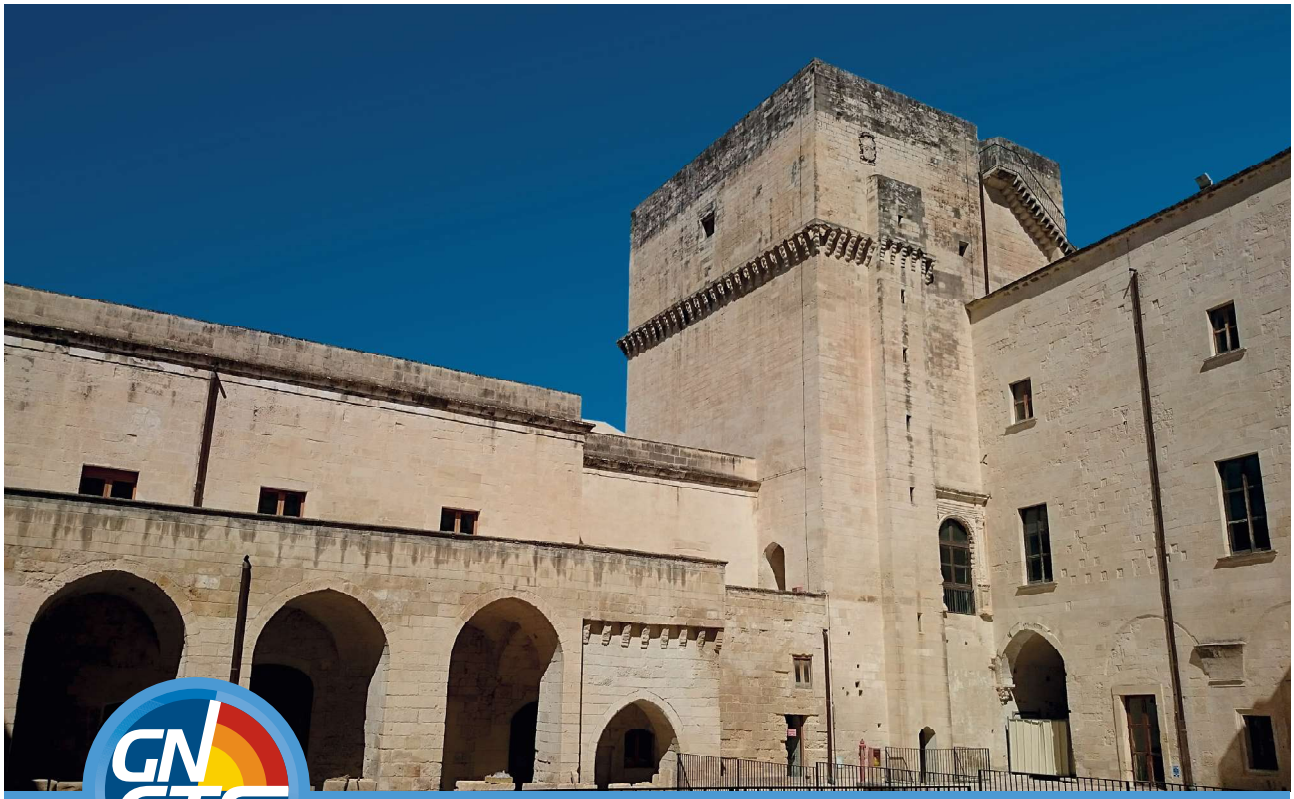

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GEOLOGICAL AND GEOPHYSICAL EVIDENCE OF THE PRETARE-PIEDILAMA NORMAL FAULT (ARQUATA DEL TRONTO, CENTRAL ITALY)

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Introduction. We here describe the geological, morphological and geophysical evidence of a Recent normal fault affecting the surroundings of the villages of Pretare and Piedilama, in the Arquata del Tronto territory in the central Apennines. Our data derives from the preliminary geological and geophysical surveys we performed in the frame of the seismic microzonation activities, promoted by the Center for seismic microzonation and its applications on behalf of the National Department of Civil Protection, in the areas that have been struck by the August 24, 2016 Mw 6.0 earthquake.

Geological setting. The Arquata del Tronto area is located in a region of the central Apennines characterised by an impressive roughly N-S oriented thrust and fold belt which is dissected by later (Plio-Quaternary) NW-SE oriented extensional features (Pierantoni *et al.*, 2013). The investigated sectors are located at the footwall of the main N10° trending main Sibillini Mountains thrust zone that separates the central Apennine mountain front from the Marche-Abruzzi foothills (Pierantoni *et al.*, 2013). This regional thrust front brings the Late Jurassic-Miocene carbonate succession of the former Adria paleomargin onto the Messinian turbiditic deposits of the Laga Formation (Ricci Lucchi, 1975; Cantalamessa *et al.*, 1980). The thrust front is associated to roughly N10 trending folds that develop in the region of Arquata del Tronto, along the valley

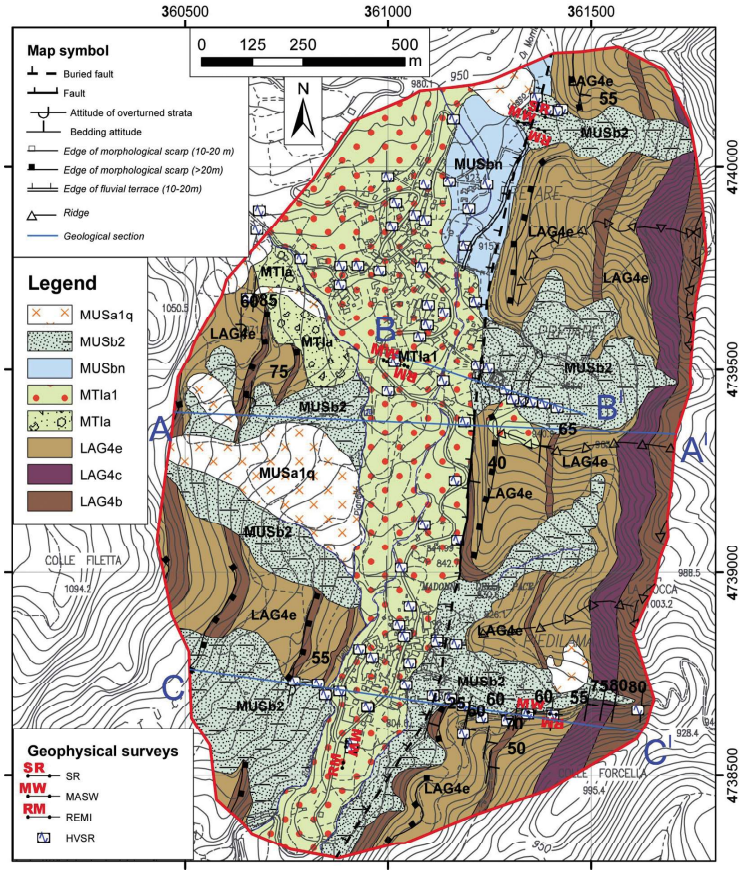

Fig. 1 – Geological map achieved by a detailed field surveys (1:5000 scale) and geophysical investigations carried out in Pretare-Piedilama area. In the legend the Quaternary continental deposits consists of: MUSa1q landslide deposits (Holocene); MUSb2 eluvio-colluvial deposits (Holocene); MUSbn terraced alluvial deposits (Holocene); MTla1 paleolandslide deposits (Upper Pleistocene); MTla paleoslope deposits (Upper Pleistocene). The geological substratum is represented by the pre-evaporitic member of the Laga Formation consisting of three lithofacies associations: pelitic-arenaceous LAG4e, arenaceous-pelitic LAG4b and arenaceous (prevailing) LAG4c.

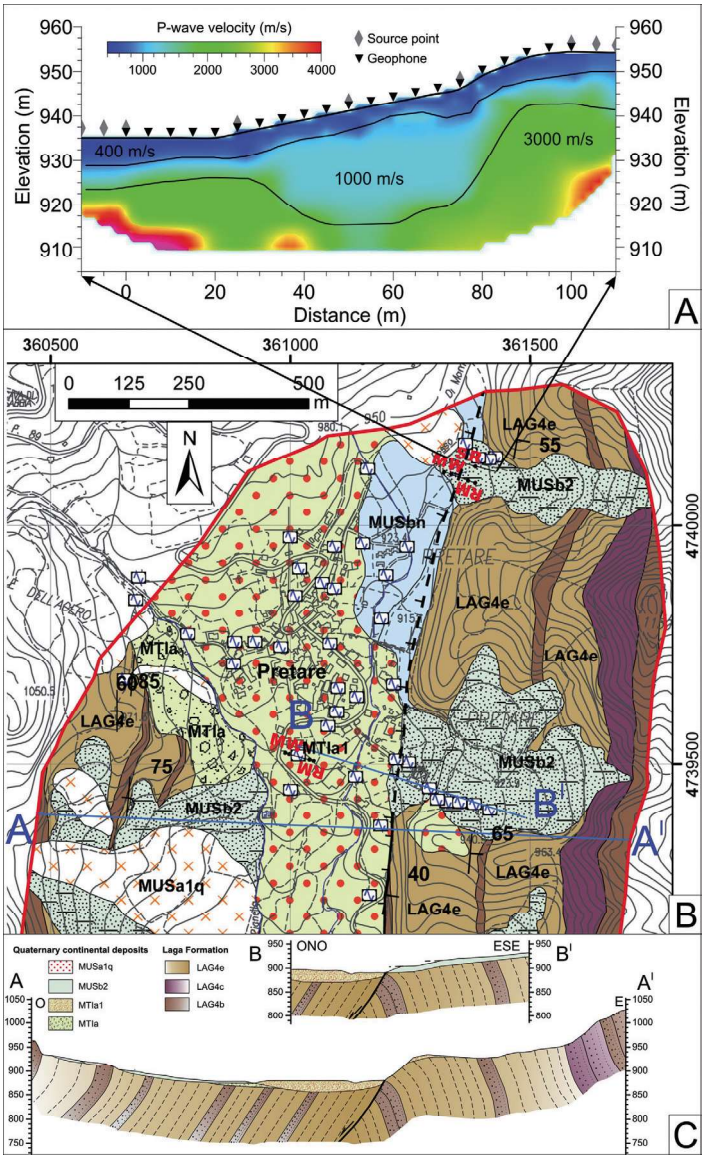

Fig. 2 – A) Seismic refraction tomography (for location see B); B) northern sector (Pretare area) of the Fig. 1; C) geological cross sections (for location see B and for the legend see the Fig. 1 caption).

of the Fosso Morricone, at the base of the eastern flank of Mt. Vettore, where the villages of Pretare and Piedilama are located (Fig. 1). The valley is floored by the deposits of a palaeo-landslide containing large carbonate blocks from the hangingwall of the Sibillini Mountains Thrust (MTIa1 in Fig. 1). On the right side of the valley, the turbidites of the Laga Formation (LAG4b, c, e) form a N10° oriented, west-dipping very steep (> 55°) monocline that represents the reverse limb of a E-verging anticline, whose hinge zone is exposed to the north of the village of Pretare, towards the village of Montegallo. On the left side of the valley, the succession of the Laga Formation forms a N5-10° trending, east dipping monocline that constitutes the upright, very steep (> 50°) western limb of a vast asymmetric syncline, whose eastern limb extends for several kilometers as far as the village of Acquasanta terme. The two east verging cylindrical fold domains, exposed on the opposite sides of the Fosso Morricone, are interrupted by a N10° oriented, west dipping normal fault, which is roughly parallel to the trend of the turbidites bedding. The fault is located at the base of the left side of the valley that represents the footwall of the structure.

Morphological, geological and geophysical evidence. During our study the Pretare-Piedilama fault line has been followed for a length of about 5 km, from the surroundings of Montegallo, to the north, to the village of Arquata del Tronto, to the south. The structure was analyzed in detail in the central part, for a length of about 2 km, in the area of Piedilama-Pretare (Fig. 1). In the study area the fault line is characterized by well defined trapezoidal facets, deriving from the dissection of a sharp linear scarp which is modelled on the pelitic-arenaceous succession of the Laga Formation. The height of the fault scarp varies from about 70 m, near Piedilama to about 40 m at Pretare. The main geological evidence of the normal fault is the sharp juxtaposition of

the two distinct fold domains on the opposite sides of the Fosso Morricone valley. The two folds, affecting Messinian horizons, are referable to a Pliocene age. Their vertical displacement is undetermined but can be estimated in the order of several hundreds of meters. The fault also displaces the Palaeo-landslides deposits (MTIa1 in Fig. 1) related to the Late Pleistocene Matelica Synthem (ISPRA-CARG Project - Sheet 314 Montegiorgio; Sheet 303 Macerata). Large part of the palaeo-landslide floor the valley, in the hangingwall of the fault, whereas a little limb is preserved in the footwall of the fault, to the east of the Pretare cemetery. The stratigraphic separation of these deposits (see profile A-A' in Fig. 2) constrains a cumulative Late Pleistocene-Holocene vertical displacement of about 50 m. The E-W trending valleys incised in the footwall of the fault are floored by colluvial deposits (MUSb2 in Fig. 1) that apparently cross undisturbed the fault line, though at places they form distinct terraced levels on the footwall of the structure (e.g. Pretare cemetery; see profile B-B' in Fig. 2). Where the colluvial deposits conceal the fault line, geophysical data have been collected in order to detect the near-surface structure across the buried fault. A seismic refraction tomography, measured on colluvial deposits concealing the fault to the NE of Pretare (Fig. 2), clearly shows a thin very low P-wave velocity (200–400 m/s) horizon, almost parallel to the W-dipping topographic surface, concealing an hanging bedrock channel, modelled on the turbiditic substratum (Vp=3000 m/s) on the footwall of the fault. The tomography also evidences that the fault zone, marked by a 30 m wide valley-shaped low-velocity zone, displaces the top of the bedrock of about 20 m.

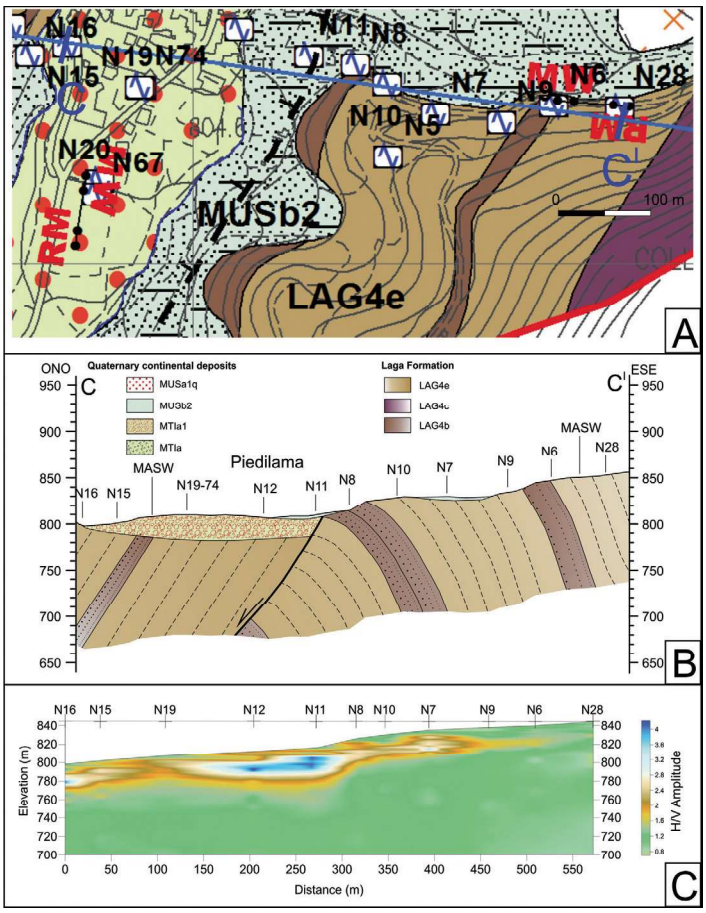

Fig. 3 – A) Clipping of the Piedilama area of the Fig. 1; B) geological cross section with the projection of the HVSR measurements (for location see A and for the legend see the Fig. 1 caption); C) transect of noise measurement (for location see N16, N15, N19, N12, N11, N8, N10, N7, N9, N6, N28 in A.)

To the east of the village of Piedilama, a 600 m long pseudo section was obtained by inverting the information coming from 11 aligned noise measurements, using formulas described in Ibs-Von Seht and Wohlenberg (1999), but calibrated by the shear wave profiles obtained in the frame of the III level seismic microzonation studies (Catalano *et al.*, this volume). The resulting pseudo section (profile C-C' in Fig. 3) clearly shows the exact location of the fault scarp and the sharp contact between the bedrock of the footwall and the paleo-landslide of the hangingwall.

Conclusions. In the Arquata del Tronto region, a N 10° oriented west-dipping normal fault has been recognised and analysed in detail, in the surroundings of the villages of Piedilama and Pretare. The orientation of the normal fault is different from the trend of the dominant NW-SE extensional features, as it developed almost parallel to the tectonic axis of the previous N10° trending thrust and fold belt features affecting the area of the main Sibillini Mts. Thrust zone. The fault plane juxtaposes two distinct coaxial fold domains. An overturned east-verging anticline was downthrown in the hangingwall of the structure, whereas an east-verging syncline forms the footwall of the fault. This geometry strongly suggests to interpret the normal fault as the product of the negative tectonic inversion of a previous thrust plane.

The geological, morphological and geophysical investigations of the structure pointed out clear evidences of its activity during the Late Pleistocene and part of the Holocene. In the frame of a revaluation of the seismic hazard in the area, further investigations (e.g. paleoseismology) should be dedicated to this tectonic feature, in order to exclude any relation between the fault and the seismicity of the area.

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