

Post-doctoral position: Desiccation and instability of clays under thermal stimulation

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Key words: clay mechanics, instability, bifurcation theory, strain localization, multi-physical couplings

Laboratoire Navier at Ecole des Ponts ParisTech is seeking a post-doctoral fellow to work on bifurcation analysis of the instabilities of clay-rich soils submitted to thermal stimulations with applications to nuclear wastes disposal, geothermal energy and unconventional oil and gas recovery.

Clays are nanostructured microporous materials that contain adsorbed water. Clay hydration and dehydration is well known to induce important deformations of the material that may end up to instabilities such as desiccation cracking of soils in dry conditions. Cracking of clay-rich rocks can be detrimental (building foundation, nuclear waste or CO₂ storage, well stability) or beneficial (enhanced fluid transfers for geothermal energy and hydrocarbon recovery). External heat stimulations (nuclear wastes, industrial processes) modify the hydration state of clays and can induce instabilities either by over-pressurization of the water on short time scales or by desiccation on longer time scales. The objective of the proposed postdoc is the study of these instabilities.

This postdoc offer is a one-year position corresponding to the second part of the TEAM2ClayDesicc project, funded by the French National Research Agency (ANR). The first part of the project was dedicated to the physical origin and modeling of the complex thermo-mechanics of clays. In this first part we developed a new model of the mechanical behavior of clays that captures the complex interplay between consolidation history, hydration and temperature. The proposed postdoc will built on this new theory and perform bifurcation analysis to analyze the onset of instability for various situations of interest (tunnel excavation, nuclear wastes, oil/gas well). Post-bifurcation numerical analysis is considered in a second step. Special attention will be paid to the consequence of the unusual thermo-hydro-mechanical couplings in clays, compared with non-swelling rocks. Apart from performing the instability analysis at the reservoir scale, this postdoc will strongly connect to the physics behind the clay behavior.

This position will be hosted in Navier Laboratory, at the Ecole Nationale des Ponts et Chaussées in Champs-sur-Marne (east of Paris). The position can start anytime during fall 2017. Applicants should hold a PhD degree in (geo)-mechanics, applied mathematics or related areas with a competitive track record. Candidates must be skilled in mechanics or applied mathematics and have previous experience in numerical scientific computing. Knowledge of bifurcation theory and thermodynamics are a plus. Applicants must be capable to communicate in good English, including the oral and written presentation of research papers. Interested applicants should contact L. Brochard (laurent.brochard@enpc.fr) or I. Stefanou (ioannis.stefanou@enpc.fr).