Ecole Doctorale - 104

Sciences de la Matière, du Rayonnement et de l'Environnement

EDSMRE

ESTABLISHMENT : Lille University

Laboratory(ies) of affiliation : LGCgE

Scientific field, Speciality: the speciality of the thesis must be one of those of the thesis (co)-director

- ☐ **DS2 Dense media, materials and components**
- ☐ **DS2 | Diluted media and fundamental optics**
- ☐ **DS3 | Earth and Universe Sciences**
- ☑ **DS3 | Earth, fluid envelopes**
- ☐ **DS4 | Theoretical, Physical and Analytical Chemistry**
- ☐ **DS4 | Organic, Inorganic and Industrial Chemistry**
- ☐ **DS4 | Materials chemistry**
- ☐ **DS5 | Molecular and Cellular Aspects of Biology**
- ☐ **DS8 | Energy, heat, combustion**
- ☐ **DS8 | Mechanics of solids, materials, structures and surfaces**
- ☐ **DS10 | Food Biotechnology, Food Science, Physiology**
- ☐ **DS10 | Biology of the environment, organisms, populations, ecology**

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Co-director: *(Name, First name, position, e-mail)*

Co-supervisor (non HDR): *(Name, First name, position, e-mail) OUNAIES Sana, sana.ounaies@univ-lille.fr*

Affiliate programme(s): *ex. labex, ERC, Horizon Europe, etc*

Planned (co)-funding *(mention: in progress/obtained)* **: ADEME PhD Programm (in progress)**

Université de Lille

Laboratoire de Génie Civil et géo-Environnement

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Title of the thesis: Evolution of hydrogeochemical conditions in aquifers in a thermal energy storage context: experimental and numerical approach

THESIS SUBJECT (ABOUT 1/2 PAGE)

As part of the energy transition, a diversification of energy resources needs to be encouraged, in particular through the development of low-carbon energies. The development of renewable energies, which is necessary for this transition, requires temporary storage solutions. One of the solutions being considered is Aquifer Thermal Energy Storage (ATES), which enables heat to be stored using the thermal inertia of the subsoil. During storage, cold water is drawn from cold wells, heated by heat network production systems, then injected into hot wells, and vice versa for discharge.

Since these injections of water are not in equilibrium with those present in the aquifer, this can lead to thermal and physico-chemical changes in the surrounding rock. The aim of this thesis will be to monitor these changes by combining an experimental approach, using laboratory reproductions of injection conditions and changes in the water, with numerical modelling to predict medium- and long-term changes in the water table.

In addition, in the context of climate change, the question of the sustainability of this storage method in the light of changes in the volume of groundwater will also be studied. Numerical models will be used to see how changes in environmental conditions may or may not affect groundwater recharge and physico-chemical conditions.

This subject is aimed at anyone with a Master's degree, or equivalent, in hydrogeology/hydrochemistry or environmental geosciences and a good knowledge of numerical modelling software in hydrogeology as well as a taste for experimentation.

Keywords: *Hydrogeology, hydrochemistry, ATES, modelling, heat transfer.*

Expected date of recruitment :10/01/2024

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Additional remarks/comments:

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