Semi-automated fabric analysis of strong rheologycally contrasting mylonitic rocks: The example from the strike-slip Palmi shear zone

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Since the early Paleocene, the complex geodynamic history of the western Mediterranean has been controlled by the activation of several crustal-scale strike-slip shear zones. These shear zones have controlled the early-Alpine drifting of the Kabilo-Calabride crystalline basement, favoring microplate dismembering and accommodating part of the African-verging transport of the more internal sectors of the original southern paleo-Alpine front. One of the best preserved relics of this meso-Alpine geodynamic activity is developed along the north-western part of the Palmi-Line (PL) (Cirrincione et al., 2015; Fazio et al., 2017), which is a WNW-ESE tectonic alignment separating the Serre from the Aspromonte massifs (Southern Calabrian Peloritani Orogen CPO – Italy). On the Tyrrhenian side of the PL can be traced inland for ~1500 m from the Tyrrhenian coast and comprises mylonitic skarns with subordinate mylonitic paragneisses and tonalities. To highlight the kinematics and rheology of the Palmi Shear Zone, we performed a detailed quantitative microstructural study of all of the lithotypes involved in the shear zone. Semi-automated image analysis of mXRF maps combined with high-resolution thin section scans permits the application of new GIS-based tools to structural analysis (e. g. Ortolano et al., 2018). This allows to quantitatively extrapolate microstructural features such as grain- size and -shape distribution, of various minerals, while at the same time storing all the potential derivative mineral-chemical and textural features within a user-friendly database. This procedure applied to mylonitic rocks allows us to collect information that helps constrain the rheology and kinematics of exhumed deep-seated deformation. The outputs obtained permitted us to separate the porphyroclastic domain levels (usually tonalites) from the weakening phase ones (usually calc-silicates rocks and marbles). Image analysis of porphyroclastic domains was useful to estimate the dominant shear-type, with Rigid Grain Analysis indicating a pure shear component of 63% while simple shear constitutes 37%. Grain boundary mapping, associated recrystallization microstructures, and quartz-c axis patterns permits us to estimate shearing temperature at ca. -430 °C and a preliminary shear strain rate estimation of 1,13E^{-11} 1/s, applying the paleopiezometer of Shimizu (2008). Our results allow us to shed new light on the kinematics and rheology of exhumed shear zones, and in particular on this relic of the deep-rooted early-Alpine strike slip tectonics of the western Mediterranean.

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