Cataclastic grain size reduction in deformation bands under very low burial conditions

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Deformation bands and cataclastic faults may significantly reduce porosity and permeability in reservoir sediments. This study presents microstructural as well as bulk and mineral chemical investigations of such structures in uncemented, friable arkosic sands of Miocene age (Vienna Basin, Austria). The observed microstructures indicate grain size reduction by grain flaking in deformation bands with small offsets (0.5 - 8 cm), and increasing intragranular fracturing and clast disaggregation with larger displacements (10-60 cm) in cataclastic fault zones. At small displacements, increasing amounts of phyllosilicate grains (< 20 μm) in the matrix can be detected. Detailed microstructural and mineral chemical analyses reveal that the phyllosilicates are released from disaggregating sericitised albite clasts. Both cataclasis of quartz grains and enrichment of phyllosilicates by mechanical expulsion from plagioclase result in grain size reduction within the fault rocks. The measured reduction in porosity of up to 40% is associated with a permeability reduction, reflected in the retention of iron-oxide rich fluids along the deformation bands and fault zones. The observations indicate that these deformation bands and cataclastic faults formed at very shallow burial depths in unconsolidated sediments, and that fault sealing occurred in the absence of chemical alteration of the fault rocks. Such localized zones of low permeability are not recognized in seismic data due to their small displacement, but might create fluid barriers significantly reducing the connectivity of a reservoir.