PHD OFFER

Theme of the thesis: Fluid-rock interaction in the context of underground hydrogen storage

Institutions: GÉOSCIENCES ; CEEP and The Transition Institute 1.5
Location: Campus Mines Paris – PSL, Fontainebleau, FRANCE (Location)

1. PhD subject outline

Given its promising prospects from an energy, a political, and an environmental point of view, hydrogen is currently considered as one of the most interesting energy vectors to ensure a successful ecological transition. This success must be accompanied by massive storage techniques making it possible to regulate the gaps between supply and demand. The two most suitable storage methods are salt caverns and natural porous media in the form of depleted hydrocarbon deposits or aquifers. In these two storage layouts, mass exchanges take place between the stored hydrogen and the surrounding environment.

The proposed PhD subject concerns the study of mass exchanges that occur in salt caverns and natural porous media between a mixture of hydrogen-based gases and the surrounding environment. This includes the thermodynamic behavior of the gas mixture, its interaction with the present aqueous solution, and its permeation into the rock of repository.

This research is based on the modeling of rock-fluid and fluid-fluid interaction phenomena as well as the experimental resources of the joint laboratory of the two research centers:

- the Centre de Géosciences (GÉOSCIENCES Mines Paris – PSL) (Link) and ;
- the Centre Énergie Environnement Procédés (CEEP Mines Paris – PSL) (Link).

2. THE TRANSITION INSTITUTE 1.5 – TTI.5

This thesis is funded by **The Transition Institute 1.5,** the first transdisciplinary institute of Mines Paris – PSL (Link). **TTI.5's scientific program** (Link) focuses on the conditions necessary for the emergence of a transition to a low-carbon world, considering technical, social, economic, political, and geopolitical issues. The goal is to define the mechanisms and strategies to be adopted to initiate and guarantee this transition.

The Institute's scientific program is divided into four areas, and **this PhD position falls under Axis 1: Design of the Transition** (Link) : clarifying the mechanisms required to ensure the desired decarbonization. **You can find the details here:** Link.

3. PROFILE OF THE CANDIDATE

This PhD work will include a considerable part of experimental work on laboratory setups dedicated to studying gas dissolution in aqueous solution and gas permeation in rock. In a next step, the experimental data will be used to validate numerical models based on the Finite Element Method (FEM). The candidate needs to show a reasonable understanding of thermodynamics and of fluid flow in porous media. Candidate profiles with some proficiency in laboratory testing and numerical modeling will be privileged.

4. ABOUT THE SCHOOL AND THE RESEARCH CENTERS

The School **Mines Paris – PSL** is a prestigious French university (Link) that is part of the **University PSL** "Paris Science Letter" (Link). The PhD thesis is a joint work that will be conducted between the Center of Geosciences and the Center Energy Environment and Processes located at **the city of Fontainebleau** (70km south of Paris). There are available student residencies, and the city is well prepared for student life with the INSEAD close by (Link).

The proposed PhD subject is the continuity of previous research, where the problems of gas dissolution in the brine and its permeation in the rock salt are of the main activities of the two centers. The selected PhD candidate will have the chance to work with experienced staff.

5. APPLICATION PROCEDURE

The application must include IN A SINGLE PDF:

- a detailed CV ;
- a cover letter ;
- MSC and BSC transcripts and the contact information of three references.

You must send your application both of the following e-mail addresses (with the e-mail object: **Fluid-rock Interaction PhD Position** + Your first name and last name):

- **Ahmed ROUABHI**, HDR Teacher-researcher at GÉOSCIENCES Mines Paris - PSL: ahmed.rouabhi@minesparis.psl.eu
- **Paolo STRINGARI**, Director of the Process Thermodynamics Laboratory, CEEP Mines Paris - PSL: paolo.stringari@minesparis.psl.eu

If you have any questions about The Transition Institute 1.5, feel free to contact by email: tti.5@minesparis.psl.eu (with the e-mail object: **Fluid-rock Interaction PhD Position** + Your first name and last name).

- Application deadline: June 30, 2024
- Starting date: October 1st, 2024

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