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Mapping Active and Capable faults in structural complex settings. A case study from central Apennines (Italy).

Alessandra Sciortino[1], Edi Chiarini[2], Giuseppe Nirta[2], Marco Spadi[1], Marco Tallini[1], Fernando Ferri[2], Luca Maria Puzzilli[2], Vincenzo Sapia[3], and Valerio Materni[3]
[1]Università degli studi dell'Aquila, Dipartimento di Ingegneria civile, edile - architettura, ambientale, L'Aquila, Italy
[2]Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Roma, Italy
[3]Istituto Nazionale di Geofisica e Vulcanologia (INGV), Roma, Italy

Earthquake-induced ground effects are strongly related to the presence and distance of active and capable faults, and they play an extremely important role in the mitigation of seismic risk. The Italian Seismic Microzonation Guidelines subdivide the active and capable faults in 'certain and defined' and 'uncertain', attributing to them microzones with defined landscape uses: 'Respect' and 'Susceptibility' zones respectively. In this work, we present the methodology used to map and analyze the Montereale basin's faults, located in the highly seismic region of the central Apennines of Italy. The Montereale faults (MFS) pertain to two fault systems with an *en echélon* array, namely the San Giovanni and Capitignano fault systems. Yet the great scientific attention in this region, these faults still lack clear evidence of relationships with the major active and capable structures in the neighboring area that are considered responsible for the seismic events that affected central Italy in recent decades.

The San Giovanni fault cuts in heterogeneous deposits consisting of calcareous lithotypes, which expose well defined fault planes and easily recognizable fault scarps. Instead, the Capitignano fault occurs on softer arenaceous-pelitic deposits, which make hard to identify tectonic discontinuities.

The approach, by which we have mapped the Capitignano fault and defined Susceptibility and Respect microzones for the MFS, is divided into the following phases: 1. Identification of morphotectonic elements by the analysis of digital terrain models (DTM 10 m and LiDAR 1 m), morphological elements (linear slopes, non-degraded triangular facets, anomalies in the drainage network, linear valleys, saddles, alignments of slope breaks) represent the most evident expression of active tectonics. 2. Geological and geomorphological survey for the interpretation of the elements recognized by remote sensing data. 3. Geophysical surveys (tomography electrical resistivity and seismic reflection), planned based on the morphotectonic features, identified in the previous stages. 4. Paleoseismological trenches, located where geophysical investigations have confirmed the presence of subsoil's discontinuities. 5. Dating of faulted soils.

Following this method, the recognition of active and capable faults was possible, even where their morphological expression was not evident or completely absent. Moreover, the study outcomes provided new pieces of evidence for a comparison with the neighboring and well-studied fault systems allowing to propose eventual structural relationships. Finally, we believe that the proposed approach can be a powerful tool in regions densely affected by earthquakes. In fact, a deep knowledge of fault network and their mutual interactions allows to limit damage to people and inhabited centers and to plan reconstruction works in areas affected by seismic events.