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Lateral propagation of active normal faults throughout pre-existing fault zones: an example from the Southern Apennines, Italy

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The main active structures in the Southern Apennines are represented by a set of NW-trending normal faults, which are mainly located in the axial sector of the chain. Evidences arising from neotectonics and seismology show activity of a composite seismic source, the Irpinia – Agri Valley, located across the Campania-Basilicata border. This seismic source is made up of two right-stepping, individual seismic sources forming a relay ramp. Each individual seismic source consists of a series of nearly parallel normal fault segments. The relay ramp area, located around the Vietri di Potenza town, is bounded by two seismic segments, the San Gregorio Magno Fault, to the NW, and the Pergola-Melandro Fault, to the SE.

The possible interaction between the two right-stepping fault segments has not been proven yet, since the fault system of the area has never been analyzed in detail. This work is aimed at assessing the geometry of such fault system, inferring the relative age of the different fault sets by studying the crosscutting relationships, characterizing the micromechanics of fault rocks associated to the various fault sets, and understanding the modalities of lateral propagation of the two bounding fault segments. Crosscutting relationships are recognized by combining classical geological mapping with morphotectonic methods. This latter approach, which include the analysis of aerial photographs and field inspection of quaternary slope deposits, is used to identify the most recent structures among those cropping out in the field area.

In the relay ramp area, normal faults crosscut different tectonic units of the Apennine chain piled up, essentially, during the Middle to Late Miocene. The topmost unit (only few tens of meter-thick) consists of a mélange containing blocks of different lithologies in a clayish matrix. The intermediate thrust sheet consists of 1-1.5 km-thick platform carbonates of late Triassic-Jurassic age, with dolomites at the base and limestones at the top, unconformably covered by Miocene clastic deposits. The lower thrust sheet is made up of deep-sea deposits of late Triassic to Eocene age, which include pelagic limestones, radiolarites, marls and turbiditic calcarenites. The relay ramp area is comprised of two main fault sets, which are NW-trending (N120-140E) and NE-trending (N60-70E). Minor E-trending (N90-100E) and NNW-trending (N160-170E) faults are also present. Maximum throws of the most developed faults, which are also characterized by the longest traces, are in the order of 300-400 m.

Crosscutting relationships and morphotectonic analyses generally show that the NW-trending faults are the most recent, as also shown by the involvement of Quaternary breccias and near surface fault rocks. Our data indicate that propagation of NW-trending normal faults in the relay ramp area took place thanks to the breaking of a pre-existing structural grain made up, mainly, of NE-trending normal faults. This process determined the different multi-scale properties to the two fault sets, and somehow inhibited the lateral growth of the NW-trending normal faults.