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Hydromechanichal behavior and transfer properties of an argillite.

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The Bure argillite is a potential host rock for an underground radioactive waste disposal in France. During the construction and the exploitation phase of the waste disposal, and after its closure, the rock mass will be submitted to various thermo-hydro-mechanical loadings. The rock, initially saturated, will partially desaturate due to the ventilation of the galleries. The drying could generate tensile stresses at the galleries wall ; however drying will also increase the rock strength and the creep strain rate will be made slower. In order to predict the short-term and long-term responses of the rock, laboratory experiments are conducted to build models and to determine the corresponding parameters which will be used to perform predictive numerical simulations. The hydromechanical models must be able to describe the transition between the saturated and unsaturated states.

This paper deals with the modelling of some aspects of the unsaturated hydromechanical behaviour and transport properties of this argillite on the basis of the interpretation of laboratory experiments performed at different relative humidities. Argillite samples of different shapes and sizes are submitted to successive relative humidity steps along a drying-wetting path at zero total stress. Some samples are brought to equilibrium under a given relative humidity and then are submitted to an instantaneous uniaxial loading. Uniaxial and triaxial creep tests at imposed relative humidity are also performed. The weight of the samples and the axial and tangential strains are continuously recorded. These measurements allow to determine the instant when the hydric equilibrium is reached. The relative humidity is also measured. Cross analysis of these experiments allows to build a hyhdro-mechanical model.

Using a linearisation of the moisture diffusion equation, the analysis of the samples mass evolution during each successive relative humidity step provides both the sorpsion-desorpsion curve and the evolution of a linearised moisture diffusivity coefficient as a function of relative humidity. The sorpsion-desorpsion curve exhibits a hysteresis which is reflected on the moisture diffusion coefficient. However an analysis of these results in term of total water permeability by assuming a generalized Darcy law shows that the permeability versus volumetric water content relationship is unique. When the relative humidity approaches unity, this total water permeability is closed to the lowest permeability values measured for this argillite when it is saturated. The strains are as large as 1% when the relative humidity is decreased from 98% to 32% RH at zero total stress. Axial strains, perpendicular to the bedding are about twice the tangential strain parallel to the bedding. Furthermore, the strain versus relative humidity relationship is highly non-linear and the main part of the drying strain occurs when the relative humidity is decreased from 98% to 90% RH. We have therefore carefully analysed the effect on strains of the small hygrometry variations (few percents) in term of linearized behavior. These results are analysed in term of hydric dilation tensor. Numerical simulations of these tests are presented by using both a linear and a non-linear analysis.