PhD position in Computational Geosciences:

Development of Physics Informed Neural Network (PINNs) methods for quantitative characterisation and prediction of deep hot fluid circulations (Geothermal)

HOST INSTITUTION: BRGM, ORLÉANS, FRANCE

DOCTORAL SCHOOL: ED MIMME, POITIERS, FRANCE

ACADEMIC LAB: LMA (UMR7348), POITIERS, FRANCE

PHD SUPERVISION TEAM - ROMAIN CHASSAGNE (BRGM ORLÉANS, FRANCE), JULIEN DAMBRINE (UNIVERSITY OF POITIERS, LMA - UMR7348, FRANCE), HUGO BREUILLARD (BRGM ORLÉANS, FRANCE).

Start date: September 2026

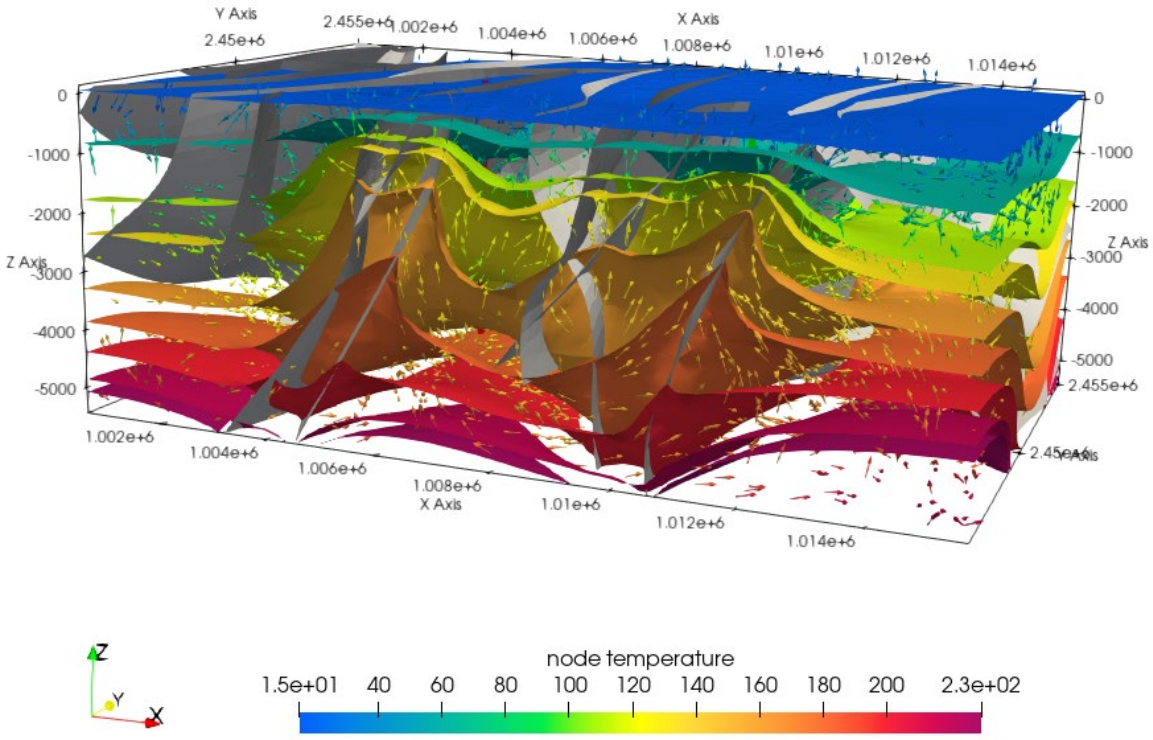
Job Description:

Understanding subsurface fluid flow is crucial for optimizing geothermal systems and mitigating risks such as induced seismicity. Current models remain limited by the scarcity, heterogeneity, and noise of available data, as well as by incomplete knowledge of the subsurface. Physics-Informed Neural Networks (PINNs) offer a solution by integrating physical laws, in the form of systems of partial differential equations (PDEs) with complex data. However, their effectiveness is still hindered by uncertainties related to both data and models. Strengthening their robustness requires explicitly incorporating these uncertainties through “soft constraints,” in order to produce more reliable and relevant simulations.

This PhD project is part of task 2.2 “Development of Artificial Intelligence methods for quantitative characterisation and forecasting of deep fluid circulation” (task leader: R. Chassagne) within the “PEPR sous-sol bien commun PC9", and will therefore use data from the Rhine Graben.

The main objective of this thesis is to contribute to the development of a comprehensive and robust model (data assimilation) of the Rhine Graben. The approach will be a hybrid data assimilation, physical model coupled with a neural network (PINNs). The use of soft-constrained PINNs represents a major advance: it allows the importance of physical constraints to be modulated according to the quality of the data and knowledge, thus offering greater tolerance to uncertainties and gaps. To relax these constraints and make PINNs more robust, several approaches can be

considered depending on the context, each offering different ways to handle uncertainties in physical modelling: Weighted PINNs adjust the importance of physical constraints within the loss function based on their reliability. Bayesian PINNs treat network weights or physical parameters as random variables, enabling uncertainty-aware predictions with confidence intervals. Stochastic PINNs introduce random terms into physical equations, making them suitable for heterogeneous media. Ensemble PINNs combine multiple independently trained models to estimate prediction variability. Domain-decomposition PINNs split the domain into regions with differing uncertainty levels to refine constraints locally. Selected approaches will be tested within a dedicated data-assimilation framework. Their performance will depend on the quantity and quality of available data. The aim is a rigorous quantification of uncertainties in the final predictions. Ultimately, the study seeks to determine how PINNs can be optimally integrated into a geothermal data-assimilation workflow.



The candidate we are looking for has:

- A good MSc degree or equivalent in applied mathematics or physics, or related area.

- Strong numerate and programming skills

- Understanding of fluids flow in porous media and the associated mathematical models

- Good communication and writing skills in English and the ability to collaborate are important

It is a plus if you have:

- Experience in neural networks

- Experience in fluid flow modelling in porous media

- Knowledge in geothermal systems

Please include in your application:

- A short (half a page) motivation letter covering your research interest and relevant experience.

- Your CV including a list of publications if applicable and contact details for two references unless reference letters are attached.

- Copies of academic qualifications.

Additional Information

The funding is for three years, based in Orleans, France.

Send your application to , *r.chassagne@brgm.fr*, h.breuillard@brgm.fr, julien.dambrine@math.univ-poitiers.fr

Deadline for applications: **2 of May 2026**

An online interview will be organised if your profile is selected from the first screening.