MONT TERRI PROJECT, CYCLIC DEFORMATIONS IN THE OPALINUS CLAY

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Shrinkage structures in the Opalinus Clay, related to seasonal changes in temperature and humidity, are observed on the tunnel walls of the Mont Terri Rock Laboratory. The structures open in winter, when relative humidity in the tunnel decreases to 65%. In summer the cracks close again because of the increase in the clay volume when higher humidity causes rock swelling. Shrinkage structures are monitored in the Mont Terri Rock Laboratory at two different sites within the undisturbed rock matrix and a major fault zone. The relative movements of the rock on both sides of the cracks are monitored in three directions and compared to the fluctuations in ambient relative humidity and temperature (Figure 1).

The cyclic deformations (CD) experiment aims to quantify the variations in crack opening in relation to the evolution of climatic conditions and to identify the processes underlying these swell and shrinkage cycles. It consists of the following tasks:

– Measuring and quantifying the long-term (now up to three yearly cycles) opening and closing and, if present, the associated shear displacements of selected shrinkage cracks along an undisturbed bedding plane as well as within a major fault zone ("Main Fault"). The measurements are accompanied by temperature and humidity records as well as by a long-term monitoring of tunnel convergence.

– Analysing at the micro-scale the surfaces of the crack planes to identify potential relative movements, changes in the rock fabric on the crack surfaces and the formation of fault gouge material as observed in closed cracks.

– Processing and analysing measured fluctuations of crack apertures and rock deformation in the time series as well as in the hydro-meteorological variables, in particular relative humidity Hr(t) and air temperature.

– Studying and reconstructing the opening cycles on a drillcore sample under well-known laboratory conditions and observing potential propagation of the cracks with evolving number of climatic cycles.

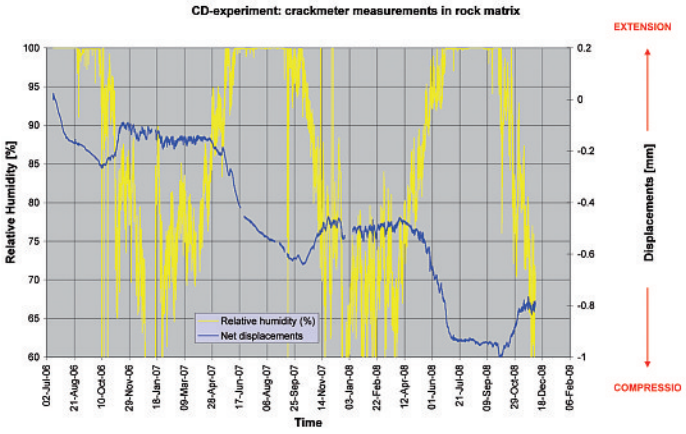

Figure 1: Crack meter measurements of a bedding plane indicate the correlation between drying cracks and ambient relative humidity (net displacements are temperature corrected). Extension and compression are related to the crack.

The experiment is running since July 2006 and data acquisition of displacements and climate in the rock in the rock laboratory are still going on. The resolution of the installed crack- and joint meters allows the identification of the opening cycles in the field. The existing time series over thee years clearly indicates the correlation between climate and differential movement with a minor lag time (Figure 1). A negative trend within the displacement data is observed even though the relative difference between the crack opening and closure remains at the same level.

Shear movement between the blocks has not been identified yet, and the investigation of crack surfaces will give additional evidence of the potential fault gouge formation at the surfaces or disturbances of the crack surfaces. First results of the *in situ* measurements, statistical analysis as well as hypotheses of the underlying processes are presented and compared.