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Compaction localization in the porous carbonates of Bolognano Formation (Majella Mountain, Italy)

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Recent field-based papers documented the presence of bed-parallel compaction bands within two different carbonate lithofacies (16%>porosity>33%) belonging to the Oligo-Miocene Bolognano Formation. Based upon field and thin section analyses, the aforementioned structural elements, which consist of narrow tabular bands characterized by a local porosity reduction, were interpreted as burial-related structures that accommodate volumetric strain by means of grain rotation/sliding, grain crushing, intergranular pressure solution and pore collapse.
Aimed at constraining the pressure conditions at which compaction bands develop, and at investigating the rock anisotropy (e.g. grain and pore size/shape and cement amount/type) that may promote compaction localization in the studied carbonates, we carried out a set of triaxial compression experiments under dry conditions and room temperature, at confining pressures ranging between 5 and 35 MPa.
The deformed specimens, characterized by a porosity comprised between 26% and 31%, were cored out from a large hand sample collected from the carbonate lithofacies more densely affected by natural compaction bands.
During the deformation, the samples displayed a shear-enhanced compaction behavior and strain hardening, associated with various patterns of strain localization (i.e. compactive shear bands and compaction bands). The brittle ductile transition was observed at 12.5 MPa of confining pressure, and the pressure conditions at which compaction bands nucleate were constrained. A positive correlation between confining pressure increase and the angular value formed by individual deformation band and the major principal stress was observed.
In addition, to the aforementioned experiments, we also performed triaxial compression tests on specimens cored at different orientations with respect to the sedimentary bedding (i.e. perpendicular, parallel and at 45 deg.), at 25 MPa of confining pressure. Focusing at the angle formed by individual deformation bands and the major principal compression direction, we conclude that it is strongly influenced by the original rock anisotropy, hence by the angle between the major principal compression direction and bedding orientation, clearly shown by the grain alignment and rock laminations.