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Development and distribution of bed-parallel compaction bands and pressure solution seams in carbonates (Bolognano Formation, Majella Mountain, Italy)

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The Oligo-Miocene ramp carbonates pertaining to the Bolognano Formation, cropping out at the Majella Mountain, Central Italy, are diffusely crosscut by bed-parallel structural elements such as compaction bands and pressure solution seams. These bed-parallel structural elements formed under a vertical loading, during the progressive burial of the carbonates. The present field and laboratory study focuses on the control exerted, on development and distribution of bed-parallel compaction bands and pressure solution seams, by compositional, sedimentological and pore network characteristics of a variety of carbonate rocks (skeletal grainstones and packstones, marly wackestones to mudstones). The main results are consistent with the following statements:
(i) bed-parallel compaction bands formed only within poorly cemented, porous grainstones (2D porosity > 10%; 3D porosity > 15%). Their dimensional parameters (i.e. length, spacing, thickness) were strongly controlled by both sorting and sphericity of the carbonate grains, as well as by the amount of intergranular macroporosity. All these rock characteristics enhanced all physical processes (i.e. grain rotation, translation and fracturing) associated to compaction banding;
(ii) bed-parallel pressure solution seams predominantly formed within fine-grained packstones made up of well-sorted and spherical carbonate grains with absence of internal pores, and small amounts of clayish matrix (2-4% of total rock volume). High contents of pre-existing cement also enhanced pressure solution;
(iii) well-sorted carbonates with spherical grains may be suitable to both compaction banding and pressure solution;
(iv) skeletal grain types which compose grain-supported carbonate rocks (grainstones and packstones), in many cases, indirectly influence the distribution of both bed-parallel compaction bands and pressure solution seams.
Considering that the containment and migration capacity of geofluids in the subsurface within carbonate rocks is strongly influenced by the distribution of compaction bands and pressure solution seams, the results of this research provide new tools useful to improve the prediction of reservoir quality by mapping/simulating/assessing carbonate facies.