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Structural diagenesis and carbonate cementation of Lower Miocene sandstone: Implications for basinal fluid flow and reservoir quality (Northern Hungary)

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The shallow marine sandstone (Pétervására Fm) was deposited via tidal currents during the Eggenburgian in the North Hungarian Palaeogene Bay, an embayment of the Paratethys(1). The sandstone was studied as an analogue for known reservoir rocks in several surface outcrops and in a borehole core section. Field observation, detailed petrography (including SEM, CL) and geochemical analysis (XRD, SEM-EDS, stable isotopes) of host rock and deformation bands were integrated to interpret the diagenetic processes and the origin of the calcite cement. Finally, the burial history was reconstructed in order to find an interrelationship between deformation and cementation. Studied deformation bands are formed just before or during the initial syn-rift phase of the Pannonian Basin. Thin section analysis revealed that band formation predated or coexist with the cementation.
The composition of fine to very coarse grained sandstones varies between subarenite and litharenite with an average of Q43F10L47 (Folk 1968). The reduction in reservoir quality is a result of several diagenetic processes; these include compaction, precipitation of diagenetic minerals such as siderite, ankerite, kaolinite, K-feldspar, albite, quartz and calcite. Feldspar dissolution had a little impact on porosity.
Calcite is the volumetrically most important diagenetic mineral in sandstone and shows various petrographic features. The stable isotopic composition of calcite is highly negative in the host rock (δ13 CV-PDB =-3.2 to -18.5 ‰ δ18 OV-PDB =-2 to -13.1 ‰ and variable in deformation bands (δ13 CV-PDB =4.1 to -10.7 ‰ δ18 OV-PDB =4.7 to -13.5 ‰. Considering the structural evolution of the studied area, these data suggest that calcite was precipitated in two stages which can be correlated to local structural evolution. First of all, in certain locations (including deformation bands), geochemistry of the calcite cement reflects the normal marine composition of pore fluid. During the next stage, fluids in connection to hydrocarbon migration had an important role in the precipitation of volumetrically smaller mesogenetic calcite. The latest stage was connected to the inversion of the basin, during which telogenetic calcite was precipitated from regionally circulated modified meteoric water. This calcite phase occurs both in host rocks and deformation bands.
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References:

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