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Architecture and microstructural properties of the seismogenetic Monte Marine extensional fault affecting partially dolomitized carbonate rocks, central Apennines (Italy)

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In the last years, growing attention has been payed to the study of seismogenic faults developed in carbonate rocks, especially in the central Apennines (Italy), where complex arrays of active faults caused up to MW 6.0 destructive earthquakes. The NW-SE-trending Monte Marine Fault Zone (MMFZ) is an extensional seismogenic fault zone located to the Northwest of the L'Aquila town in the central Apennines (Italy). The fault zone is composed by two near-parallel and hard-linked major fault strands and crops out almost continuously for $\sim$8 km along the Aterno valley, from the village of Barete (to the Northwest, where only one fault segment is exposed) to the village of Arischia (to the Southeast, where the two major fault segments are exposed). Overall, the fault zone is characterized by variable amounts of loose cataclastic materials exposed in the footwall block, whose thickness range from few meters up to several tens of meters. To study the along-strike fault zone architecture and related fault core rock properties, two key sectors were mapped at 1:500-1:5000 scale and two detailed geological cross sections were constructed (namely Barete and Pizzoli sections).

Near Barete, the master slip surface is very smooth and quasi-planar and crops out discontinuously with an average attitude of 204/65 (dip dir/dip). The fault core is about 20 m wide. Based on grain size and shape distributions (obtained combining field observations and laboratory analyses) we have divided the fault core in three cataclastic facies. Facies 1 is localized along the master slip surface and has grains with diameter $<$ 1 mm with sub-rounded shapes. Facies 2 and 3 have coarser grain sizes and sub-angular clasts. The latter facies are also cut by secondary synthetic normal faults, some of them showing ultra-comminuted cataclastic material localized in mm-thick slip zones. Facies 2 hosts carbonate-cemented concretion-like structures, suggesting sin- to post-kinematic fluid circulation.

Near Pizzoli, two partially overlapped fault strands are linked by a complex set of oblique-slip, transfer faults. In this sector, the fault core is very wide ($\sim$30 m) and includes an additional external cataclastic facies, called facies 4, characterized by very angular coarse clasts (1-15 cm) dispersed in a clast-sustained matrix. The boundary between fault core and footwall damage zone is marked by a transition zone composed by m-thick blocks of cemented cataclastic rocks surrounded by loose cataclastic material of facies 4. These blocks are also offset by subsidiary normal faults.

The distribution of fault zone rocks documented in this study suggests that the largest volumes of loose cataclastic materials are located where the two fault strands overlap. Here, the increased structural complexity provides favourable conditions for cataclasite development. The spatial distribution and the quantitative analysis (e.g. grain size and shape preferential distributions) of cataclastic facies may unravel the processes (seismic vs aseismic) controlling the evolution of fault zones in carbonate rocks.