

Proposition de thèse de doctorat

Début 2018-2019 (Autumn 2018)

Title : **Effect of Microstructural factors on deformation and fluid transport in partially saturated low permeability materials**

Laboratory : GeM

Equipe : MEO

Location : Ecole Centrale de Nantes and the University of Rome TorVergata

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Description

Storage of energy into underground reservoirs is one of current solutions to solve irregularities between energy production and needs. For short or long term storage, the interface between the reservoir material and the caprock is a potential area for critical hydromechanical behavior due to different material and fluid properties. This interface generates possible instabilities and environmental risks so the characterization of its mechanical properties is a high scientific challenge.

The thesis deals with the investigation of the mechanisms of deformation at different fluid interfaces at the meso and microstructure scales of low permeability materials. In particular, it focuses on the experimental identification of quantitative interactions between the microstructure, fluids and deformation of partially saturated low permeability clayey materials.

At the laboratory scale (0.5µm-cm), analogous materials of low permeability clayey soils will be used to study their response to hydro loadings and to hydromechanical biaxial loadings. The evolution of microstructure and fluids will be followed by high speed cameras on the sample cell surface of a new transparent biaxial apparatus adapted to unsaturated soils. Full-field measurements of displacements, deformations, fluid distributions and microstructure changes will be quantified by digital image correlation and mark tracking.

Two experimental campaigns will be held on two different materials with low hydraulic conductivities, to investigate separately chemo-mechanical and physico-mechanical couplings between fluids and microstructure.

The challenge of this experimental activity is multi-fold, from the preparation of analogous geomaterials to the experiments and the development of a new methodology to compare quantitatively deformations, fluid distribution and microstructure in low permeability materials.

The expected results will strongly improve the understanding of quantitative relationships between fluid interfaces and deformation of low permeability geomaterials which constitute the caprock of underground reservoirs.

Key words : low permeability materials, digital image correlation, unsaturated soils, microstructure, deformation, fluid

Required competences

- Strong competences in fluid mechanics, soil mechanics, engineering geology and programming ; knowledge in digital image correlation will be appreciated.
- Ability to work in a group
- Ability to assist with the supervision of master students, produce reports and presentations for project meetings and publications

Additional remarks

The thesis will be co-driven by Ecole Centrale de Nantes and by the University of Rome TorVergata. Main experimental activities are based at ECN but the PhD candidate will spend several months in Rome.

The study is developed within the framework of the ANR project «STOWENG» underground STOrage of reneWable ENergies in low permeability Geomaterials.