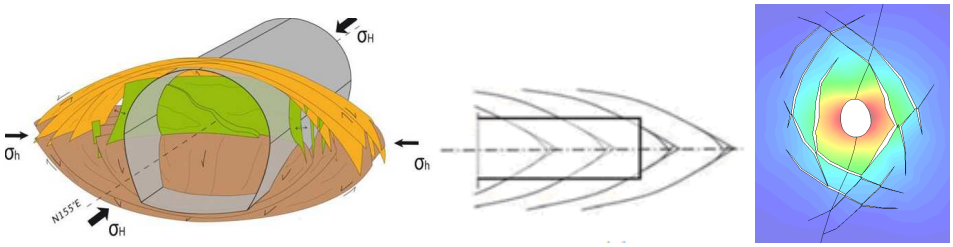
*Champs sur Marne, February 7, 2015*

*PhD Position in Geomechanics*:

***Mechanisms of initiation and propagation of fractures in the Excavation Damage Zone around deep underground galleries in claystone***

Navier Laboratory is a research center in Mechanics at the Ecole des Ponts ParisTech (http://navier.enpc.fr/) leading, in particular, researches on rock mechanics and deep underground structures for Environmental or Energy-related applications. The PhD project focuses on the behavior of galleries excavated in deep claystone (500m depth) for radioactive waste storage by ANDRA (French Agency for Radioactive Waste Management). The excavation action induces a damage zone (micro-cracks or fractures) that strongly affects the hydromechanical properties in the near-field around the gallery and potentially the long-term integrity of the project [1]. Many recent experimental, theoretical and numerical researches have focused on the origin and mechanisms of evolution of EDZ. Field observations have allowed to describe the geometry of the fractures; their shape, extensions and periodicity [2]. However, the mechanisms underlying the genesis and evolution of the fractures remain still little known. The fractures observed around theses galleries have some similarities with the fractures observed in other cases of deep openings in quasi-brittle rocks, like some oil wells, and the interest of this research exceeds the field of radioactive waste the storage in claystone.

The PhD project aims to the theoretical and numerical study of the fracturing processes around deep galleries in quasi brittle rocks on the basis of available observational and measurements data. The Finite Element code *POROFIS* developed specifically for modeling coupled hydromechanical processes in porous fissured or fractured media [3,4] can be used for this purpose. The facilities provided by this code should make possible major advances in the understanding of fracturing mechanisms.




(a) (b) (c)

FIG: (a) Fractures identified around deep galleries in claystone [2], (b) Schematic representation of shearing fractures in the radial plane, (c) modeling of the EDZ with *POROFIS*.

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The objective of this research is to enable a better design of excavation works in order to reduce the EDZ extension and a better prediction of its evolution in the future life of the gallery under hydro-mechanical solicitations.

Candidates must have deep knowledge of continuum mechanics concepts and of Geomechanics and strong skills in theoretical and numerical modeling. They must be less than 26 years old and have European nationality. During they PhD period, they will be employee of ANDRA and will receive a gross salary of about € 1,990 / month.

Applicants shall send their CV and cover letter to Prof. Ahmad Pouya (ahmad.pouya@enpc.fr) before March 15, 2015. The selection results will be known around April 15, 2015. The PhD will start on September 1, 2015 for a period of three years.

References

[1] G. Armand, A. Noiret, J. Zghondi, D.M. Seyedi,2013, Short- and long-term behaviors of drifts in the Callovo-Oxfordian claystone at the Meuse/Haute-Marne Underground Research Laboratory, Journal of Rock Mechanics and Geotechnical Engineering 5,pp 221–230.

[2] G. Armand, F. Leveau, C. Nussbaum, R. de La Vaissiere, A. Noiret, D. Jaeggi, P. Landrein, C. Righini, 2014, Geometry and Properties of the Excavation-Induced Fractures at the Meuse/Haute-Marne URL Drifts, Rock mechanic and Rock engineering, Volume 47, Issue 1, pp 21-41.

[3] Pouya A., Bemani Yazdi P. A damage-plasticity model for cohesive fractures. Int. J. Rock Mech. Min. Sci. 2015; 73: 194–202.

[4] Pouya A., A Finite Element Method for modeling coupled flow and deformation in porous fractured media, International Journal for Numerical and Analytical Methods in Geomechanics, 2014 (submitted).

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