2-year PostDoc position: Modelling mechanical and chemical erosion in porous media

Laboratory: Earth Sciences Institute of Orleans, University of Orléans/CNRS/BRGM.

Advisor: Cyprien Soulaine (cyprien.soulaine@cnrs.fr), Guillaume Richard

We are looking for a talented postdoctoral fellow to model mechanical and chemical erosion in porous media. The position is part of the French National Agency for Research (ANR)-founded project **PhysErosion**.

PhysErosion background:

Chemical erosion constitutes often the first step, during a process called the weathering, which weakens the rock and allows then the mechanical erosion. For example, a water flow attacks in a first step a solid substrate by a chemical reaction, dissolution or corrosion, which weakens the mechanical strength of the material and enables the hydrodynamic transport of detached solid fragments. Erosion causes thus the weathering of building materials subjected to environmental conditions like rainfalls. The most striking impact of erosion processes is the formation and the evolution of landscapes at various space and time scales (see Fig. 1). Erosion by water is the prime process at work in this field: rivers carve the Earth's surface. Rainfall on continents turns into runoff, which is collected by rivers, which merge into each other to form drainage networks. These networks are shaped by the water they carry, which moves the sediments they are made of. Even in its simplest form, the morphogenesis of streams and rivers is made nonlinear by the coupling between the flow and the solid boundary that contains it.

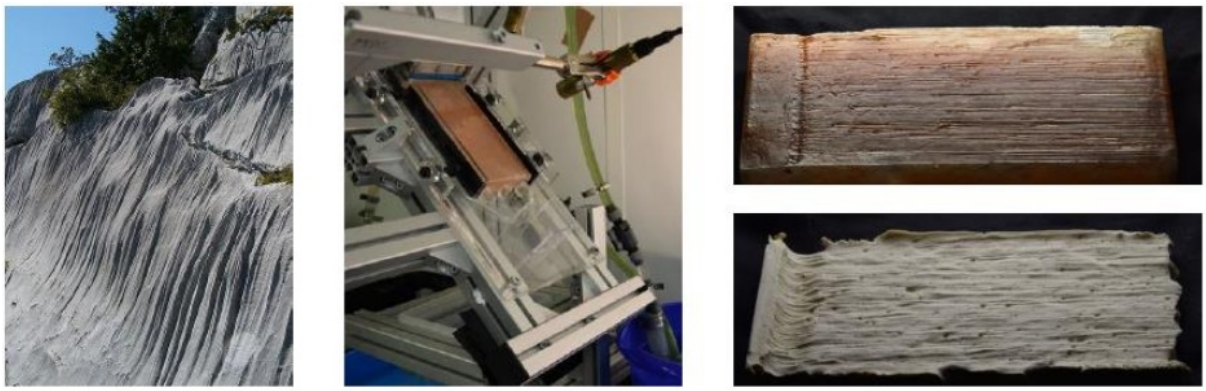

Figure 1: Reproduction in the laboratory of the longitudinal pattern created by thin runoff flows on a soluble inclined

The objective of this postdoctoral position is to model and decipher the complex feedback between hydrodynamics and mechanical-chemical erosion. The candidate will develop an efficient and robust simulator for predicting erosion – both mechanical and chemical – processes at different scales of interest over a wide range of flow, chemistry, and material conditions. The developments will rely on

porousMedia4Foam, our in-house OpenFOAM-based package coupled with PHREEQC for geochemistry. This package is based on the concept of micro-continuum models, i.e. a unique mathematical formulation that can solve flow and transport problems in porous media at different scales of interest (e.g. pore-scale, continuum-scale, and hybrid-scale). It is particularly well-suited to model moving solid-free / porous interfaces when mechanical and chemical erosion occurs. A step-wise strategy will be adopted that focuses first on the modelling of chemical and mechanical erosion mechanisms in porous media fully saturated in water and then on chemical erosion in unsaturated systems, i.e. when gas and air fill the pores and a multiphase description is needed.

About the candidate and the position:

We are looking for a motivated postdoctoral fellow with a strong background in fluid dynamics and computational sciences. Expected skills include fluid dynamics, flow and transport in porous media, reactive transport, mathematical upscaling, and computational fluid dynamics (CFD). The candidate is familiar with programming languages including C++ and is motivated by code developments. Preliminary knowledge of OpenFOAM is a plus but not a prerequisite.

The candidate will

- Develop its own line of research,
- Perform a comprehensive literature review on erosion models for CFD,
- Extend the current capabilities of porousMedia4Foam to model mechanical and chemical erosion, and couple the hydrodynamics and transport models with geochemical packages,
- Run simulations in our high-performance computing resources, analyze, and compare the results with the experimental dataset of our partners,
- Participate to the weekly group meeting,
- Present the results in national, international conferences and in high-ranked journal.

The position is part of the PhysErosion project funded by the French National Agency for Research (ANR). PhysErosion is a consortium of 4 academic partners including: Laboratoire Matière et Systèmes Complexes (MSC, Université Paris Cité), Institut de Physique du Globe de Paris (IPGP, Université Paris Cité), Institut Lumière Matière (ILM, Université Claude Bernard Lyon) and Institut des Sciences de la Terre d'Orléans. Regular meeting with the project partners are expected.

About us

The position is located at the Earth Sciences Institute of Orléans (ISTO) in France. ISTO is a joint research laboratory between CNRS, the University of Orléans, and BRGM located on the Geosciences campus of Orléans close to Paris, France. The Porous Media Research Group develops cutting-edge research and worldwide recognized expertise on multi-scale modelling and microfluidic experiments of multiphase flow and reactive transport in geological formations. Our objective is to decipher the mechanisms involved in the remediation of contaminated groundwater, in the underground storage, and in new energy vectors based on the use of the subsurface.

In addition to the project partners, the candidate will join a network of leading-edge national research institutions including CNRS, BRGM, Sorbonne University, Geosciences Rennes, and Université de Pau et des Pays de l'Adour, and international collaborations including Heriot-Watt University, Julich Forschungszentrum, Ghent University, TU Delft, Lawrence Berkeley National Lab, Princeton University, and Stanford University.

About the position

Duration: 24 months (12 months renewable).

Net salary: CNRS salaries.

Starting date: between June 2023 and February 2024

Deadline for application: until the position is filled

How to apply?

Send a CV, research statement, cover and recommandation letters to

https://emploi.cnrs.fr/Offres/CDD/UMR7327-MARROU0-032/Default.aspx?lang=EN