

Centre de Géosciences – PhD position announcement

Experimental investigation of the coupled THMC response of the caprock to CO₂ injection in a pilot test site

1. Context

Geo-energies, such as geothermal energy, CO₂ storage and underground energy storage, have a great potential to contribute to meet the Paris Agreement targets on climate change. Yet, their deployment has been hindered by a lack of a full understanding of the processes that are induced in the subsurface by large-scale fluid injection/extraction. The various processes involved (e.g., fluid flow, geomechanical, geochemical and thermal effects) imply complex interactions that cannot be predicted without considering the dominant coupled processes, which is rarely done. As a result, some early geo-energy projects have occasionally developed unpredicted consequences, such as felt and damaging induced earthquakes, gas leakage and aquifer contamination, dampening public perception on geo-energies. SMILE (MultidiSciplinary and MultIscale approach for coupLed processes induced by geo-Energies) is a EU Marie Marie Skłodowska-Curie Doctoral Network whose main target is to overcome these challenges in developing geo-energy solutions by training a new generation of young researchers that will become experts in understanding and predicting coupled processes. Thus, they will be capable of proposing innovative solutions for the successful deployment of subsurface low-carbon energy sources while protecting groundwater and related ecosystems. To achieve this ambitious goal, the early-stage researchers will be exposed to an interdisciplinary training on experimental, mathematical and numerical modeling of coupled processes, upscaling techniques and ground deformation monitoring using field data from highly instrumented pilot tests and industrial sites. While hosted at one institution (in this case, Mines Paris/Armines), the students will make secondments in other institutions of the consortium.

2. Research project outline

Objectives: Monitoring, analysing, and interpreting of interaction between injected CO₂ and potential caprocks, especially changes in temperature, pressure, and deformation based on experimental data. Together with partners in the planned secondments (see below), analysing potential correlation between hydrological, thermal, geomechanical, geochemical, including quantitative and qualitative uncertainty analysis. Evaluation of monitoring strategies and development of workflows including natural and anthropogenic signal analysis for scenarios of long-term experiments in underground rock laboratories.

Planned secondments: BGR, Germany (geochemical analysis and modeling of ongoing experiments at Mont Terri URL); CSIC, Spain (data analysis of ongoing fluid injection experiments).

3. Keywords

THMC coupling; CO₂ injection; field testing; modeling; uncertainty analysis; geochemical reactions

4. Prerequisite skills and knowledge

Continuum solid mechanics

Modeling experience

Hydrogeology

Fluent in English and ideally French (oral, spoken, written)

Eager to work in a multidisciplinary environment

5. Applications should be sent to laura.blanco_martin@minesparis.psl.eu as soon as possible and include:

- a. CV
- b. Motivation letter
- c. MSc and BSc transcripts
- d. Proof of English proficiency
- e. Names and contact information of three references

The successful candidate is expected to join our team in October 2023. Please note the EU mobility rule: “At the time of selection by the host organization, researchers must not have resided or carried out their main activity in the country of their host organization for more than 12 months in the 3 years immediately prior to their recruitment”