

PhD position 2023-2026

Push-It Project

Deadline:05/31/2023

#heatstorage, #microbiology, #geochemistry, #biodiversity, #reservoirs,
#experimentations #Horizon Europe

Title « Evolution of the geochemistry and the microbial diversity during an aquifer thermal energy storage process »

Scientific Structures (BRGM and GFZ)

BRGM, the French geological survey, is France's leading public institution for Earth Science applications for the management of surface and sub-surface resources with a view to sustainable development. Under partnerships with numerous public and private stakeholders, BRGM focuses on scientific research, expertise and innovation. Its activity meets 4 objectives: understanding geological phenomena and related risks, developing new techniques and methodologies, producing and distributing data for surface, subsurface and resource management, providing the tools required to manage the surface, subsurface and resources, prevent risks and pollution, and manage policies in response to climate change. BRGM's action is in line with 6 major scientific and societal challenges: geology and knowledge of the subsurface, groundwater management, risks and spatial planning, mineral resources and the circular economy, subsurface potential for the energy transition, digital data, services and infrastructure.

The Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences, the GFZ is Germany's national research center for the solid Earth Sciences. Our mission is to deepen the knowledge of the dynamics of the solid Earth, and to develop solutions for grand challenges facing society. These challenges include anticipating the hazards arising from the Earth's dynamic systems and mitigating the associated risks to society; securing our habitat under the pressure of global change; and supplying energy and mineral resources for a rapidly growing population in a sustainable manner and without harming the environment.

These challenges are inextricably linked with the dynamics of planet Earth, not just the solid Earth and the surface on which we live, but also the hydrosphere, atmosphere, and biosphere, and the chemical, physical, and biological processes that connect them. Hence, we view our planet as a system with interacting components. We investigate the structure and history of the Earth, its properties, and the dynamics of its interior and surface, and

we use our fundamental understanding to develop solutions needed to maintain planet Earth as a safe and supportive habitat.

IPGP: The PhD student will be attached to IPGP (Institut Physique du Globe de Paris) doctoral school at Université de Paris.

The Horizon Europe Push-it Project

The EU aims to have a net-zero greenhouse gas (GHG) economy by 2050. At present, heating and cooling represent around 50% of the final energy use in Europe and are mainly supplied by fossil fuel derived energy. Because sustainable heat is mainly available in summer and demand is in winter, large scale seasonal heat storage is a key strategy to decarbonize heating in order to achieve EU ambitions. The French Geological Survey (BRGM) and the German Research Center for Geosciences (GFZ) are part of a large European project called PUSH-IT (2023-2026) lead by TU Delft that will showcase and develop full-scale application of heat storage (up to 90°C) in geothermal reservoirs. Six different sites in Europe using three different technologies will be studied: Aquifer, Borehole and Mine Thermal Energy Storage (ATES, BTES, MTES).

The main objective of PUSH-IT is to showcase the full-scale applications of heat storage (up-to 90°C) of 3 different technologies in geothermal reservoirs at 6 different sites with various societal, heat network and geologic conditions relevant across Europe. PUSH-IT will implement, develop and test the ability of mine, borehole and aquifer thermal energy storage technologies (MTES, BTES and ATES) to store and recover heat. This will expand options for using sustainable heat sources and reduce fossil fuel demand. The advancement of these heat storage technologies will be pursued through a socio-technical strategy to ensure tandem objectives of optimal system performance and engagement practices aimed at achieving societal integration. At the end of PUSH-IT, 3 different concepts will be proven in operational demonstration projects. Future projects will benefit from key advances that PUSH-IT will make.

PhD subject and objectives within Push-it project

The PhD student will be involved in "Water quality issues" tasks within the project, more specifically on Water quality and environmental impact control. The candidate will on all possible consequences of microbiological and geochemical evolutions due to heat storage in geothermal reservoirs and upper aquifer (notably corrosion and scaling in the well, cement degradation, possible clogging in the near-well, changes of injectivity/productivity/flows in the reservoir). The PhD student will work on all possible consequences of geochemical and microbiological phenomena due to heat storage in geothermal reservoirs and on perturbation of other water resources not directly targeted

for heat storage. The PhD student will focus on issues that have a strong impact for the demonstration projects (either for performance or for environmental purposes) and on issues specific to heat storage in geothermal reservoirs.

The PhD work will focus on the two ATES pilots, at Berlin and Delft. Inter-seasonal heat storage in aquifer is a promising solution to manage temperature inside building. Storage and recovery of thermal energy is achieved by extraction and injection of groundwater from aquifers using groundwater wells. Groundwater are extracted in summer, used for cooling by transferring heat from the building to the groundwater by means of a heat exchanger. Then, the heated groundwater is injected back into the aquifer, which creates a storage of heated groundwater. The flow direction is reversed in winter, such that the heated groundwater is extracted and can be used for heating. Thus, the ATES system uses the subsurface as a temporal storage to buffer seasonal variations in heating and cooling demand.

The objectives for the PhD candidate will be to:

- Characterize the microbial diversity and geochemistry (of the natural environment) for each site before and “after” UTES process.
- Identifying the effect of thermal variations induced by UTES process on the microbial communities and the impact on their activities (= functions), in particular linked with possible modifications of the geochemistry, bio-dissolution and bio-precipitation of minerals.

The candidate will focus on reservoirs and shallow aquifers also. The work plan will be divided in 3 steps:

- Definition of a natural microbiological baseline to identify the main microorganisms in underground systems and characterize natural variation through time and space. This part will consist in performing water sampling at several time and space to analyse microbial diversity.
- Study effect of temperature variations and cycling. Dedicated high-pressure set up will be design for sampling and studying the microorganism evolution in the [BioREP](#) platform
- Monitoring of shallow waters compositions (geochemical and microbial)
- Identification of the microbial functions.

Therefore, several fieldtrips are planned in order to sample sites and go back to the laboratory for percolation or batch experimentations.

Scientific program:

The PhD student will start by doing a first phase of field data acquisition in order to establish a biogeochemical baseline (mapping) for each site. He will have experimentation development to perform in HP (High Pressure) experimental devices developed specifically for this project. Part of the experimental part will be in dynamic reactors and part of it in static reactors, where rocks will be inoculated. The program will include a characterization of the temporal biogeochemical evolution of the systems.

Profile and competences

Candidate background: we are looking for an excellent candidate with the following qualifications, knowledge and skills:

- A master in geochemistry or microbiology, biotechnology.
- A team player who thrives working with people in different organizations with different skillsets.
- A curiosity inspired and creative researcher, who is able to plan, execute, deliver and communicate research.
- Excellent written and oral communication skills in English.

Contract schedule

36 months from September 2023-2026, mostly located in BRGM laboratory (Orleans, France) and partly in GFZ laboratories (Postdam, Germany).

1 month per year on the field in Postdam (Germany) and in Delft (Holland) and participation to Push-it project workshops and international conferences.

Contacts

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