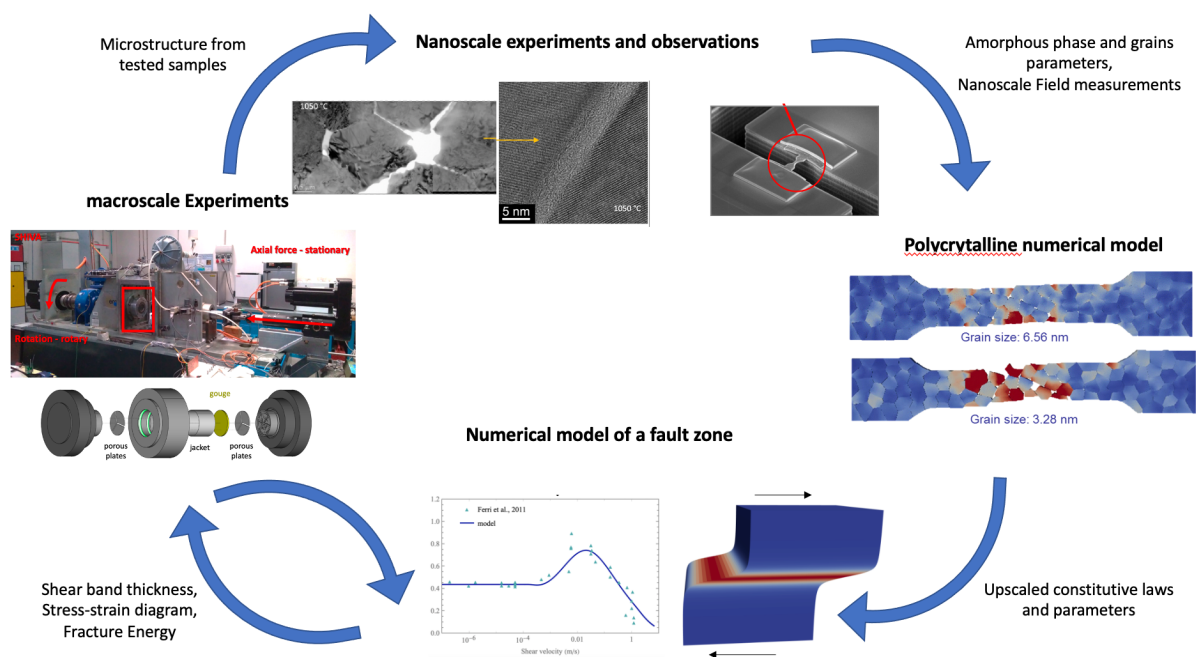


## 3 PhD positions opening – Nanomechanics for Geodynamics and Geoengineering

We are hiring 3 motivated PhD students in the IMMC institute at UCLouvain, Belgium, to participate in a multi-disciplinary project NanoGG focusing on rocks mechanical behavior to better constrain faults' behavior, earthquake propagation and plate tectonics. One of the biggest challenges faced by the industry for underground energy extraction technologies like deep geothermal or underground Hydrogen or CO<sub>2</sub> storage is the triggering of induced earthquakes. This project aims at better understanding the physics behind these events and more generally the deformation processes in rocks at depth by investigating their behavior from the nanoscale to the macroscale combining original numerical and experimental developments. The PhD projects will be co-supervised by an interdisciplinary team composed of Hosni Idrissi, Laurent Delannay and Hadrien Rattetz.



### Abstract of the project

Based on unprecedented experiments and on the development of advanced numerical models, we expect to demonstrate the relevance of stress-induced amorphization in the mechanics of silicates, aiming to contribute to the understanding of earthquakes and tectonic motion. The project will address fundamental issues in geoscience like the ductile-fragile transition of rocks or the deformation at high strain rates within faults. The fundamental aspects behind these phenomena need to be solved in order to overcome technological challenges e.g. in the

implementation of (deep) underground CO<sub>2</sub> and H storage or geothermal production of electrical power. The originality of the project comes from the combination of different disciplines: geomechanics, nanoscale characterization and testing, and micron-scale polycrystalline modeling and experimental testing.

### **Descriptions of the positions**

- **PhD1** will study the behavior of faults from a geomechanical perspective and the mechanisms behind the propagation of earthquakes. The goal will be to conduct high velocity shear experiments using a rotary shear apparatus (in collaboration with Giulio Di Toro at the university of Padova), and model them considering multi-physical couplings. This project will be mainly supervised by H. Ratticez ([Hadrien.ratticez@uclouvain.be](mailto:Hadrien.ratticez@uclouvain.be)) and will imply collaboration with H. Idrissi for the electron microscopy characterization of the microstructures, and it will also involve collaboration with L. Delannay for the elaboration of a multiscale model.
- **PhD2** will study the mechanical properties and the fundamental plasticity and failure mechanisms of rocks at small scales. This project will be supervised mostly by H. Idrissi ([hosni.idrissi@uclouvain.be](mailto:hosni.idrissi@uclouvain.be)) and will focus on micro- and nano-mechanical tests and their observation using electron microscopy. They will imply collaboration with H. Ratticez for the analysis of macroscopic slip bands in samples pre-deformed in rotary shear tests, and with L. Delannay for the local stress analysis in push-to-pull experiments and post-mortem TEM analysis of micropillars after compression in a nano-indenter.
- **PhD3** will focus on the micromechanics of polycrystals from a modelling and experimental perspectives. The goal will be to conduct micropillars experiments on rocks at different temperatures, and model them considering crystal plasticity. He/she will be under the supervision of L. Delannay ([laurent.delannay@uclouvain.be](mailto:laurent.delannay@uclouvain.be)) and will collaborate with H. Idrissi in order to investigate the deformation mechanisms in the tested microstructures and with H. Ratticez to model the heterogeneous microstructures produced in rotary shear experiments and develop a multiscale model.

### **Contact and application**

Interested candidates should send an application (including a CV, a cover letter describing interests and qualifications related to the topic(s) and two reference Professors, all compiled in a single PDF file) to the main supervisor associated to the position described above.

The successful applicants are due to start between September 1<sup>st</sup>, 2023 and January 1<sup>st</sup>, 2024.