# INTERACTION BETWEEN CREEP, SWELLING AND PRESSURE - SOLUTION DURING INDENTATION TESTS

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This study was performed under FORPRO Research Contract OO-I, in cooperation with J.P. Gratier LGIT, Grenoble.

The mechanisms governing argillite mechanical behavior are still incompletely known. Previous tests on Bure argillite have proven that this rock, when submitted to large deviatoric stresses (say, 10 MPa) exhibit strain rates of the order of $3.10^{-11}$ $s^{-1}$ to $3.10^{-10}$ $s^{-1}$, rates which are significant enough when one considers deep underground galleries which will remain opened during one century.

Extrapolation of few-month-long creep tests to much longer period of times must be based on a better understanding of the mechanisms governing argillite behavior. As Bure argillite contains a relatively high amount of carbonates, effects of pressure-solution mechanisms were suspected to be of some importance. Standard indentation tests, involving high applied forces, are performed in LGIT, Grenoble. This effort is completed by similar tests performed under small mechanical loading by LMS, Palaiseau ; these tests are described in this paper.

Five indentation tests have been performed. During each test, three indents, 5.2 mm in diameter, are pressed on an argillite sample ; the loading stress is in the order of 3 MPa. Under such a load, very slow penetration rates are expected. For this reason high resolution strain measurement sensors are used and the room temperature and hygrometry are made quite stable by setting the testing apparatus in a gallery of an old underground quarry, 20 m below ground level.

A testing fluid is placed above the sample surface. Various testing fluids were used to assess their effect on indent penetration rate. The obtained results are somewhat surprising. For instance, when ethanol is used as a testing fluid, penetration rate is negative: in other words, sample swelling is much faster than sample creep below the rigid indent. This result can be compared to similar observations performed during standard creep tests: when low compressive stresses are considered, sample swelling is significantly larger than sample creep. However when no fluid is used, a stabilized penetration rate ($3.10^{-12}$ $m.s^{-1}$ is a typical figure) can be observed after a couple of weeks. When pure soft water is used as a testing fluid, penetration rate are very large and it is observed at the end of the test that cylindrical holes have formed on the surface sample.

This set of results proves the significance of the chemical composition of the testing fluid when mechanical behavior is considered, with potential consequences for the prediction of the long-term evolution of underground galleries.