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Failure modes in carbonates and their impact for fault development: Majella mountain, central Apennines, Italy

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We document different modes of failure and the hierarchy of the fault development, in the slope-basinal sequence of marls and carbonate grainstones in the eastern part of the Majella Mountain, central Apennines, Italy. In low-porosity breccia/grainstone units, the early formation of pressure solution seams (PS) and their subsequent shearing are the basic structures leading to fault zone development. In the micrite/marly units, sheared pressure solution seams may form splays in closing mode or opening mode (joints) and their subsequent higher order shearing results in fault development. In the high porosity grainstones, the earliest structures are deformation bands of both shearing and compaction modes. The later deformation, however, involves pressure solution and the subsequent shearing of the pressure solution seams leading to cataclastic shear zones. The resulting fault zone architecture depends on lithology, failure modes, amount of slip and spatial proximity to the frontal thrust. We distinguish small faults (slip of a few cm up to 1 m), intermediate faults (slip between 1 and 10 m) and large fault zones (slip $>$10 m). Our observations show that each fault within these dimensional classes has characteristic architecture and damage zone structures controlled primarily by the fundamental failure modes. We conclude therefore that fault zone architecture depends not only on the amount of slip, but also on lithology and rheology, which may have important implications for fluid flow properties of the faults and the associated structures in different intervals of carbonate reservoirs.