In-situ Experiment on the Influence of Humidity on the Cyclic and Long-Term Deformation Behavior (CD-A) of the Opalinus Clay at the Mont Terri Rock Laboratory, Switzerland: Excavation of the Twin Niches, First Measurements, Simulations and Analysis

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Claystone is characterized by a complex, highly coupled hydraulic-mechanical behavior. The physical understanding of the related effects is of great importance concerning the stability during the construction phase as well as for the safety assessment of the integrity of a potential repository for high-level nuclear waste. The rock laboratory Mont Terri, Switzerland, provides the unique possibility to conduct in-situ experiments in the Opalinus Clay for a broad international community. The experiment on the influence of humidity on the cyclic and long-term deformation behavior (CD-A experiment) is conducted in the new part of the rock laboratory, which has been finalized in 2019.

To compare the coupled hydraulic-mechanical effects under different conditions, two parallel oriented niches, called twins, have been excavated in autumn 2019. The twins have a length of 11 m and a diameter of 2.3 m and no shotcrete support. The first twin remains under “natural conditions”. Here, the atmospheric conditions are characterized by a seasonal change in air humidity and temperature. This leads to a desaturation of the claystone around the niche. The second twin is locked. In this area, the air conditions imply a high humidity and the desaturation of the claystone will be avoided as much as possible.

In both twins, a geological characterization of drill cores and of rocks exposed in the niches have been carried out. Furthermore, a long-term measurement program of the related parameters has been launched. It includes measurements of the air humidity, the temperature, the deformation (extensometer), the convergence of the niches, the pore water pressure (piezometer) and the water content (Taupe). Additionally, periodic measurements of the permeability, electrical resistivity (ERT), and nuclear magnetic resonance (NMR) on the niche walls as well as petrophysical
analyses of drilled cores are planned. Seismic borehole measurements will also be carried out. The measuring program will be accompanied by the numerical simulation of the coupled hydraulic-mechanical effects in the vicinity of the niches. The comparison of the measurements with simulation results considering different model approaches should support the identification of significant physical effects of the complex coupled material behavior.

This contribution will focus on the observations during the excavation of the twin niches and analysis of the first measured data as well as numerical investigations carried out with OpenGeoSys.