Geophysical Research Abstracts
Vol. 14, EGU2012-5631, 2012
EGU General Assembly 2012

New insights to pore space morphologies in Boom Clay – results from 2D BIB-SEM investigations and mercury injection porosimetry

S. Hemes, G. Desbois, and J.L. Urai

Structural geology, Tectonics and Geomechanics, RWTH Aachen University, Lochnerstrasse 4-20, 52056 Aachen, Germany (s.hemes@ged.rwth-aachen.de)

BIB-SEM investigations on Boom Clay (Mol-Dessel reference site for radioactive waste disposal, Belgium) of different grain sizes yield new insights to pore space morphologies and pore-size distributions down to the resolution of state-of-the-art SEM.

Non-clay minerals embedded into a clay matrix form the overall fabric of the different samples investigated. We identified four main porous mineral phases: clay, pyrite, mica and fossils. Regardless of the origin and the grain-size distribution of samples, characteristic pore morphologies were found for each different mineral phase.

Our approach allows segmenting pores with a practical pore resolution of 25-30 nm in pore size (equivalent radius, ER) resulting in total porosities of 10-20 % and log-normal pore-size distributions at the scale of observation.

Detailed studies of segmented porosities within the clay matrices point to a power-law distribution of pore-areas over three orders of magnitude, interpreted as self-similarity of the pore space. Moreover, two classes of pore-sizes were distinguished within the clay-matrix: biggest pores were found within the first 100 nm from non-clay mineral grain-boundaries, whereas pores smaller than 100 nm (ER) are homogeneously distributed within the clay matrix. Our calculations show clearly that the median pore-size value of the biggest pores is linked to the grain size parameter, which suggests that the grain- size and the amount of non-clay minerals is controlling the contribution of the largest pore-size fraction to the overall porosity.

Bulk porosities measured by mercury injection porosimetry (MIP) are between 26-33 %. The comparison of our microstructural investigations inferred by BIB-SEM with MIP data, indicates that a significant pore fraction is not detected by using the BIB-SEM method (about 10-15 % of the total porosity), corresponding to pores smaller than 30 nm (ER). However, the extrapolation of power-law pore-size distributions, inferred for pores within the clay matrix, down to the resolution of MIP, allows retrieving porosities within a range of good agreement (20-30 %). This suggests further that the clay-matrix almost essentially controls the connectivity of the pore space in Boom Clay and that pores detected by the BIB-SEM method are interconnected via small pores with sizes below 30 nm (ER). We observed also that the peak-position in MIP (pore-size – frequency) curves is related to the grain-size of the samples; linked to our microstructural investigations, the non-clay minerals in large grain-sized samples are proposed to create preferred pathways for fluid flow in the material, via the development of interconnected big pores.