PROJECT TITLE: Frozen-in: characterising the micro-environment of ice inhabiting microbes

DTP Research Theme(s): Living World, Changing Planet

Lead Institution: University of Bristol

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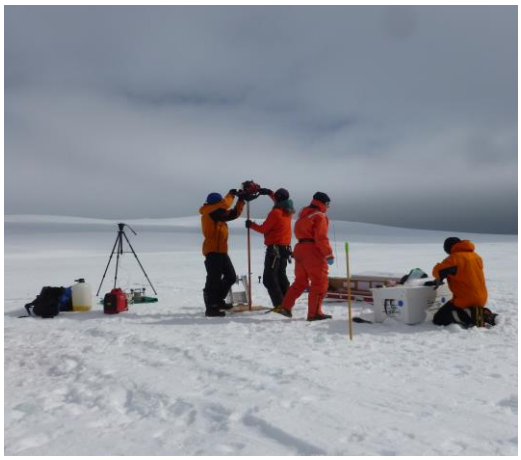
Project keywords: cryosphere, glaciers, microbes, ice cores, biogeochemistry

Morterartsch glacier, Switzerland (summer 2020), where ablating ice harbours ancient microbial communities previously frozen into the ice matrix and contemporaneous blooms of microbial communities within the weathered ice surface.



Drilling shallow ice cores on Bouvet Island, South Atlantic. Ice cores from the sub-Antarctic islands and Antarctica will be used in this project.

Project Background

Permanently cold ecosystems make up more than 70% of the Earth's biosphere, though paradoxically, the microorganisms that thrive in these extreme habitats are the most poorly understood. Whilst we are beginning to gain an understanding of the diversity and functioning of key microbial groups that dominate across the cryosphere, several key questions remain unanswered. For example, what is the micro-environment experienced at the scale of an individual cell that lives within a complex snow or ice matrix? How has this shaped their physiological capabilities and survival strategies? And how does this vary between different cryospheric habitats (snow to firn to glacier ice), throughout freeze-thaw cycles, or with long-term burial within glaciers? Answers to these questions are important not just for learning about the ecophysiology of extremophile microbial communities, but also to provide critical contextual knowledge on the interactions between microbial communities and key physical (snow/ice formation, melt and fine-scale structure) and chemical (carbon and nutrient cycles) processes within the cryosphere.

Project Aims and Methods:
This overarching aim of this studentship is to characterize the fine-scale spatial distribution and micro-environment of snow and ice inhabiting microbial communities, to enhance understanding of their true physiological capabilities, survival strategies, and interactions with key physical and biogeochemical processes. During Year 1, the student will characterise the fine-scale spatial distribution and micro-environment of microbes residing within supraglacial environments. In the event of ongoing pandemic restrictions, this can be achieved using existing samples (snow, weathered surface ice and shallow sub-surface ice cores). However, the project will be enhanced by in-situ observations and we will endeavour to provide opportunities to undertake fieldwork in the European Alps or Greenland. Sample processing will proceed in the University of Bristol's MicroLab and Biogeochemical facilities, and the British Antarctic Survey's class-100 clean room and cold room facilities, with training provided in all relevant methodologies (see 'Training' below). During Year 2, the student will conduct manipulative experiments to examine micro-environment development and microbial physiological responses during ice formation and freeze-thaw cycling, using the UoB's Low Temperature Experimental Facility (LOWTEX). Finally in Year 3, the student will extend the knowledge gained by characterising ancient microbial communities along Alpine, Arctic and Antarctic ice cores to uncover long-term responses to burial within glacier ice and potential viability with the onset of melt.

Candidate requirements: This project will suit a student with a first-class degree in physical geography, earth or biological sciences, with experience in one or more of the following: microbiology, biogeochemistry, glaciology, remote field work campaigns.

Collaborative partner: This highly interdisciplinary project unites the MicroLab research group of the Bristol Glaciology Centre, with the Ice Core Group of the British Antarctic Survey (BAS). The successful candidate will spend significant time at BAS and be integrated into the ice core team. Additional to the extensive infrastructure and scientific resources that BAS brings to this project, the successful candidate will benefit from full exposure to this world-leading research institution. Although Antarctic fieldwork cannot be guaranteed, and is not an essential component of this project, we will endeavour to provide fieldwork opportunities such as those available through the Collaborative Antarctic Science Scheme.

Training: The student will receive extensive training in remote field-work techniques, microbial imaging, enumeration and identification, snow/ice physics, biogeochemical analyses, ice-core and cold room practices. Candidates will emerge with a strong background in interdisciplinary sciences including advanced field and laboratory skills, and an extensive network spanning the cryospheric research community. A demonstrable track-record in highly marketable transferable skills, including numeracy, written and spoken presentation, and an ability to work effectively within a multidisciplinary team will also be developed. The student will have extensive opportunities for overseas travel for both networking (conferences) and fieldwork purposes.

Background reading and references
Useful links
School URL: http://www.bristol.ac.uk/geography/courses/postgraduate/
MicroLab URL: https://microlabbristol.org
Ice Core Group URL: https://www.bas.ac.uk/team/science-teams/ice-and-past-climate/

NERC GW4+ DTP Website:
For more information about the NERC GW4+ Doctoral Training Partnership please visit https://www.nercgw4plus.ac.uk.

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2020/doctoral/phd-great-western-four-dtp/
How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

The application deadline is Friday 8 January 2021 at 2359 GMT.
Interviews will take place during the period 8th to 19th February 2021.

General Enquiries:
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