PROJECT TITLE: The Reactivity of Peatland Carbon and Its Fate In a Changing Climate

University of Bristol Theme: Climate and Environment Research Challenge Area
Research Group(s): Organic Geochemistry Unit
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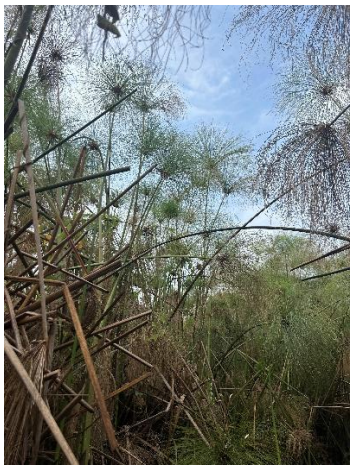
Project keywords: Organic geochemistry, analytical chemistry, microbiology, GC-MS, NMR
Funder: University of Bristol Scholarship



Papyrus peatland from 2024 Mpologoma, Uganda campaign.

Peat monolith ready to be brought home, analysed and used in incubations. Photos from Amy Oakeshott.

Project Background

Microbial processes in peatland are critical to governing greenhouse gas emissions. Despite being studied for decades, many of the processes that govern those emissions remain poorly understood: peatlands are more diverse and complex than previously assumed; their organic matter composition is similarly diverse, with implications for its reactivity and metabolic accessibility; and associated microorganisms continue to reveal new metabolic capacities. All of these factors combine to govern the ultimate fate of organic matter in a given peatland, with profound impacts on its capacity as a carbon sink and the fate of that sequestered organic matter in a changing climate. Through several large projects, we have established a network of partnerships and access to sites all over the world. Our initial work, some of the first on tropical peatland, has revealed a strong control of peatland vegetation on organic matter character and microbial populations. In this project, we will apply state of the art techniques to modern and ancient peatland to determine whether the carbon sequestered in ancient peatland is as non-reactive as it appears.

Project Aims and Methods

This project builds on existing ones, creating great scope for the student to co-develop a project with the supervisory team. We have collected cores from multiple global sites, with plans to collect more over the coming years; these will be used to explore past changes in climate and carbon accumulation. Therefore, the project will have at least two interrelated opportunities. The first is to link past changes in climate and vegetation to changes in microbial ecology through biomarker proxies. We will build on our findings that climate, vegetation and anthropogenic disturbance govern the composition of preserved organic matter through microbially mediated degradation by examining ancient ecological disturbances and transitions. We will explore that further through experiments on different types of ancient organic matter, exploring under what conditions they can be degraded into greenhouse gases. This will generate an improved understanding of Earth history, allowing new interpretations of climate archives, while also providing new insights into peat organic matter vulnerability to future climate change.

Candidate

The Organic Geochemistry Unit (OGU)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 minoritized and marginalised and value a diverse research environment.

Project partners

This project will be linked to a two large grants (focused on tropical and degraded peatlands, respectively) that will enable field work, interdisciplinary collaboration and global partnership opportunities. Among the partners are Universities in Colombia and Uganda as well Natural Resources Wales. The project also benefits from a long-standing partnership between the Bristol and Exeter supervisors.

Training

Through its connections to ongoing projects, there will be 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 organic geochemical and microbiological investigation of peat cores, with the opportunity to conduct experiments exploring organic matter reactivity under different conditions. The Earth Sciences Biogeochemistry and Geomicrobiology labs have fantastic facilities and opportunities for training in both culture-dependent and culture-independent microbiology and geochemistry, whilst the OGU has a long track record of providing training in organic geochemistry to diverse students from all backgrounds. Successful applicants will also be able to access the extensive transferable skill training associated with the NERC GW4+ Doctoral Training Partnership, as well as those of Bristol's Doctoral College.

Background reading and references

Huang, X. et al., 2018, Response of carbon cycle to drier conditions in the mid-Holocene in central China. Nature communications 9, 1369.

Pancost, R.D., 2024. Biomarker carbon and hydrogen isotopes reveal changing peatland vegetation, hydroclimate and biogeochemical tipping points. *Quaternary Science Reviews*, *339*, p.108828.

Useful links

http://www.bristol.ac.uk/earthsciences/courses/postgraduate/

Eligibility

UK and International students are eligible for a University of Bristol Scholarship. UoB Scholarships are fully funded for 4 years and cover university fees, living expenses at the UKRI standard rate, and an allowance of £2100 per year towards research expenses.