Geophysical Research Abstracts
Vol. 18, EGU2016-1664, 2016
EGU General Assembly 2016

In-situ investigation of the influence of the long-term shear strength of faults on the regional stress field in a granite rock mass

Bruno Figueiredo (1), Francois Cornet (2), Luís Lamas (3), and José Muralha (3)

(1) Uppsala University, Uppsala, Sweden, (2) Institut de Physique du Globe de Strasbourg, Strasbourg, France, (3) Portuguese National Laboratory for Civil Engineering, Lisbon, Portugal

A case study is presented to show how stress field measurements may be used to assess the long-term rheological behaviour of an equivalent geo-material. The example concerns a granitic rock mass at the km3 scale, where an underground hydropower scheme including a new 10 km long power conduit and a powerhouse complex will be constructed. For design of the underground cavern and hydraulic pressure tunnel, several in situ stress measurements were carried out, using hydraulic borehole testing, overcoring and flat jack techniques.

A first continuum mechanics model, with a homogenous material, was developed to integrate the several in situ test results and to assess the regional stress field. This model is based on elasticity and relaxation of the elastic properties measured through laboratory tests conducted on cores. Results of integration show that the long-term behavior of this granite rock mass differs markedly from the short-term behaviour as defined by laboratory tests. This suggests that the in-situ stress field depends mostly on the softer material that fills up the faults and hence results from the shear stress relaxation over a large number of pre-existing fractures and faults.

A second continuum mechanics model, with consideration of two fault planes located nearby the hydraulic tests, was studied. This model is based on elasticity for the overall rock mass, with the elastic properties extracted from laboratory measurements, and visco-elasticity with small long-term shear strength for the two fault planes. Results show that the overall granite rock mass may be viewed as a combination of stiff elastic blocks separated by soft low strength material, leading to a fairly large scale homogeneous axisymmetrical stress field with vertical axis. Advantages and limitations of the two modelling approaches are discussed.