Job Position ref. SIT/RNOS

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Postdoctoral position (Geophysics/Geomechanics) :

Understanding and modelling of THMC processes in deep geothermal systems

Supervision : Z. OURAGA (R&D engineer, Ineris), M. SOULEY (R&D engineer, Ineris)

Keywords : Geothermal, induced seismicity, Fault and fractures reactivation, THMC coupling, numerical modelling, laboratory and in-situ experiments.

The postdoctoral position is offered in the Natural Hazards, Underground structures and storages unit within the Site and Territory Division at Ineris. The unit activity covers all aspects of risks prevention related to the exploitation and post-exploitation of ground and underground including underground excavations, abandoned mines, salt caverns, deep boreholes, gas underground storage, geothermal systems and rock slopes. The core expertise of the unit is numerical modelling of thermo-hydro-mechanical and chemical (THMC) coupled processes in geomechanics. In order to better understand the causal mechanisms of induced seismicity in deep geothermal systems, the unit aims to develop new approaches for numerical modelling of fracture initiation, propagation and slip (seismic or aseismic) as a result of fluid injection and/or withdrawal.

In the framework of this research, we will focus on Enhanced Geothermal Systems (EGS), which consist in the production of hot water (generally between 120 and 200 °C) from deep naturally fractured reservoirs located between 2 and 5 km. To increase the permeability in the vicinity of the borehole and to connect the natural fractures, techniques known as rock stimulation are used. These techniques involve the injection of fluid (often cold) at high pressure, causing mechanical, thermal and chemical effects. This stimulation process as well as the production and reinjection of the geothermal fluid in the exploitation phase lead to changes in the fields of temperature, pore pressure and in-situ stresses which can result in fracture initiation and propagation and the reactivation of discontinuities such as joints or faults. These processes are followed by dynamic readjustments, which may emit seismic waves. Such induced seismicity is inherent to the development and exploitation of deep geothermal reservoirs. However, when it is felt at the surface (magnitude ≥ 2), it becomes a major concern to the public and the local authorities and can harm the development of this activity.

The complexity of the fracture behaviors and their interactions, the lack of physical fundamentals, coupling between thermo-hydro-chemical-mechanical (THMC) and potentially biological (THMC-B) processes, make it extremely difficult to predict and control the seismicity induced by geothermal exploitation. Specific numerical approaches and powerful calculation resources are also required to consider the 3D geometric complexity and heterogeneity of geothermal reservoirs.

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Your Responsibilities

The post-doc will consist in reviewing bibliography on the phenomenology and underlying mechanisms of induced seismicity in geothermal systems as well as on the modelling approaches and numerical tools developed to reproduce the dynamic relaxation of fault and fractures in geothermal reservoirs. This bibliographical study will include:

- identifying THMC processes leading to fault activation and seismicity induced by fluid injection in deep geothermal reservoirs (e.g. from the feedback of EGS systems that have generated induced seismicity);
- reviewing experimental laboratory and in situ tests carried out to help understanding the fluid-rock interactions in geothermal reservoirs;
- reviewing the numerical 2D/3D THMC approaches and tools developed for modelling the stimulation and exploitation of deep geothermal reservoirs;
- writing a report or article.

Profile

- PhD in Geomechanics with a strong focus on Geophysics
- Ability to work both independently and in a team environment
- Appetence for reading scientific articles
- Synthetic thinking, good writing skills in English and/or French.

Location : Ineris, Rue Jacques Taffanel, 60550 Verneuil-en-Halatte, France

Duration : 6 months

How to apply

The application should be submitted in French or in English. It must include a resume (including a list of publications and the names and positions of your former research advisers) and a cover letter. Mail to: Zady.Ouraga@ineris.fr