ARIES funded PhD project

Bio-protection: long-term modification of rock weathering by microorganisms?

Supervisor(s): Dr Anirban Basu (RHUL), Dr Javier Cuadros (Natural History Museum), Dr Anne Jungblut (Natural History Museum)

Project description

One of the most important questions related to the critical zone research and long-term climate stability is how biology influences weathering. This PhD project investigates a crucial question of Earth's biogeochemistry: do microorganisms accelerate rock weathering or slow it down under environmentally relevant conditions? Because microorganisms have been extracting nutrients and energy from rocks for ~3.7 billion years there is a mutual life-lithosphere modification, which is not yet well-explored. Very slow weathering observed at the field scale contradicts the idea of microbially enhanced rapid weathering from experimental studies. Therefore, it is important to test the hypothesis that microbial biofilms around minerals inhibit weathering by regulating the transport and loss of weathering products. Knowing the metabolic diversity of microbial communities, grain-scale interactions between microbial communities and minerals, and the weathering intensity is important to link the roles of biological agents to erosion and climatic change.

Research methodology

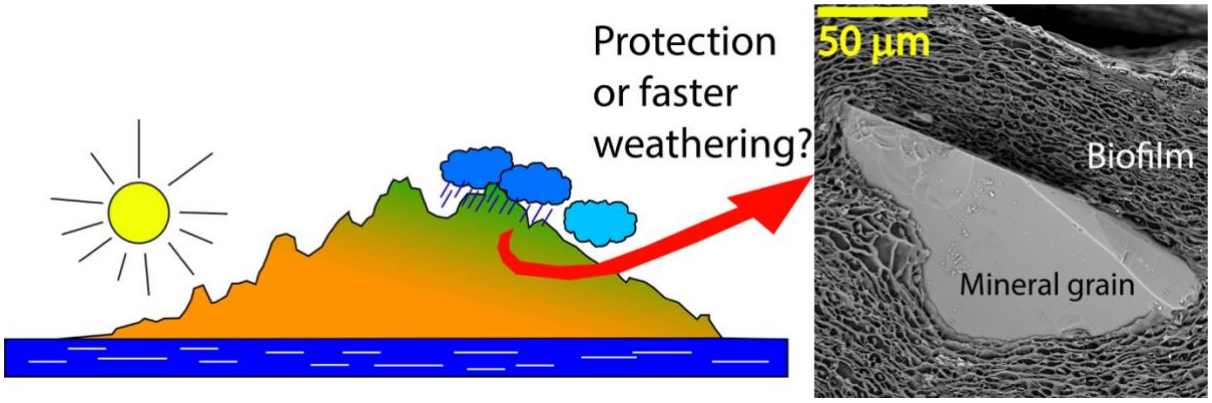
Gran Canaria (Canary Islands) is a natural laboratory providing two essential constraints for the project - 1) volcanic rocks of homogeneous composition and the same age, and 2) large differences of rainfall inducing large differences of microbial development in soils. This PhD project will apply cutting-edge chemical, mineralogical, isotopic and microbiology techniques and bioinformatics to determine the relationship between soil weathering rates, atmospheric precipitation and microbial communities and assess how microorganisms modify weathering intensities. U series isotopic disequilibrium ($^{234}U/^{238}U$) in porewater/stream water and soils will be used to independently constrain the weathering intensity.

Training

The student will obtain training in field work and sample collection in Gran Canaria. They will receive training in X-ray diffraction, wet chemical analysis methods, molecular, microbiology techniques and bioinformatics (environmental DNA, high throughput sequencing, microbial community structure analysis, metagenomics and phylogenetic interference) at NHM. They will also receive training in clean lab techniques and isotopic measurements using multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS) at RHUL. They will gain highly interdisciplinary quantitative geochemical skills integrating mineralogical, microbial, chemical and isotopic data.

Person specification

A good background in Earth Sciences, preferably with some knowledge of chemistry and biology.



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Application

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Closing date for applications to Royal Holloway Direct*:*7th January 2020

This project has been shortlisted for funding by the ARIES NERC Doctoral Training Partnership. Shortlisted applicants will be invited to interview in late February 2020.

Successful candidates who meet UKRI's eligibility criteria will be awarded a NERC studentship (in 2018/19 the stipend was £14,777). In most cases, UK and EU nationals who have been resident in the UK for 3 years are eligible for a full award.

For non-UK EU-resident applicants NERC funding can be used to cover fees, RTSG and training costs, but not any part of the stipend. Individual institutes may, however, elect to provide a stipend from their own resources.