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Claystone as a Potential Host Rock: Scale-Dependent Observations in X-ray CT, Mineralogy and Geomechanics

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Argillaceous formations are investigated as possible host rocks for the deep-level disposal of radioactive waste, among them Opalinus Clay which is studied in the Underground Rock Laboratory (URL) of the international Mont Terri project. For the understanding of deformation processes it is necessary to obtain detailed information about the mineral composition and the microstructure of the materials at different scales.

In this study a clay drill core of 100 mm diameter and 180 mm length was tested in a triaxial apparatus until failure and then sub-sampled down to ca. 30 mm and finally 3 mm diameter. Non-destructive X-ray CT scans were carried out on each of these scales. Mineralogical, geochemical and scattering electron microscopic investigations completed this study.

The 100 mm Opalinus Clay sample was first scanned with the speed|scan CT 64 (GE Ahrensburg, Germany). The CT results show good contrast resolution due to its high power (up to 72 kW), layering within the core can be nicely detected. Cracks and pores are spatially resolved down to 0.5 mm. Secondly, a CT scan of the same sample was recorded with the v|tome|x L300 system (GE Wunstorf, Germany) with a scan time of 145 min and a spatial resolution of about 60 μm . With this higher resolution the delicate network of cracks can be clearly visualized. For the 30 mm and 3 mm samples a nanotom m system (GE Wunstorf, Germany) allowed a resolution of 18 μm and 3 μm in 120 min scans, respectively. Due to this high resolution one can detect small fractures (down to 3 μm) and microstructural features like gouges (Figure 1).

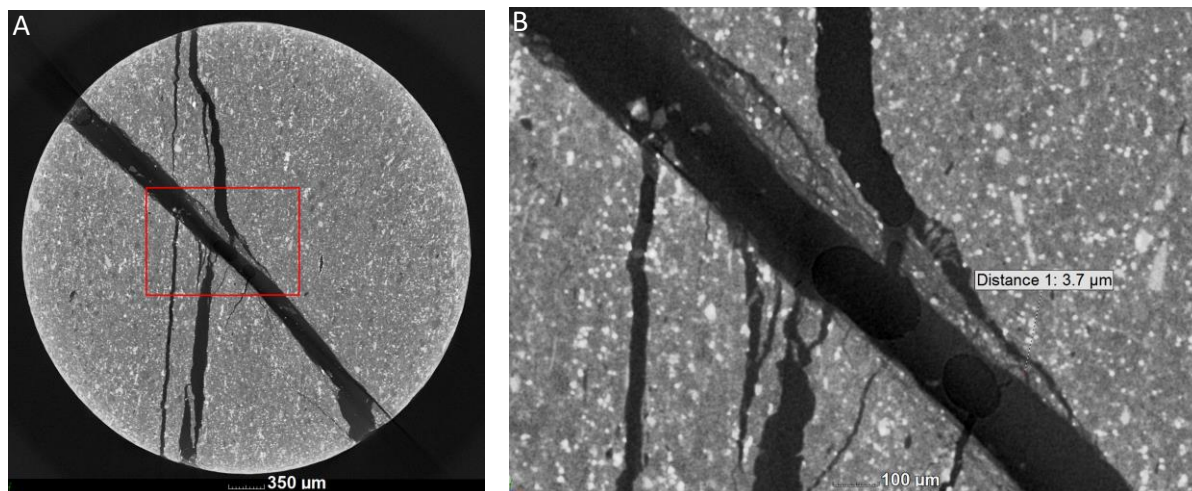


Figure 1: X-ray CT investigation of Opalinus Clay, sandy facies A) shear failure (diagonal) and diking (vertical) and B) gouge zone in the field of shear failure.

Geochemical and mineralogical investigations are used to identify homogeneous areas which can be considered representative of the entire rock. Hence, the CT information gathered from a small volume can be used to understand the mechanical processes in the entire rock.

