



Post-doctoral position: granular modeling of clays

Supervisors: L. Brochard; M. Vandamme, J.-N. Roux

Key words: clay mechanics, granular and colloidal modeling, hydration, consolidation, damage

Laboratoire Navier at Ecole des Ponts ParisTech is seeking a post-doctoral fellow to work on the granular modeling of clays.

Clay-rich rocks are considered as sealing medium for various geomechanical applications (e.g., CO₂ storage, nuclear wastes disposal). Damage due to thermo-hydro-mechanical couplings are detrimental to such applications in which long term sealing is needed. Much effort has been dedicated to the development of numerical FEM models, but state of the art models still lack insight into the elementary mechanisms of damage (e.g., arbitrary descriptions of micro-cracking). The elementary physics of clay mechanics is indeed complicated. Clays are nanostructured microporous materials made of mineral layers on which water adsorbs. At the mesoscale clay exhibit complex arrangements of clay layers. While the mechanical behavior at the scale of the clay layer is reasonably well understood, upscaling it to the engineering scale is a challenging task because of these complex mesostructures. Conventional homogenization techniques are limited to simplistic hypothesis about the microstructure (e.g. Eshelby inclusion). As an alternative, this project aims at developing a discrete element approach describing clay mineral as particles interacting through an implicit water medium. This modeling will be validated against classical soil mechanics tests (e.g., consolidation, swelling). The modeling will enable to investigate some microscopic mechanisms behind clay mechanics such as the microstructure evolution, the role of water hydration, and that of layer flexibility. A main goal is to investigate mechanical failure in order to improve current macroscopic descriptions of clay damage used in FEM codes.

This postdoc offer is a one-year position. It is part of a broader project 'VARAPE', funded by the CNRS NEEDS-MIPOR initiative, which focuses on local variability in the mechanical properties of the elementary constituents of clays with ultimate objective to improve state of the art numerical FEM models. The proposed postdoc will contribute to this project by providing novel insight into clay damage. An ultimate goal is to propose a physically based description of damage in place of the current description considered in state of the art FEM models. Special attention will be paid to relate insight from the granular modeling to the engineering application.

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, physics of granular materials or related areas with a competitive track record. Candidates must have a strong motivation for numerical scientific computing. Experience of granular simulations and clay mechanics 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).