Geophysical Research Abstracts
Vol. 17, EGU2015-1529-2, 2015
EGU General Assembly 2015

Experimental investigations for the modeling of chemo-mechanical processes of anhydritic rock

Tara Huber, Erich Pimentel, and Georg Anagnostou
ETH Zurich, Switzerland

When anhydritic rock comes into contact with water, the anhydrite dissolves and gypsum precipitates as a result of an oversaturation of the sulphate and calcium ions in the water. This anhydrite to gypsum transformation (AGT) leads to an increase in the solid volume by roughly 61% and possibly also of the pore volume, thus resulting in macroscopic swelling. In tunneling, swelling rock can cause massive damage, since it can exhibit high pressures on the lining or result in large deformations of the lining. Even though this phenomenon has already been observed more than a century ago, AGT in sulphatic rock still raises many open questions.
One question we focus on is the mechanical (i.e. stress, strain) behavior of anhydritic rock during swelling. The coupled chemo-mechanical processes, i.e. the development of stresses and strains during AGT, has not been fully understood so far. A chemo-mechanical model must be considered which take anhydrite dissolution, gypsum precipitation as well as stresses and strains into account.
In this contribution we present some fundamental research which was done in order to establish a relationship between AGT and the resulting or applied strains and stresses. The research contains experiments on samples consisting of anhydrite and kaolin under oedometric conditions. In order to reduce uncertainties due to swelling of clay as well as inhomogeneous compositions and structures of the natural rock samples, the experiments at the present stage of this research are performed on artificially created, reproducible samples. The samples contain 40% industrial anhydritic powder and 60% Polwhite E Chinaclay (of which the main component is kaolinite). The powders are mixed and compacted in a steel ring under high axial pressure, thus creating intact discs with a dry density of roughly 1.9 g/cm3.
In a first series of Oedometer tests the swelling strain under various constant axial stress is measured until the maximal strain is reached. At the highest stress level chosen no swelling occurred during the duration of the test. Based on these tests, a relationship between the swelling strain and axial stress is observed. In a second series of tests the samples are all submitted to the same axial stress and extracted after different test durations, which gives us a relationship between the reached swelling strain and the transformed anhydrite over time for a specific axial stress. The structure and the composition of the samples are analyzed posttest (via thermogravimetry and X-ray diffraction) in order to determine the amount of precipitated gypsum and remaining anhydrite in the sample. The results of the tests mentioned above will be discussed in this contribution.