PROJECT TITLE: Reconstructing past changes in wetland hydrology and carbon cycling

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bristol

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Project keywords: Climate Change; Palaeoclimate; Earth System; Methane; Wetlands

Project Background

Microbial processes in terrestrial settings are critical to governing greenhouse gas emissions. The modern carbon soil reservoir exceeds that of terrestrial vegetation and the atmosphere combined, and soil microorganisms annually cycle 1/3 of the carbon photosynthesised and account for the largest natural methane flux. In doing so, they govern the chemical and climatic state of our planet. And yet these processes remain poorly understood, mediated by a range of environmental factors. Insight can be derived from geological archives that document the responses of biogeochemical systems to past environmental perturbations. Our previous studies on peat and lignites provide tantalising insights into climate-driven disruption of the carbon cycle, but the underlying mechanisms remain unresolved. This project will address that by developing new approaches and records based on the isotopic composition of peat organic matter derived from plants and bacteria.

Project Aims and Methods:

Peat and lignite deposits have long been used to explore past changes in climate, especially changes in temperature and precipitation. What is much harder to ascertain are changes in biogeochemical processes. When it becomes warmer is organic matter (OM) preservation enhanced due to higher productivity or is that OM degraded due to enhanced microbial activity? If degraded, is that manifested as an increased flux of carbon dioxide? Or methane? Or neither because microorganisms also adapt to consume these greenhouse gases before they can escape from the wetland? We have obtained some insight by determining the carbon isotopic composition of individual compounds in the peat, some derived from plants and others derived from microorganisms, allowing us to probe the rebalancing of carbon flow during environmental disruption.
However, our current investigations are limited, having focused primarily on temperate rather than tropical wetlands. We have also been unable to resolve, until now, more nuanced changes in microbial ecology. In this project, we will explore and compare environmental and biogeochemical disruptions in Welsh, English, Panamanian and Colombian peatland (the specific sites and time intervals developed in collaboration with the PhD student and the supervisory team). We will then refine and apply recent analytical innovations – the determination of bacterial hydrogen isotopic compositions – to ascertain the relationships between past changes in peatland hydrology, bacterial metabolism and carbon cycling.

**Candidate requirements**
The Organic Geochemistry Unit has a long history of interdisciplinary research; as such, we host intellectually diverse applicants, welcoming your new perspectives into our lab and our obligation to train you in the methods you will use. Similarly, we welcome and encourage student applications from under-represented groups. We value a diverse research environment.

**Project partners**
This project builds on a long-standing Bristol-Exeter collaboration in which we have developed and applied new approaches to understanding peatland processes. We also have collaborations in Wales, Colombia and Panama, ensuring access to samples and sites.

**Training**
This project is a collaboration with a funded EU project, creating outstanding opportunities for field work and associated training. We recognise the constraints field work imposes on applicants from some backgrounds, however, and field work is not mandatory (with samples provided by partners). The PhD focuses on geochemical investigation of peat, including characterisation of organic matter, quantification of biomarkers and cutting-edge stable isotope methods. As the NERC Facility for organic isotope analyses, the OGU has a long track record of providing such training to diverse students from all backgrounds.

**Background reading and references**
Inglis, G.N. et al., 2019, $\delta^{13}$C values of bacterial hopanoids and leaf waxes as tracers for methanotrophy in peatlands. Geochimica Cosmochimica Acta 260, 244-256.

**Useful links**
http://www.bristol.ac.uk/earthsciences/courses/postgraduate/
http://www.bristol.ac.uk/chemistry/research/ogu/

**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/2022/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 Monday 10 January at 2359 GMT. Interviews will take place during the period 23 February – 9 March 2022.

**General Enquiries:**
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