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Micro-fabric damages in Boom Clay inferred from cryo-BIB-SEM experiment: recent results

Guillaume Desbois (1), Joyce Schmatz (2), Jop Klaver (2), and Janos L. Urai (1)

(1) Structural Geology, Tectonics and Geomechanics, RWTH Aachen University, Germany(guillaume.desbois@emr.rwth-aachen.de), (2) MaP – Microstructure and Pores GmbH, Aachen, Germany

The Boom Clay is considered as a potential host rock in Belgium for nuclear waste disposal in a deep geological formation. One of the keys to understand the long-term performance of such a host rock is the fundamental understanding of coupling between microstructural evolution, poromechanical behaviour and the state of hydration of the system.
At in situ conditions, Boom Clay is a nearly water-saturated (>94%) clay-rich geomaterial. Subsequently, for measurement of mechanical and transport properties in laboratory, cores of Boom Clay are vacuum-packed in Al-coated-poly-ethylene barrier foil to be best preserved at original hydric state. Because clay microstructures are very sensitive to dehydration, the validity of investigations done on such preserved or/and dried samples is often questionable.
Desbois et al. (2009, 2013, 2014) showed the possibility to image fluid-filled porosity in Boom Clay, by using the FIB-cryo-SEM (FIB: Focussed Ion Beam) and FIB-cryo-SEM (BIB: Broad Ion Beam) techniques. However, surprisingly in Desbois et al. (2014), BIB-cryo-SEM experiments on Boom Clay, shown that the majority of the pores were fluid-free, contrasting with result in Desbois et al. (2009). In Desbois et al. (2014), several reasons were discussed to explain such discrepancies. The likely ones are the sealing efficiency of the Al-barrier foil at long term and the volume expansion due to the release of in-situ stress after core extraction, contributing both to dehydration and microfabric damage.
This contribution presents the newest results based on cryo-BIB-SEM. Small pieces (30 mm3) of Boom Clay were preserved in liquid nitrogen after the core extraction at the MOL/Dessel Underground Research Laboratory in Belgium. A maximum of ten minutes time span was achieved between opening the core, the sub-sample extraction and the quenching of sub-samples in liquid nitrogen. First results show that all pores visible at cryo-SEM resolution are water saturated. However, water–filled micro-cracks are also present and they are interpreted to result from the releasing of in-situ stress after the core extraction. Moreover, the comparison of the clay micro-fabrics in the same preserved and dried sample suggests collapsing of the clay aggregates' pores in dried sample.
These newest results are still preliminary and they need to be analysed in more details. However, if they are confirmed they may be important input to discuss about the validity of measurement of mechanical and transport properties done in laboratory.

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