LOCALIZED COMPACTION IN RESERVOIR DEFORMATION

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Recent field [1,2] and laboratory observations [3-8] have shown that compaction in porous sandstones may not occur uniformly but, instead, can occur non-uniformly in one or more narrow, planar bands. In these bands, the porosity is significantly reduced [1,2] compared to the surrounding material and, as a result, laboratory and field measurements have shown that the permeability is reduced by one or two orders of magnitude. Consequently, these bands form barriers to fluid flow. The presence of these bands can alter the flow characteristics of the reservoir and complicate reservoir management. Because these features are localized, they are difficult to detect by surface geophysical or borehole measurements. An analysis of conditions for the inception of these bands, similar to that used for the inception of shear bands, shows that they can form for stress states on a yield surface "cap", as is often used to model porous materials [3, 8-10]. The precise conditions depend in detail on the evolution with inelastic strain and on the nature of the intersection of the cap with the shear yield surface. Although this analysis gives some insight into the conditions for the inception of the bands, the factors controlling their subsequent evolution and the different morphologies that have been observed are not understood. Because the analysis demonstrates that compaction band solutions can arise as bifurcations from homogeneous deformation, they raise the same computational issues of non-uniqueness, constraint and resolution that are associated with shear bands.

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