Project Title: **The evolution of metabolisms that shape life on Earth**

**Lead Institution/Department:** University of Bristol, School of Geographical Sciences  
**Primary Supervisor:** Patricia Sanchez-Baracaldo  
**Co-Supervisor:** Casey Bryce, School of Earth Sciences  
**Co-Supervisor:** Lewis Alcott, School of Earth Sciences

**Summary:** A fully funded PhD studentship including UK fees, annual stipend, and a research budget, is available at the University of Bristol to study the evolution of microbial iron oxidation. Study will begin in September 2024 and is funded for four years. The deadline for applications is 9th January 2024. Please contact Patricia Sanchez-Baracaldo for informal enquiries.

(Left) Iron oxidation in a mountain spring (Middle) Cultivation of iron oxidizing bacteria in the lab (Right) Microbes encrusted in iron minerals (source J. Byrne)

**Project background**

Iron is one of the most abundant elements on Earth. It is an essential element for most existing life forms and serves as a crucial cofactor in various redox-active proteins involved in vital biochemical pathways. Additionally, iron serves as an energy source for certain microorganisms. Today, microbial transformations of iron play a crucial role in the biogeochemistry of soils, sediments, lakes and oceans; control the mobility of pollutants and contaminants; and even influence greenhouse gas emissions. They also played a significant role in the evolution of life on Earth. In the primordial ocean, ferrous iron (Fe(II)) was abundant until the oxygenation of the atmosphere occurred, leading to its oxidation and subsequent precipitation, creating a period of massive iron ore deposition that we benefit from today. Iron-cycling microorganisms shaped the early oceans and were likely responsible for forming vast deposits of iron minerals that tell us about the early Earth environment. As a result, iron availability likely exerted selective pressure on the evolution of life.

**Project aims and methods**

Using large genomic data sets, this project aims to study how and when fundamental metabolisms evolve, specifically the oxidation of iron. We will use a combination of cutting-edge phylogenetic and culturing methods to address the following questions: 1) how and when did different pathways of iron oxidation evolve? 2) what are the evolutionary patterns (both vertical and horizontal) across these bacterial groups? 3) How did the evolution of microbial iron oxidations impact Earth’s early oceans.
Candidate Requirements

This project would provide an excellent opportunity for students interested in evolutionary biology, phylogenetics, Astrobiology, Geobiology and the origin of life. The ideal candidate will have a strong background (preferably MSc-level) in a related discipline e.g., Microbiology, Molecular Biology, Bioinformatics, Physical Geography or Environmental Science as well as a strong interest in Environmental Microbiology and Phylogenetics. Computer programming skills in a relevant language, e.g. C/C++, Python, R or Matlab would be an advantage. Experience with wet chemical laboratory methods, microbial cultivation or molecular ecology would be highly beneficial. Good written and oral communication skills are required, as is the ability to work independently and in a team. For International students, English Language IELTS scores of at least 6.5 (no less than 6.0 in any element). We welcome and encourage student applications from under-represented groups. We value a diverse research environment.

Training

This project will provide training in cutting-edge laboratory and computational methods required for microbial cultivation, genomics and phylogenetics analysis. The student will be trained in computer programming (e.g. Shall Scripting, R Scripting, or Python), bioinformatics and phylogenetics. All the skills they will learn are highly transferrable and will be useful to them irrespective of what career path they will choose within the realm of evolutionary biology and microbial genomics more broadly (e.g. bioinformatics and genomics). The student will be encouraged to participate in personal development courses to develop both technical and personal skills essential for a successful scientific career. Opportunities to present at conferences will be actively supported.

Background Reading


Dreher et al. (2021) Microbial processes during deposition and diagenesis of Banded Iron Formations. PalZ.

Useful Links

- https://www.bristol.ac.uk/geography/courses/postgraduate/
- https://www.bristol.ac.uk/study/postgraduate/research/geographical-sciences-physicalgeography/  
- https://sanchezbaracaldo.wordpress.com/

How to Apply: The deadline for this position is 9th January 2024. The studentship will begin in September 2024. Please apply to the “PhD in Geographical Sciences (Physical Geography)” at https://www.bristol.ac.uk/study/postgraduate/apply/