Upscaling the impact of heterogeneity on subsurface heat transport processes: towards the catchment/regional scale modelling

Offer description

We are pleased to announce a 2-years postdoc position at University of Rennes, France on the modelling of heat transport processes in the subsurface. This position is offered in the frame of the recently funded ERC starting grant "CONCRETER" (Groundwater flow CONtrols on CRitical ZonE).

The characterization and predictive modeling of heat transfer processes in geological fractured media is of central interest for hydrogeological studies as well as for numerous industrial applications (radioactive waste disposal, geothermal systems). Traditionally, the integration of hydrothermal processes in (hydro)geological models follows approaches that do not take into account the complex nature of the circulation of fluids in the system (fracture network, fault zones). Only recently, through field experiments and theoretical investigations at the single fracture scale, we have provided evidence that flow channeling has a crucial impact on heat transport [Klepikova et al., 2016, https://doi.org/10.1002/2016WR018789; Klepikova et al., 2021, https://doi.org/10.1016/j.advwatres.2021.104042]. The next challenge is to reveal mechanisms of the coupling between the fracture and network-scale flow and heat transport complexities. This project aims at developing a new generation of heat transport model to explore large-scale thermal behavior in a fractured geological formation. This new model will be based on the DFN.lab software platform that is developed in Rennes and uses the discrete fracture network (DFN) approach. The latter, contrary to widely used continuum modelling approaches, explicitly represents fractures as discrete features that form a network [e.g., Long et al., 1982, https://doi.org/10.1029/WR018i003p00645; Maillot et al., 2016, https://doi.org/10.1002/2016WR018973; Davy et al., 2018, https://onepetro.org/ARMADFNE/proceedings-abstract/DFNE18/1-DFNE18/D013S000R001/122702]. Through direct numerical simulations in synthetic configurations, a direct link between flow and heat transport behavior and the geometric and hydrological characteristics of the structure supporting the flow will be revealed. Based on these results, we will define simplified effective models at large scales in order to develop computationally efficient models enabling joint consideration of relevant heat transfer processes.

Requirements

Research Field - Geosciences or Physics or Environmental science

Education Level – PhD or equivalent

Skills/Qualifications

- Experience with computer programming /scripting (Python, Matlab, R)

- Sound and quantitative understanding of geological fluid flow

- Applicants must be proficient in both written and oral English

- Experience in fluid flow modelling in porous media is an advantage

- Experience with either reservoir modelling or hydrodynamic modelling is an advantage.

- Applicants must be able to work independently and in a structured manner and demonstrate good collaborative skills.

Scientific environment

The Rennes hydrogeology group is composed of 15 permanent staff and is internationally recognized as one of the leading group in this field.

The postdoc will be supervised by Maria Klepikova and Philippe Davy. The PhD student will also benefit from collaborations with the Fractory - a joint laboratory established in between the CNRS, the Univ. of Rennes and the company ITASCA Consultants SAS in the field of the modeling of environmental systems, fractorylab.org.

Please include in your application:

- a brief account of the applicant's research interests and motivation for applying for the position;
- the names and contact information for two referees;
- a CV;
- a list of any works of a scientific nature (publication list).

The application and appendices with translations into English or French must be sent to maria.klepikova@univ-rennes1.fr.