Geophysical Research Abstracts
Vol. 13, EGU2011-2281, 2011
EGU General Assembly 2011

Calculating permeability from μCT 3D porosity datasets of deformation bands in a carbonate grainstone

Alexander Rath (1), Ulrike Exner (1), and Marcin Dabrowski (2)

(1) Department of Geodynamics and Sedimentology, University of Vienna, Austria , (2) Physics of geological processes, University of Oslo, Norway

We performed a combined study focused on the evolution of Deformation bands and their changes in petrophysical properties. Deformation bands are commonly found in porous siliciclastic sediments, where strain is accommodated by rotation, translation and fracturing of individual grains rather than by the formation of a sharp discontinuity. We investigated deformation bands in a high porosity carbonate rock from the Eisenstadt-Sopron Basin, on the border between Austria and Hungary, using a combination of microstructural and petrophysical methods (Rath et al., in press). We used cathodoluminescence and electron microprobe analyses to assess the distribution and chemical composition of the carbonate particles, deformation bands and cements. The earliest deformation bands formed prior to the cementation of the limestone, mainly by rotation of elongated bioclasts to an orientation parallel to the deformation bands. Further movement along the bands after the generation of a blocky cement around the bioclasts resulted in cataclastic deformation of both allochems and cement. The observations indicate a change in physical properties of the rock due to cementation during the generation of deformation bands, which result in a change of deformation mechanism from grain rotation and compaction to cataclastic deformation along a single band.

Moreover, we documented a reduction of porosity from 22-35 % in the host rock to 2-5 % in the deformation bands by micro computed tomography (μCT) and conventional helium porosimetry. Permeability is reduced up to three orders of magnitude relative to the host rock, as documented by pressure decay probe permeametry. The reduction of porosity and permeability, which is even stronger than observed in most silicilastic rocks, affects the migration of fluids in groundwater or hydrocarbon reservoirs.

From the 3D pore network obtained from μCT data, we performed a numerical analysis of permeability using the Stokes flow model. Comparing different datasets, we investigate the effect of spatial resolution as well as sample size on the calculated effective permeability. The thereby calibrated permeability values are used to examine the reliability of permeability measurements performed with conventional laboratory techniques.

Rath, A., Exner, U., Tschegg, C., Grasemann, B., Laner, R. & Draganits, E. (in press): Diagenetic control of deformation mechanisms in deformation bands in a carbonate grainstone. AAPG Bulletin.