

Postdoctoral Openings in Geomechanics

Topic: Chemo-mechanics of damaged rocks undergoing carbon mineralization

The injection of carbon dioxide (CO₂) into rock formations may result into mineralization reactions which produce carbonate minerals. This project aims to study and improve technologies aimed at permanently storing CO₂ in geologic formations by engineering subsurface carbon mineralization practices. Specifically, our team aims to study from a mechanical viewpoint the interactions between fluid transport, mineralization reactions, and rock deformation at length scales ranging from individual pores to entire rock formations. The goal of these activities is to formulate predictive theories explaining the interaction between these processes, use computational models to guide the design of novel carbon storage technologies, and optimize the implementation of storage operations to maximize their long-term efficacy. One Ph.D. position and one postdoctoral position are about to be opened in the Geomechanics Group at Northwestern University, both aimed at creating a diversified team exploring this intriguing topic. Both positions will focus on the multi-scale behavior of micro-cracked rocks subjected to mineralization reactions, with emphasis on the constitutive modeling of rock inelastic deformation and damage during mineralization and on the numerical modeling of localized failure and fracture during reactive transport.

Position Descriptions

The selected candidates will work under the supervision of Prof. Giuseppe Buscarnera. Both the Ph.D. student and the postdoctoral scholar will be part of a highly multi-disciplinary team, covering expertise in geomechanics, geochemistry, subsurface hydrology, and remote sensing and including partners from numerous institutions at national and international level. In terms of constitutive modeling, the project activities will focus on the use of poromechanics, elastoplasticity, damage mechanics, and rock multi-physics, as well as on the implementation of constitutive equations into numerical modeling platforms. In terms of numerical modeling, the project activities will involve the use and development of computational models for coupled multi-physical systems, with emphasis on the interaction among mechanical, hydraulic, chemical and thermal processes. Competitive salary, exposure to a dynamic, collaborative, and multi-disciplinary international environment and opportunities for professional development will be essential elements of the two positions. While the two positions are considered independent, opportunities for collaboration exist and will be encouraged.

Selection Criteria

- An M.S. or B.S. in Civil Engineering, Mechanical Engineering, or related fields (for applicants to the Ph.D. position).
- A Ph.D. in Engineering, Geomechanics, Mechanics or related fields (for applicants to the Postdoctoral position).
- Expertise and/or interest in constitutive modeling and micromechanics.
- Expertise and/or interest in numerical methods for multi-physical problems.
- Excellent preparation and/or interest in computer coding.
- Ability to work independently.
- Excellent communication skills.

How to Submit Your Application

Applicants interested in the Ph.D. position can find more information about how to apply to the Ph.D. program at Northwestern University at the following website <https://www.mccormick.northwestern.edu/civil-environmental/academics/graduate/>. They are also encouraged to contact Prof. Giuseppe Buscarnera (g-buscarnera(at)northwestern.edu) for enquiries about the selection process and its timeline. Applicants interested in the Postdoctoral position can forward a single PDF consisting of a 1-page cover letter, a curriculum vitae, contacts of two references and two representative publications to Prof. Buscarnera. For additional information you can contact the above email address or visit the website <http://www.civil.northwestern.edu/people/buscarnera/>.

Selection Process

The review of candidates for the Ph.D. position will follow the timeline of the general admission to the Ph.D. program, thus starting on December 15th, 2022. Admission decisions will be finalized no later than April 15th, 2023. The review of candidates for the Postdoctoral position will instead begin on January 1st, 2023. In this case, applications will be accepted until the position is filled.