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Bio-mediated silica weathering and coupled CO_2 sequestration – Master projects (2-3 persons)

Background and aim of the project

Current climate policies, even if strictly followed by all partners will not reduce atmosphere CO_2 sufficiently, resulting in net warming higher than the 2°C warming limit of the Paris Agreement. Fast progress in the development of negative emission technologies (NETs) is needed, to decarbonise the atmosphere. No NETs, however, are close to achieving a substantial contribution to the climate crisis in a sustainable, energy-efficient, and cost-effective manner. An NET which shows promise, however, is the biologically enhanced weathering of silica minerals as a sink for CO_2. A recently funded project (BAM!), seeks to investigate broad scale bio-mediated enhanced silicate weathering, through the development of a large scale, multi-variable bio-reactor. The project focuses on unparalleled reactor experiments, to maximize biotic weathering stimulation at low resource inputs, and the implementation of an automated, rapid-learning process that allows the rapid improvement and adoption of critical weathering rate breakthroughs. However, the development of a high efficiency bioreactor, requires a detailed investigation of the mechanisms and processes on a microbe scale, which presently is not prioritised within BAM!. In this proposed project, we build on the established infrastructure to investigate the details and mechanisms of bio-mediated silicate weathering, on a microbial scale, investigating threshold concentrations of nutrients and metals for microbial growth and symbiosis, gas exchange rates, gene expressions for biomineralization, and the competitive capacity of individual microorganisms in a diverse microbial community. *Understanding the mechanisms, growth conditions and microbial strains involved in biomineralization of certain minerals, such as apatite and metal carbonates, will further our ability to develop efficient biomineralisation based NETs. The goal of the project, is to utilize the available large-scale infrastructure to target and precisely investigate biomineralising microbial communities, to fully understand and outline the boundaries of complex microbial (both bacteria and fungi) community structures and their capacity to sequester CO_2.*

Aim of the project

The aim of the project is to determine the biochemical/microbial conditions and prerequisites that control microbial biomineralization. What is the effect of C source and C:N ratio on microbial growth rates? Can fungi and microorganisms weather/colonise minerals/rocks (basalt, basanite, dunite and steel slag)? Does the C source affect colonisation and the weathering rate? Is the best C source mineral dependant? What are the effects of combining different fungi and/or microbes

Methods

Microbial growth experiments, Optical microscopy, fluorescence microscopy, Environmental Scanning Electron Microscopy (ESEM), GC, HPLC.

The requirements

We would like to offer 2-3 students the opportunity to be a part of an interesting, novel and international project on carbon sequestration. The project was recently funded by EU and will give the student good opportunities for a future career as a researcher either at a university or in the private sector.
The optimal student has knowledge on biological systems and nutrient cycling in the environment, bioweathering and some knowledge of carbon compounds and their importance for microbial growth. A background in biology/microbiology is preferred.

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