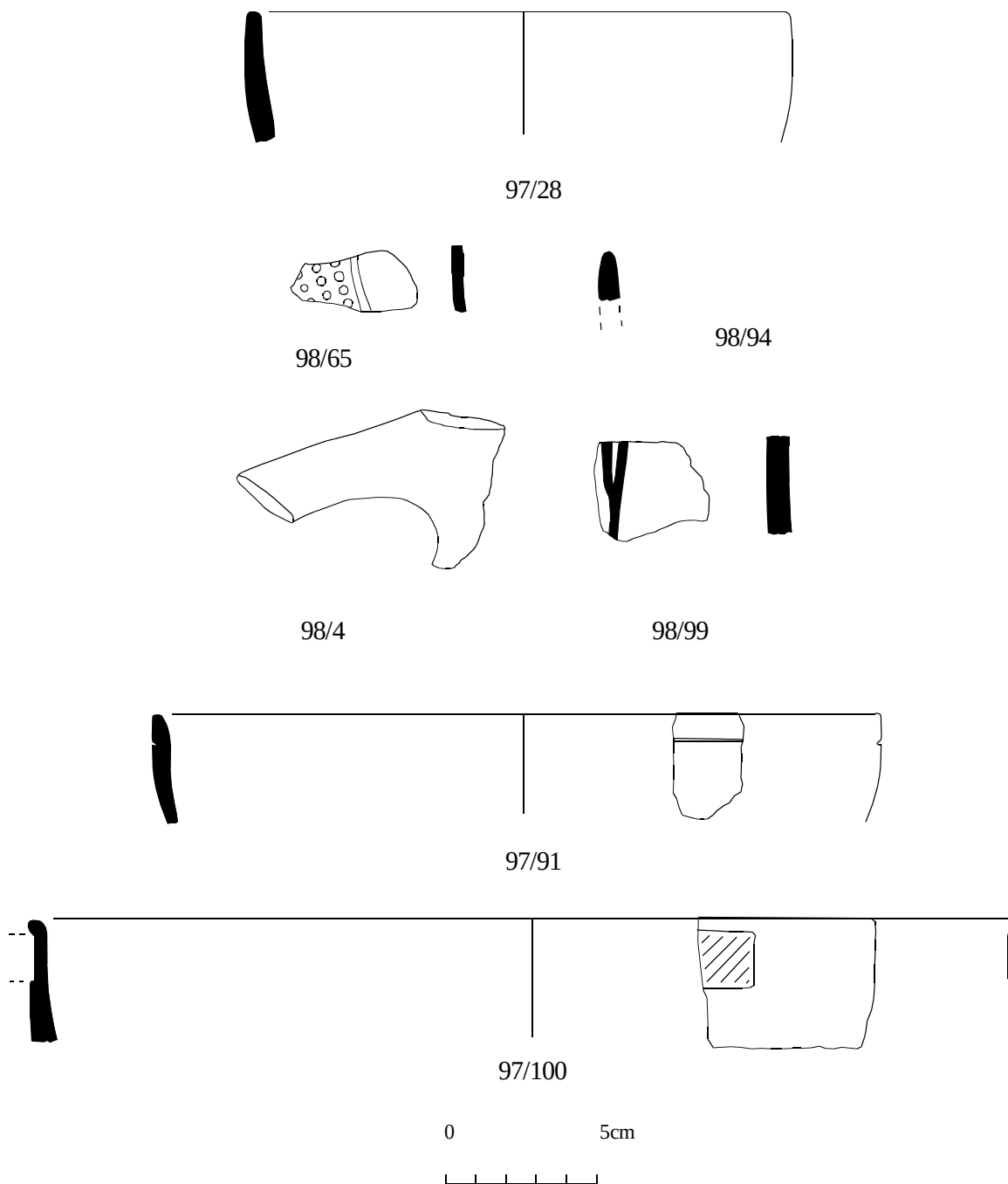
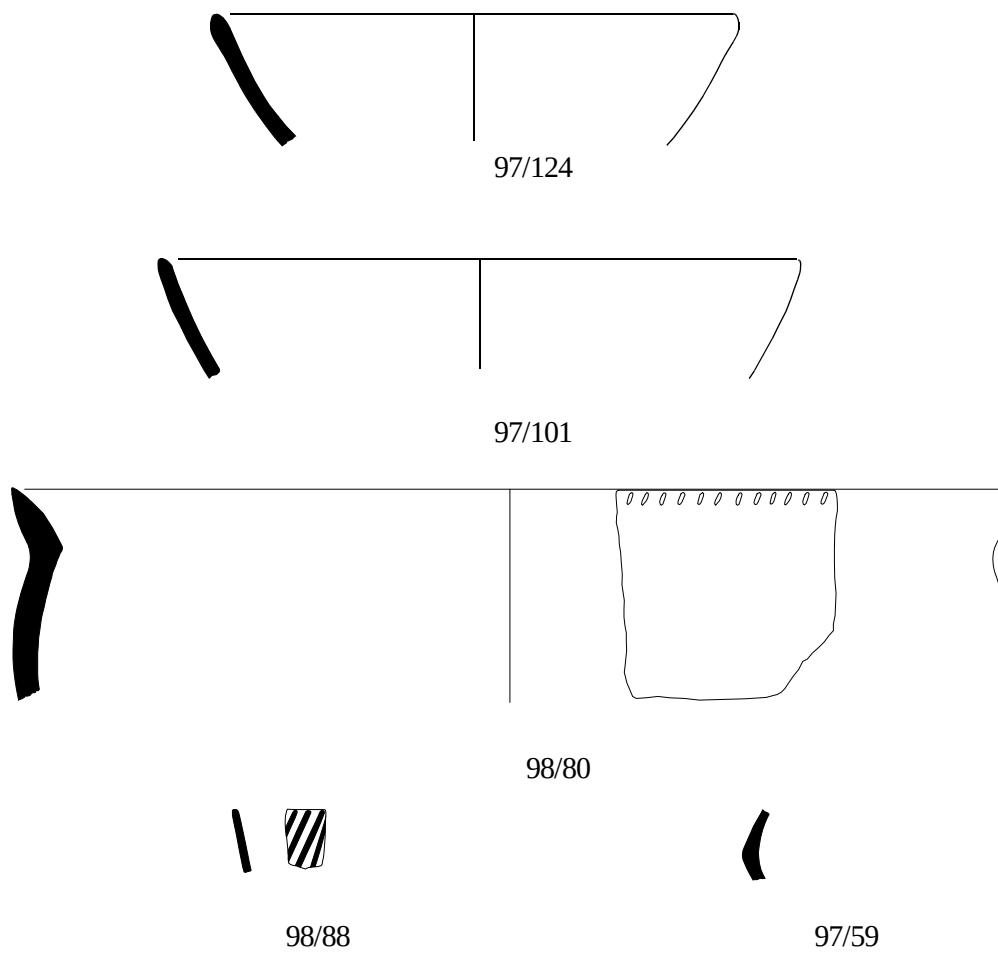


Figure VIII.25. Fabrics 13, 14, 16, 17



0 5cm

Figure VIII.26. Fabrics 23, 31, 33, 34

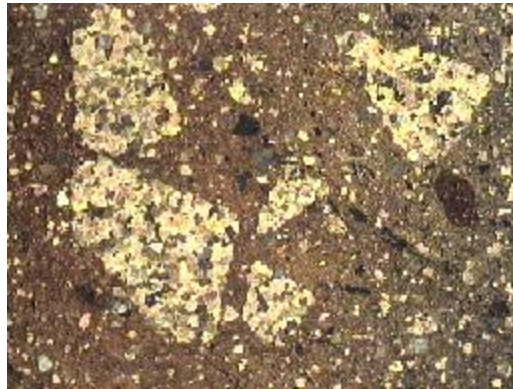


Plate 1. Fabric 1a

(Width of Image = 4.0mm)

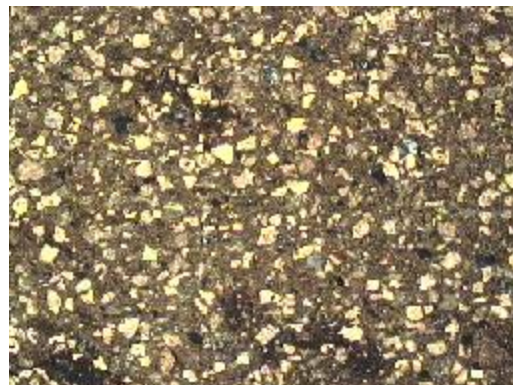


Plate 2. Fabric 1b

(Width of Image = 4.0mm)



Plate 3. Fabric 1d

(Width of Image = 4.0mm)



Plate 4. Fabric 1e

(Width of Image = 4.0mm)



Plate 5. Fabric 1f

(Width of Image = 4.0mm)



Plate 6. Fabric 1i

(Width of Image = 4.0mm)



Plate 7. Fabric 2a

(Width of Image = 4.0mm)

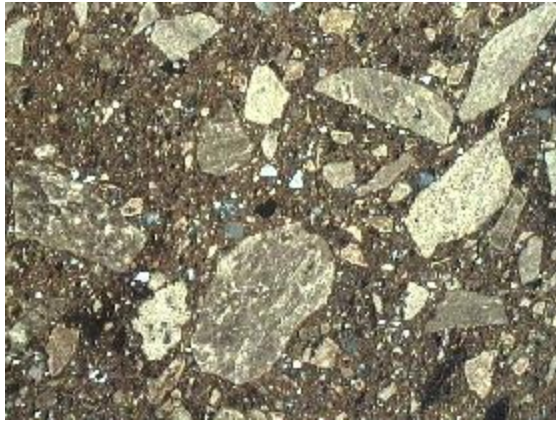


Plate 8. Fabric 2b

(Width of Image = 4.0mm)

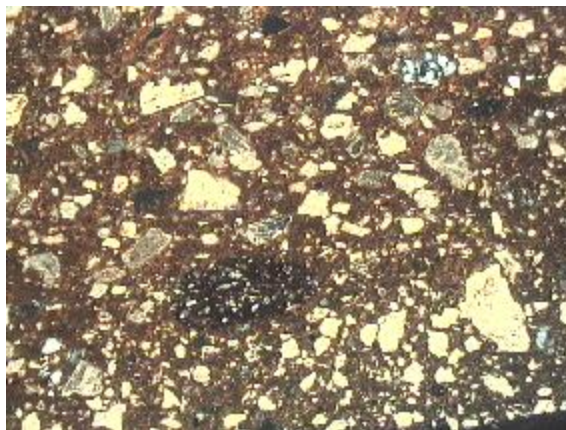


Plate 9. Fabric 2c

(Width of Image = 4.0mm)



Plate 10. Fabric 2e

(Width of Image = 4.0mm)

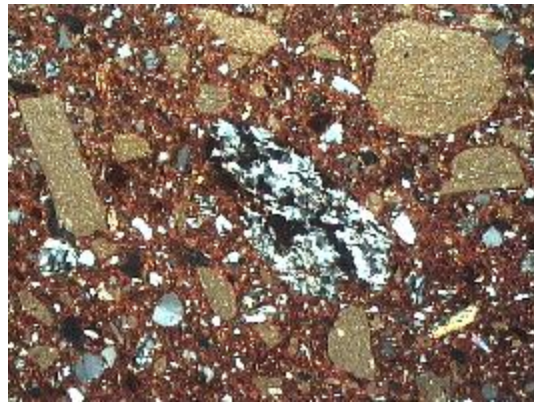


Plate 11. Fabric 5a

(Width of Image = 4.0mm)

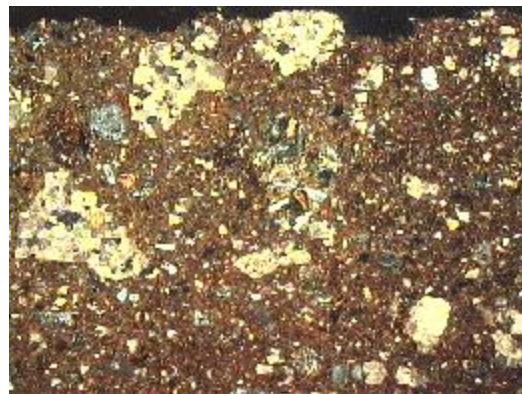


Plate 12. Fabric 7

(Width of Image = 4.0mm)



Plate 13. Fabric 8

(Width of Image = 4.0mm)

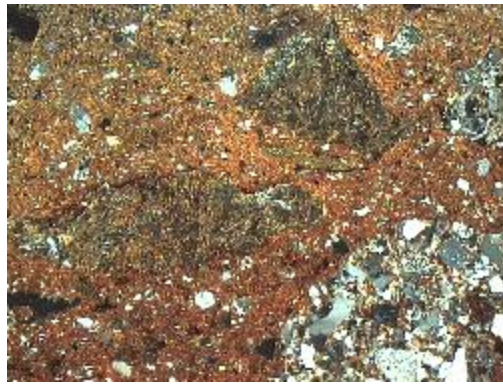


Plate 14. Fabric 6

(Width of Image = 4.0mm)

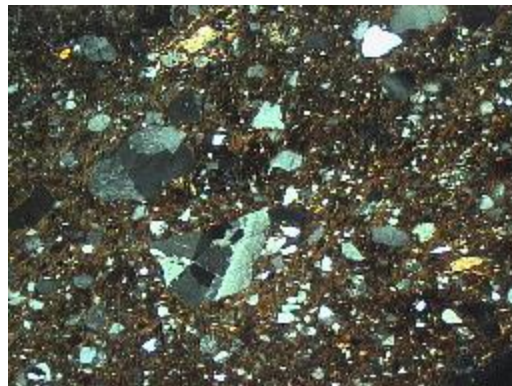


Plate 15. Fabric 12

(Width of Image = 4.0mm)

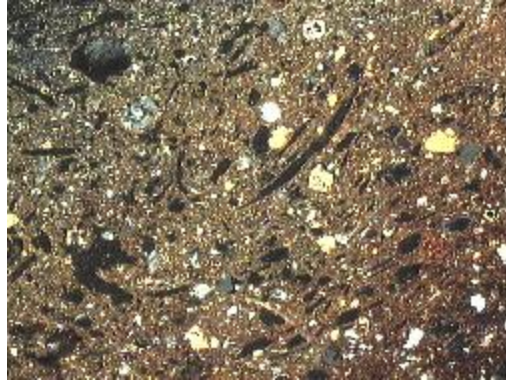


Plate 16. Fabric 15

(Width of Image = 4.0mm)



Plate 17. Fabric 31

(Width of Image = 4.0mm)

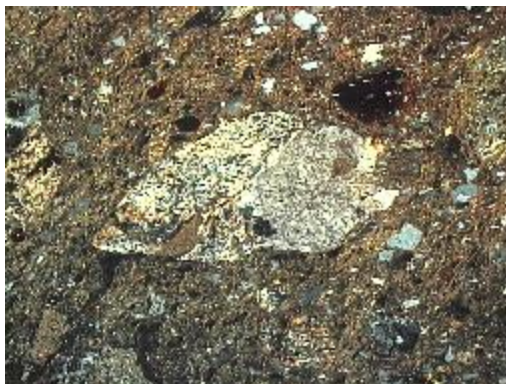


Plate 18. Fabric 35

(Width of Image = 4.0mm)



Plate 19. Fabric 1c. Micritic Clot with Red Ring (Iron Migration)
(Width of Image = 2.5mm)



Plate 20. Fabric 2a. Micritic Clot Exhibiting Relict Primary Texture (Sparite)
(Width of Image = 2.5mm)



Plate 21. Fabric 5a Fine Clay Component of Clay Mix
(Width of Image = 2.5mm)

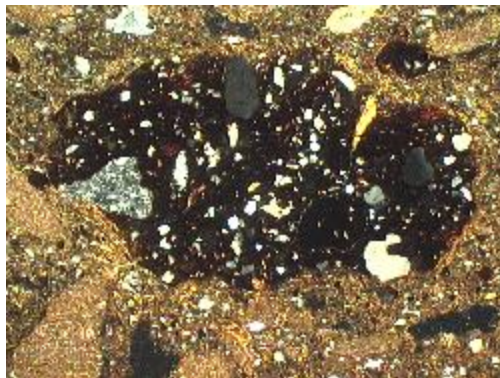


Plate 22. Fabric 5a Coarse Clay Component of Clay Mix Containing Chert
(Width of Image = 2.5mm)

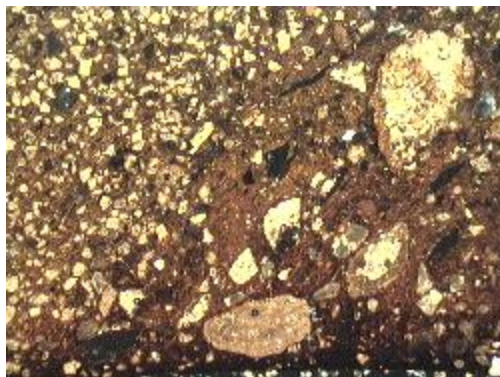


Plate 23. Fabric 3 (97/140) Showing a Join Between Coils in Fabric 1b and 1d
(Width of Image = 4.0mm)



Plate 24. Fabric 1e (97/79) Coil Join Viewed with Lambda Plate
(Width of Image = 4.0mm)

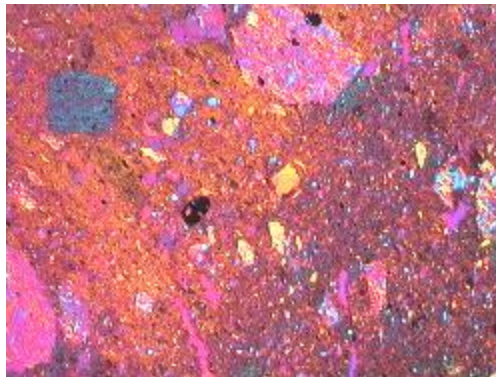


Plate 25. Fabric 13 (97/12) Coil Join Viewed with Lambda Plate
(Width of Image = 4.0mm)



Plate 26. Fabric 5a (98/63) Compacted Surface Layer Viewed with Lambda Plate
(Width of Image = 2.5mm)

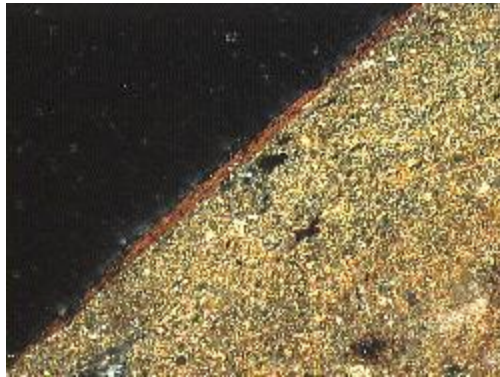


Plate 27. Fabric 1d (97/111). Non-Calcareous Slip Layer
(Width of Image = 2.5mm)

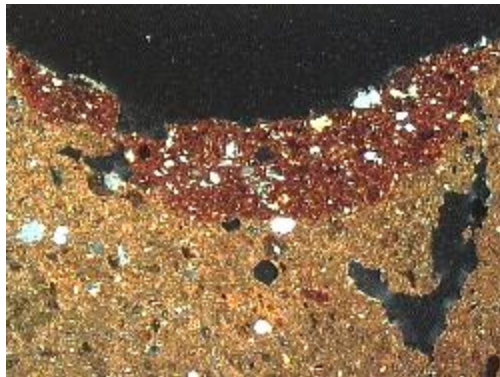


Plate 28. Fabric 28. Clay Layer
(Width of Image = 4.0mm)



Plate 29. Burnished Decoration

Fabric 21: Sample 9735 (Left); Sample 97/20 (Right)



Plate 30. Polished Decoration

Fabric 1a



**Plate 31. Slipped and Polished Decoration (EN1a) in Fabric 1a:
Non-Calcareous Slip (Left); Calcareous Slip (Right)**



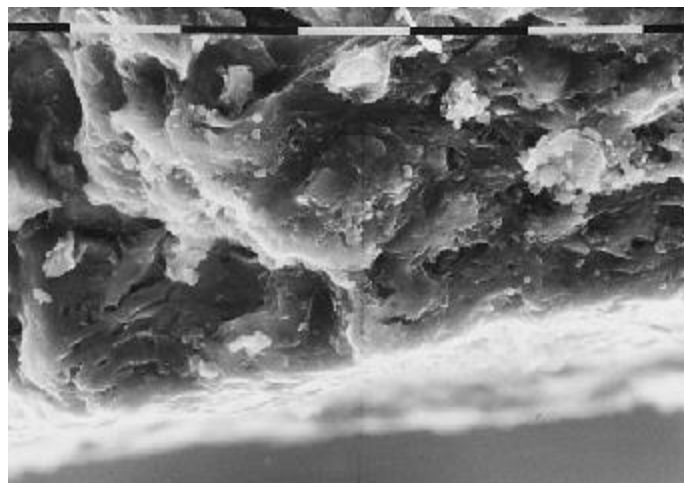
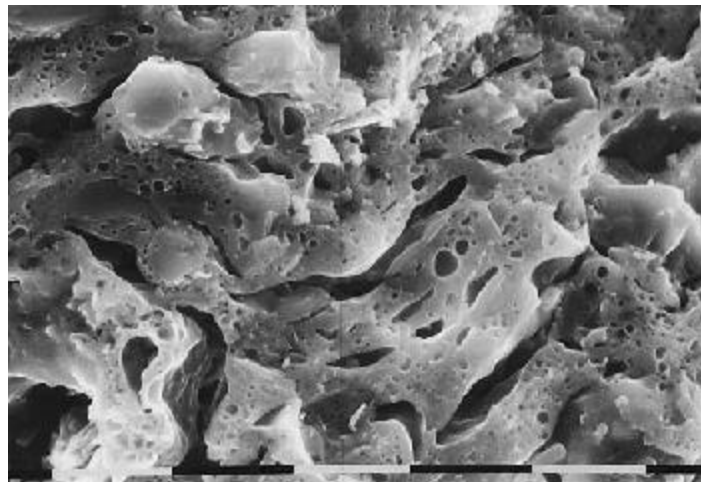
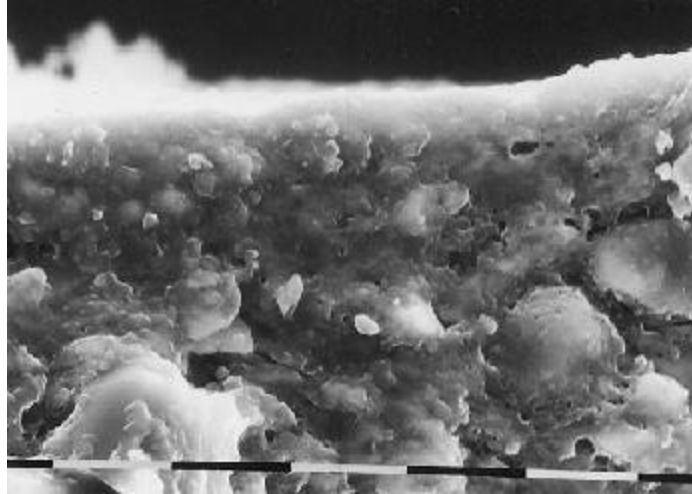
Plate 32. Fabric 5a Dark Polished Bowls and Jars



**Plate 33. Dark Polished Straight-Sided Bowls
in Fabrics 6 (Left), 5a (Centre) and 2a (Right)**



**Plate 34. Dark Polished Bowls and Wishbone Handle
in Fabric 12 (Mirabello Bay)**



Plates 35-7. Non Homogenous Firing in Sample 97/121 (Fabric 1e)
Upper: V Exterior; Middle: V/TV Core; Lower: TV Interior Slip
Bar = 10µm

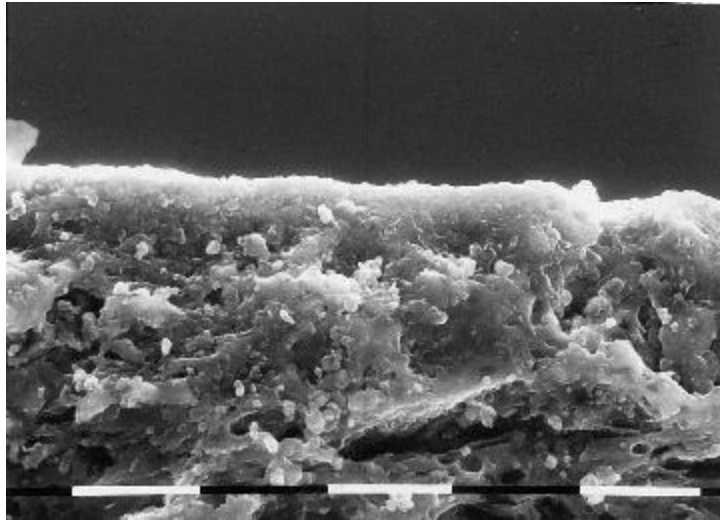


Plate 38. Compacted Surface Layer in Sample 97/84 (Fabric 1d)
Bar = 10 μ m

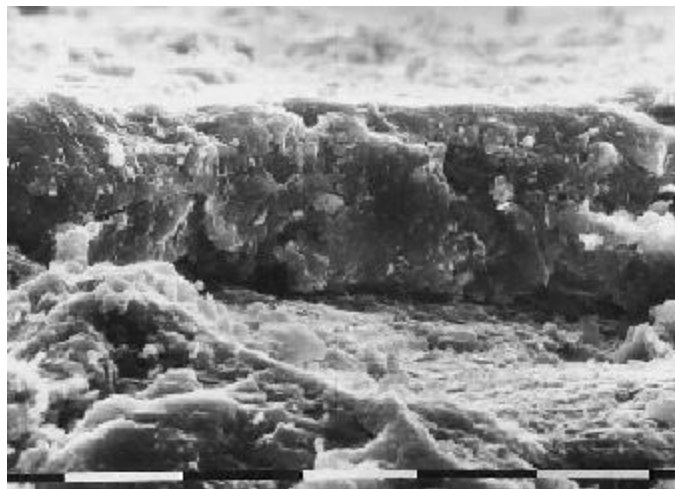


Plate 39. Vitrified (Illitic) Slip Layer (Fabric 8)
Bar = 10 μ m

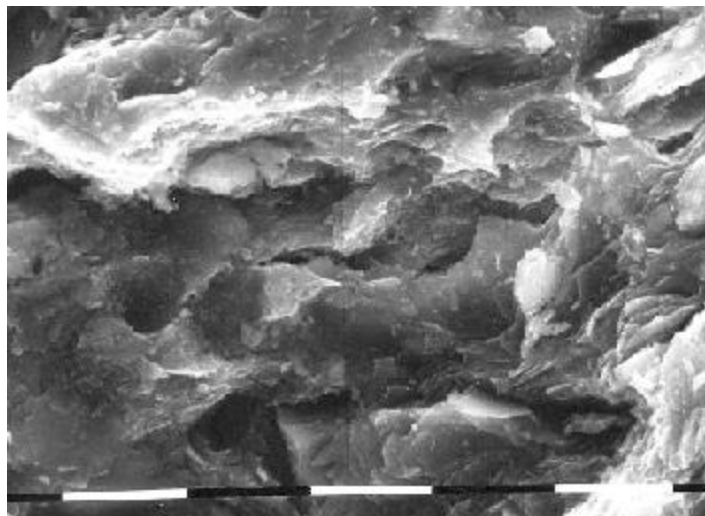


Plate 40. Fabric 5a NV Body (Sample 97/23)
Bar = 10 μ m

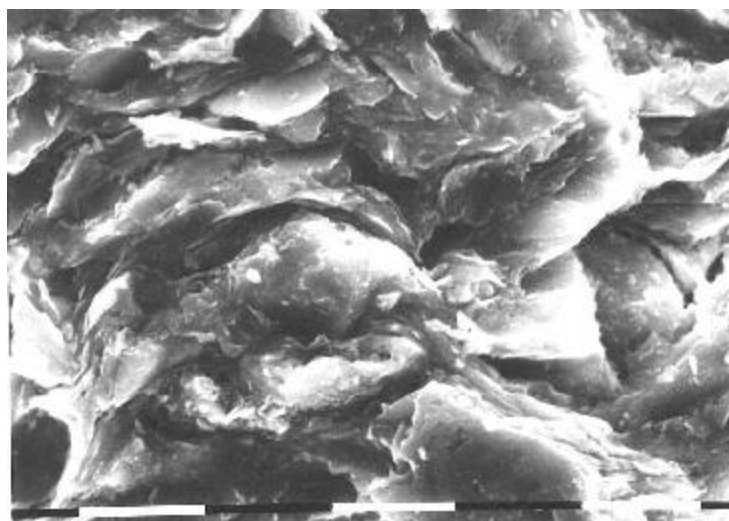


Plate 41. Fabric 5a IV/V Body (sample 97/114)
Bar = 10 μ m

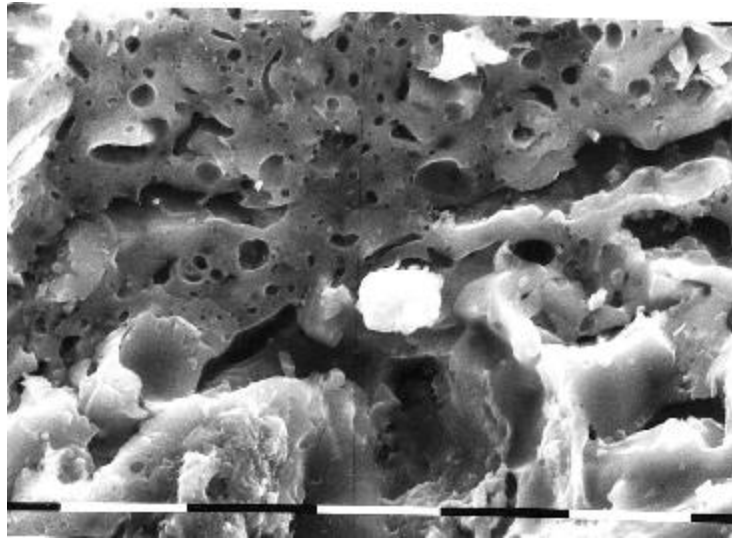


Plate 42. Fabric 5a: VC+/TV Body with Fine Bloating Pores (Sample 97/9)
Bar = 10 μ m

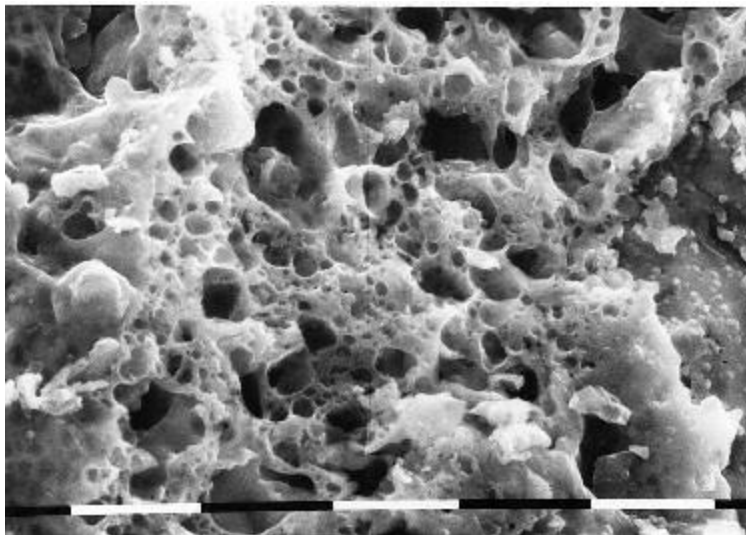


Plate 43. Fabric 5a: TV Body with Fine Bloating Pores (Sample 97/9)
Bar = 10 μ m



**Plate 44. Clay Mixing in Fabric 19 (Sample 97/92)
NB Red Quartz-rich Clay Pellet (no foraminifera)
in Calcareous Groundmass Rich in Foraminifera**

Width of Image = 2.5mm



Plate 45. Deep Bowls in Fabric 15



Plate 46. Deep Bowl (Fabric 6)
NB Regular Sequence of Horizontal Fracture Lines



Plate 47. Coil-Built Rounded Base (Fabric 8)



Plate 48. Coil Joins (ENII) in Fabric 1b



Plate 49. Experimental Forming ENII Style Pinched Up Coil Join



Plate 50. Experimental Forming. Adding The Final Coil/Offset Rim



Plate 51. ENII Plug-Attached Handle (Fabric 1b)



Plate 52. Pebbles Probably Worn by Burnishing (ENI-II)



Plate 53. Scribble Burnished Interior (Fabric 2a) (ENIa)



**Plate 54. White Slipped Vessels in Fabric 4
NB Burnt Interior**



Plate 55. Dribble Painted Sherds in Fabrics 1d (Left, Centre) and 18 (Right)



Plate 56. Mend Holes (ENII)



Plate 57. ENIb Collared Jar (Fabric 5a)



Plate 58. EN1b Collared Jar (Fabric 6)



Plate 59. Fabric 23 Samples 97/60 (Left) and 97/61 (Right)



Plate 60. Fabric 2a/b 'Wood Grain Effect' Horizontal Burnishing



**Plate 61. House Model (Unpublished) (Fabric 1f)
Sounding AABB**



Plate 62. Stone Bowl (ENIc)



Plate 63. Fabric 6

Samples 97/68 (centre left), 98/16 (centre right), 98/23 (upper right)



Plate 64. Fabric 10

Samples 98/40 (upper right), 98/48 (upper right),
97/71 (lower right), 97/108 (lower centre), 98/47 (lower right)



Plate 65 Fabric 21

Sample 97/33



Plate 66. Fabrics 26, 27 and 29.

Samples 97/86 (upper right), 97/76 (upper left),
98/26 (lower left), 98/91 (lower right)



Plate 67. Fabric 28.

Samples 98/89 (upper left), 98/96 (upper centre), 98/22 (upper right)
97/36 (centre left), 98/87 (centre)



Plate 68. Fabric 24

Samples 98/44 (upper left), 98/43 (upper right), 98/29 (lower)



Plate 69. Fabrics 20 and 30

Sample 98/90 (left) and 98/33 (right)



Plate 70. Painted Sherds in Fabrics 1e and 32

Samples 98/79 (left) and 98/78 (right)



Plate 71. Fabric 35

Sample 98/10

