PROJECT TITLE: Co-evolution of high latitude CO$_2$, climate, and biodiversity over Earth history

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

Lead Institution: University of Bristol

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Project keywords: CO$_2$; climate change; biodiversity; Cretaceous/Paleogene (K/Pg)

Fieldwork in Antarctica (left) and Tibet (right) to collect high-latitude and high-altitude samples, respectively.

Project Background

Context: As CO$_2$ continues to rapidly rise today, we need to define its precise relationship with climate, as well as the consequences on biodiversity and ecosystem resilience. To address this, data from the geologic past has allowed us to start untangling complex Earth systems under different climates and has provided the building blocks for the general circulation models that predict our future climate scenarios.

Problem: However, we are missing crucial data across periods of transition (e.g., greenhouse to icehouse climate) or sudden events (e.g., across the mass extinction that killed the non-avian dinosaurs) that could provide insights on major ecosystem responses. In particular, the high latitudes and high altitudes – the most sensitive places on Earth and thus at the forefront of anthropogenic climate change today – remain the most difficult regions to constrain.

Project Aims and Methods

Aim: You will explore the relationships between in CO$_2$, climate, and biodiversity across different climate states, emphasizing high latitude sites. You are encouraged to shape your project based on your interests, with guidance from the supervisory team. Within this project, you may: 1) Develop CO$_2$ records using new advances in organic geochemistry, 2) Further resolve the relationship between CO$_2$ and temperature for general circulation models; and 3) Determine the impacts of thermal stress on biodiversity at high latitudes (e.g., linking changes in non-fossilizing plankton groups preserved in the organic geochemical record with biodiversity, body size, and bioturbation preserved in the fossil record).

Focus periods: You will look at both long-term trends and rapid climate events, in the context of our future climate scenarios. Long-term trends may explore the transition from the super-hothouse Cretaceous to the coolhouse Oligocene. Rapid climate events may include the Cretaceous/Paleogene mass extinction that killed off the non-avian dinosaurs and extreme global warming (aka “hyperthermal”) events common throughout the Paleogene, like the Palaeocene-Eocene Thermal Maximum.
**Methods and samples:** You will use organic geochemical proxies i.e., compounds made by living organisms that preserve in the geologic record (aka “molecular fossils”) and reflect the environment that they had once lived in. You will be embedded in the Organic Geochemistry Unit (OGU) in the Schools of Earth Sciences and Chemistry; the OGU is a diverse, interdisciplinary, and dynamic international research team with world-leading expertise and state-of-the-art laboratories and analytical instrumentation.

The sample set comprises rare marine sedimentary archives from high-latitude and high-altitude locations, filling a major gap in the data (especially CO₂) and thus enhancing our understanding of past climate sensitivity and impacts on biodiversity in these regions. Several datasets represent ‘dark data’: taking advantage of existing museum and research centre collections never previously used for organic geochemical analyses.

**Candidate requirements**
A background in Earth Sciences, Geography, Chemistry, or relevant research area, and a broad interest in paleoclimate. We welcome and encourage student applications from under-represented groups. We value a diverse research environment and aim to integrate intersectionality within our group.

**Project partners**
You will have the exciting opportunity to work with scientists and obtain samples from the British Antarctic Survey (BAS) and Natural History Museum (NHM), with expertise including palaeontology, palaeoecology, palaeobiology, and climate modelling. These co-supervisors and colleagues will provide expertise and complementary analyses; depending on your interests, you will have opportunities to gain skills and learn methodologies within these subdisciplines.

**Training**
You will receive training in a world-leading research group using exciting state-of-the-art analytical methods in organic geochemistry and isotope geochemistry and learn the broad context of climate change over Earth history. We encourage the candidate to participate in NERC GW4+ DTP training courses to develop both technical and personal skills, as well as University of Bristol training courses. Funding is provided to present your research at major international conferences around the globe and to conduct fieldwork.

**Background reading and references**

**Useful links**
- [http://www.bristol.ac.uk/earthsciences/courses/postgraduate/](http://www.bristol.ac.uk/earthsciences/courses/postgraduate/)
- [http://www.bristol.ac.uk/chemistry/research/ogu/](http://www.bristol.ac.uk/chemistry/research/ogu/)
- [Bristol NERC GW4+ DTP Prospectus:](https://www.bristol.ac.uk/study/postgraduate/research/great-western-four-doctoral-training-partnership-nerc/)

**How to apply to the University of Bristol:**
- [http://www.bristol.ac.uk/study/postgraduate/apply/](http://www.bristol.ac.uk/study/postgraduate/apply/)

Please note: If you wish to apply for more than one project, please contact the Bristol NERC GW4+ DTP Administrator to find out the process for doing this.

**The application deadline is Tuesday 9 January 2024 at 2359 GMT. Interviews will take place from 26 February to 8 March 2024.**

**For more information about the NERC GW4+ Doctoral Training Partnership please visit**
[https://www.nercgw4plus.ac.uk](https://www.nercgw4plus.ac.uk)

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