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Active faulting and deep-seated gravitational slope deformation in carbonate rocks (Central Apennines, Italy)

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Abstract

Active faulting and Deep-seated Gravitational Slope Deformation (DGSD) constitute common geological hazards in mountain belts worldwide. In the Italian central Apennines, km-thick carbonate sedimentary sequences are cut by major active normal faults which shape the landscape generating intermontane basins. Geomorphological observations suggest that the DGSDs are commonly located in the fault footwalls.

We selected five mountain slopes affected by DGSD and exposing the footwall of active seismic normal faults exhumed from 2 to 0.5 km depth. We combined field structural analysis of the slopes with microstructural investigation of the slipping zones from the slip surfaces of both DGSDs and major faults. The collected data show that DGSDs exploit pre-existing surfaces formed both at depth and near the ground surface by tectonic faulting and, locally, by gravitational collapse. At the microscale, the widespread compaction of micro-grains (e.g., clasts indentation) forming the cataclastic matrix of both normal faults and DGSDs is consistent with clast fragmentation, fluid-infiltration and congruent pressure-solution mechanisms active at low ambient temperatures and lithostatic pressures. These processes are more developed in the slipping zones of normal faults because of the larger displacement accommodated.

We conclude that in carbonate rocks of the central Apennines, DGSDs commonly exploit pre-existing tectonic faults/fractures and, in addition, localize slip along newly formed fractures that accommodate deformation mechanisms similar to those associated to tectonic faulting. Furthermore, the exposure of sharp slip surfaces along mountain slopes in the central Apennines can result from both surface seismic rupturing and DGSD or by a combination of them.