



PhD position: “Physicochemical fingerprints and quantification of microbially-mediated mineral weathering” (M/F)

Location: ISTerre, Grenoble, France

PhD advisors: Damien Daval (ISTerre, Grenoble) and Karim Benzerara (IMPMC, Paris)

Contract duration: 36 months

Expected starting date: 1 September 2024

Gross salary: 2135 €, according to the CNRS salary scale

Funding: ERC Mobidic

Description

The Institute of Earth Sciences (ISTerre, UMR 5275) is looking for a creative, qualified and motivated individual to lead an interdisciplinary thesis project at the interface of Earth sciences, microbiology and materials sciences.

Quantifying the contribution of microbes to rock dissolution rates is one of the main challenges to improving numerical models of rock alteration, a process that contributes to the geochemical cycles of most chemical elements, and partly controls atmospheric CO₂ uptake and Earth's climate over geologic timescales. Defining the signatures left by microorganisms at the surface of altered minerals resulting from bioalteration appears as a prerequisite to shedding new lights on this contribution, as well as for defining biogenicity criteria that are requested for the search of life in the geological record on Earth and on other planets. To reach this goal, we recently developed an approach that makes it possible to analyze and quantify microbe-mineral interactions from the nm- to the cm-scale, including that of the microbial cell.

The objective of the thesis project is to develop and apply new experimental and analytical approaches to characterize the development of physicochemical fingerprints related to microbial weathering of minerals, combined with the quantification of associated elemental fluxes. Experiments will be conducted either under sterile conditions, or using microbial consortia, or model microbial strains, and the reactivity and the physicochemical properties of altered mineral surfaces will be characterized through a combination of spectroscopy and microscopy techniques. This PhD work will provide an experimental basis for the development of numerical models aimed at simulating mineral (bio)alteration processes, and ultimately unraveling the contribution of microorganisms to weathering fluxes of primary minerals on Earth.

Working context

The work will be conducted in the framework of the ERC project Mobidic (2021-2026; see <https://cordis.europa.eu/project/id/101001275>).

The thesis will be jointly supervised by Damien Daval (ISTerre, Grenoble) and Karim Benzerara (Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie (IMPMC), Paris) and developed in collaboration with Philippe Ackerer (Institut Terre et Environnement de Strasbourg). The thesis work will be carried out mainly within the Geochemistry team of

ISTerre in Grenoble, with regular stays envisaged in Paris (several weeks / year), financially supported by the project.

ISTerre is a Unité Mixte de Recherche de l'Université Grenoble Alpes, CNRS, USMB, IRD and Université Gustave Eiffel, located 1381 rue de la Piscine 38400 Saint-Martin d'Hères and on the scientific campus of Bourget du Lac.

It is part of the Observatoire des Sciences de l'Univers de Grenoble (OSUG) and of Pôle de recherche PAGE of the University of Grenoble Alpes (UGA). It has a staff of about 300 people and an average annual budget of €7 million.

It is organized around 9 research teams and services, the scientific objective being the physical and chemical study of the planet Earth, particularly by focusing on the couplings between observations of natural objects, experimentation and modeling of the associated complex processes. ISTerre also provides solid Earth observation missions, hosts and maintains national parks of geophysical instruments, and a data center.

The selected student will enjoy a large degree of academic freedom, will lead experimental developments, and will have access to a wide range of state-of-the-art microbiological and physicochemical characterization instruments and analytical techniques, including vertical scanning interferometry, atomic force microscopy, scanning and transmission electron microscopy, X-ray spectroscopy (absorption, transmission, scattering, reflectivity), confocal microscopy and the use of innovative experimental devices dedicated to fluid-microbe-mineral interactions (reaction cell dedicated to in situ interferometry imaging).

Several regular stays at IMPMC, Paris, will be financially supported by the project.

Additional information

Candidates must have a master degree and/or an engineering degree with knowledge in mineralogy, chemical kinetics and thermodynamics and/or microbiology. Complementary skills in statistical processing and/or numerical modeling would be a plus. Practical experience with some of the analytical (ICP-AES, SEM, VSI, confocal microscopy) and/or experimental (conducting fluid-mineral interaction experiments, microbial culture) techniques used will be a particularly valuable asset. Good oral and written communication skills in English are also required.

Applications should include a CV and a cover letter, as well as the contact information of at least two referees in the academic field. They should be posted by responding to the relevant vacancy on <https://emploi.cnrs.fr/Offres.aspx>.

Applications will be considered until the position is filled. The desired start date for the thesis is the beginning of September 2024.