

# EFFECT OF TEMPERATURE AND SATURATION ON THE MECHANICAL BEHAVIOR OF CALLOVO-OXFORDIAN CLAYSTONE

### Context and motivations of the thesis

As part of the optimization of the underground structures of the Cigéo repository project, the potential future gains will result from a better representation of the diffuse damage of the Callovo-Oxfordian argillite and from a more detailed characterization of the associated thermo-hydro-mechanical parameters. Previous studies have shown a greater influence of relative humidity on compressive strength than temperature. In addition, the characterization tests carried out on samples having been exposed to very high temperatures during the CRQ and ALC1605 experiments carried out in situ within the Meuse/HauteMarne underground research laboratory indicate little or no alteration of the mechanical properties. Moreover, compression tests on heated samples carried out as part of the HITEC Work Package of the European EURAD program indicate a slight drop in resistance with temperature. In order to increase the understanding of the influence of the saturation state on the behavior of the tested samples, the thesis work will focus on the study of the impact of temperature on the hydromechanical behavior of the Callovo-Oxfordian argillite.

The GeoRessources laboratory, and more particularly the HGM (Multi-Scale HydroGeoMechanics) team, has been involved for many years in laboratory experiments aimed at characterizing the mechanical behavior of Callovo-Oxfordian argillite and the impact of temperature, within the framework of collaborations with ANDRA and within the framework of the European EURAD project. The proposed thesis is a continuation of these previous works. She is motivated by the need to perform a large amount of innovative laboratory experiments.

### Objectives of the thesis

The objective will be to carry out thermo-hydro-mechanical tests on the Callovo-Oxfordian argillites in order to characterize the impact of temperature on hydromechanical behaviour. The tests will be carried out in triaxial compression cells equipped with heating systems in order to test the material up to temperatures of 100°C. The thermo-hydro-mechanical experiments will be carried out under triaxial loading conditions representative of in situ storage conditions. Thus, different stress paths (uniaxial and triaxial compression, lateral extension) and different hydrous conditions (saturation condition, drained, non-drained) will be considered. The anisotropy of the material (transverse isotropy) will be taken into account in this study. The deformation, damage and rupture of the rock will be analysed using measurements of deformations and propagation velocities of ultrasonic waves.

Ultimately, the short-term mechanical properties (criteria of rupture, elastic coefficients) of the Callovo-Oxfordian argillite will be characterized. Knowledge of the mechanical behavior under these very complex experimental conditions is essential to assess the feasibility and long-term safety of this type of underground repository.

## Scientific skills required

Solid basis in continuum mechanics, rock mechanics, transfers in porous media, rock physics. Knowledge of geomaterials will be appreciated. The taste and interest for laboratory experiments are essential. Motivation and initiative, ability to work in a team.

## Contract details

Duration: 3 years (October 1<sup>st</sup>, 2023 to September 31<sup>th</sup>, 2026)

Gross salary (ANDRA thesis): around 2200 € per month

Subject to acceptance of the application by ANDRA (audition of the candidate scheduled for the first half of May 2023).

## Application file

Application deadline: **March 20<sup>th</sup>, 2023**

Documents to provide:

- Cover letter
- Curriculum vitae
- Copies of certificates of each university degree and Master's 1 and 2 scores
- Recommendation letter

Eligibility:

- All European citizens can apply
- Non-European candidates who already have student status in France can also apply
- Candidates must hold a Master's degree or equivalent
- Candidates whose first language is not French must have written and oral English skills

## Supervision and contact

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