COMPARISON OF THE POROELASTIC BEHAVIOR OF MEUSE/HAUTE MARNE AND TOURNEMIRE ARGILLITES: EFFECT OF LOADING AND SATURATION STATES

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This paper will present a synthesis of the experimental work conducted by IFP on rock samples taken out of the Meuse/Haute Marne and Tournemire underground research laboratories host formations, named "argillites". The behavior of these clayey rocks is studied within the framework of Biot's mechanics of fluid saturated porous solids. Drained and undrained uniaxial strain tests ("oedometric tests", Figs. 1 and 2) are performed to determine the poroelastic parameters for various applied stresses: drained and undrained bulk moduli K_0 and K, shear modulus G, Biot's coefficient b and Biot's modulus M.

The theoretical relations used to determine the hydromechanical parameters suppose that the rock is saturated. As the provided plugs are not fully saturated, a particular care is given to preliminary resaturation phase of the samples and the estimation of their final saturation. Swelling effects during the resaturation phase are also characterized.

Preliminary results on Meuse/Haute Marne argillites show an influence of the applied stress on the poroelastic parameters: the measured Biot's coefficient decreases when the axial stress increases, while the drained bulk modulus and the shear modulus increase (Figs. 3 and 4). The effect of the applied stress on Biot's modulus is more difficult to interpret, because the measure of this specific parameter strongly depends on the saturation state of the sample. Meuse/Haute Marne argillites poromechanical behavior appears to depend on the rock saturation state: samples with a greater initial saturation seem to show a lesser apparent surconsolidation degree and a higher compressibility.

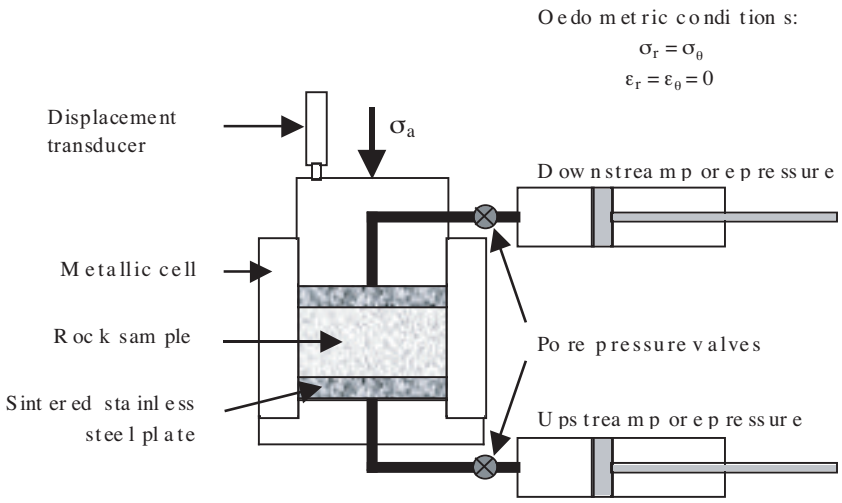

Figure 1: Principle of oedometric test.

Fully coupled hydromechanical behavior of Tournemire argillites has been rather less studied than Meuse/Haute Marne argillites. The results obtained will then give precious comparison data.

The full paper will describe the followed experimental method, including the resaturation phase, the followed loading paths and the estimation of the sample saturation. The experimental results will be analyzed to show the influence of both the saturation state and the applied stress and compare the hydromechanical behavior of Meuse/Haute Marne and Tournemire argillites.

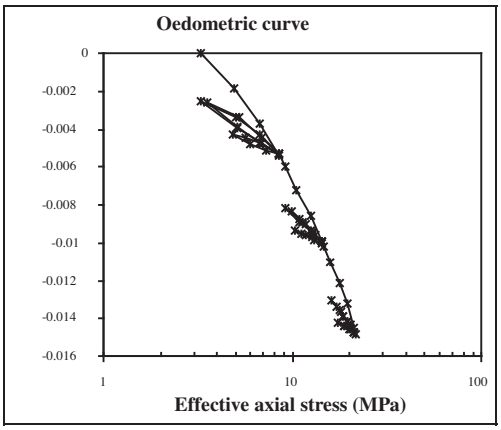

Figure 2: Oedometric curve of a Meuse/Haute Marne argillites sample.

Numerical modeling of the oedometric tests will also be described. Finite element calculations enable to estimate the permeability of the samples by fitting the experimental pore pressure equilibrium curves obtained during hydromechanical loading.

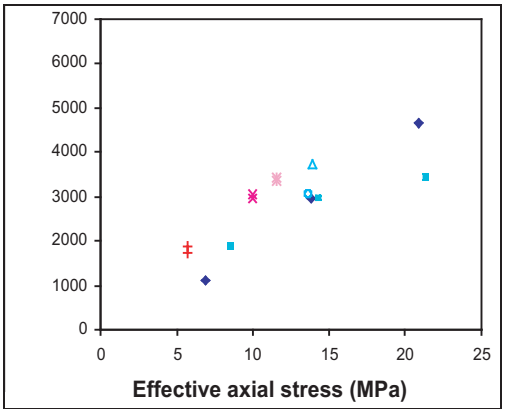

Figure 3: Ko+4G/3 as a function of the applied axial stress (Meuse/Haute Marne argillites).

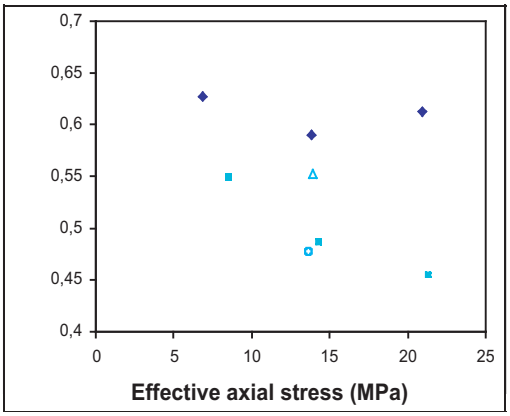

Figure 4: b as a function of the applied axial stress (Meuse/Haute Marne argillites).

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