School of Earth Science, PhD Project

PROJECT TITLE: Earth's evolving oceans

University of Bristol Theme: Net Zero and Climate Change
Research Group(s): Marine and Terrestrial Environments
Lead Supervisor: Dr Lewis Alcott, University of Bristol, School of Earth Sciences
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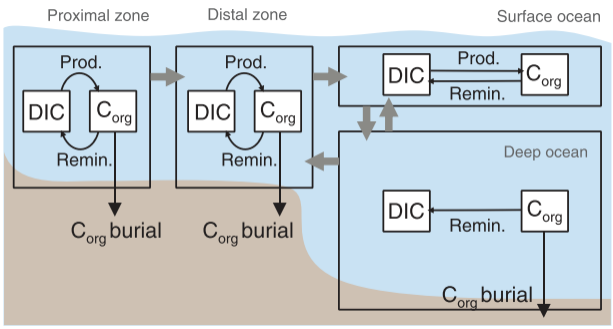
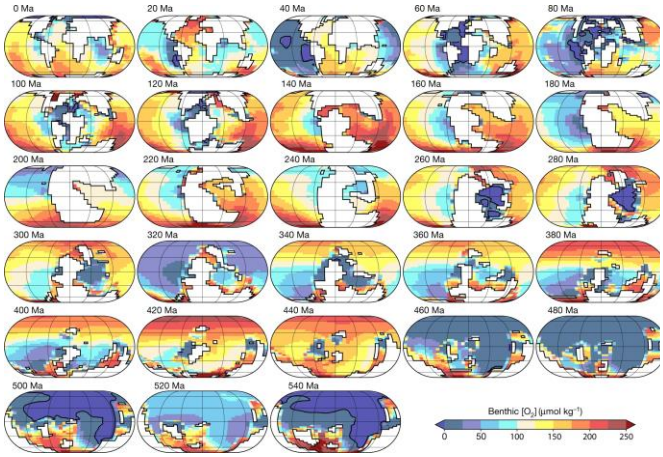
Funder: University of Bristol Scholarship



A schematic of the carbon cycle from a biogeochemical model where the ocean geometry does not change through time, but can be run continuously for billions of years. From Alcott et al. (2019)



Benthic oxygen concentrations from a model where the ocean geometry does change but the model can only run for snapshots of time. From Pohl et al. (2022)

Project Background
The chemical composition of Earth's ocean has varied dramatically throughout time, in the process impacting upon its capability to host complex life. To try and understand the mechanisms which have driven changes in ocean chemistry and its subsequent effect on marine life, researchers build numerical models of the Earth system, including in them processes such as plate tectonics, and continental weathering. However, while some numerical models (e.g. cGENIE, LOSCAR etc.) change their ocean geometry, they either have few configurations available and/or can only be run for snapshots of time, rather than being able to continuously model millions of years of Earth history. On the other side of the spectrum, those models capable of the continuous modelling of long timescales (e.g. SCION, COPSE etc.) do not include changes to ocean geometry, thus miss the ability to identify regions of the ocean susceptible to anoxia or rapid changes in temperature, which affect marine habitability.

Project Aims and Methods
The aim of this project is to develop a biogeochemical model of Earth's oceans as they have geometrically evolved through Earth history, capturing for example, the impact of sea level changes on ocean chemistry under different climate regimes.

Once developed, the researcher will have several possible future avenues of investigation, including: determining spatially, the worst places impacted during mass extinctions; and the most likely parts of the ocean likely to experience anoxia, to name just two options. Following this, the researcher will work to couple this new model to an existing one which contains continental weathering processes, to create an evolving land-ocean model capable of fully capturing Earth's evolution.
The numerical model will be built in a programming language such as MATLAB.
Candidate

Applicants should have a background in natural sciences, mathematics or computing to MSc/MSci level., and the candidate should have a strong interest in Earth history and geochemistry. Formal training in programming is not essential, but an enthusiasm for computing is necessary.

Project partners

The supervisory team will also include:
Dr Richard Stockey (University of Southampton), who will provide guidance to the researcher on the evolving geometry of Earth's ocean through time, which is key to the creation of the new model as described in the project aims.
Dr Alexander Krause (Cardiff University) who will provide guidance on the coupling of the new model to a different, already established biogeochemical model, which can spatially-resolve continental weathering.

Training

The researcher will be trained in the use of programming languages, such as MATLAB, and how to construct numerical models of the Earth system in these languages, by the research team and will be encouraged to attend other programming courses, run by e.g. Software Carpentry. The researcher will be expected to present their findings at conferences nationally and internationally, and will be supported in this by the research team and the University's internal training programmes.

Background reading and references

Alcott et al. (2019) Stepwise Earth oxygenation is an inherent property of global biogeochemical cycling, *Science*, **366**, 6471, 1333-1337
Pohl et al. (2022) Continental configuration controls ocean oxygenation during the Phanerozoic, *Nature*, **608**, 523–527
Zeebe (2012) LOSCAR: Long-term Ocean-atmosphere-Sediment CArbon cycle Reservoir Model v2.0.4, *Geoscientific Model Development*, **5**, 149–166
Mills et al. (2021) Spatial continuous integration of Phanerozoic global biogeochemistry and climate, *Gondwana Research*, **100**, 73-86

Useful links

https://www.bristol.ac.uk/earthsciences/postgraduate/
https://www.bristol.ac.uk/science-engineering/postgraduate-research/pgr-scholarships/
https://www.bristol.ac.uk/directory/visas/student-visa/apply/money

Eligibility

UK and International students are eligible for University of Bristol Postgraduate Research Scholarships. These are funded for 4 years and cover university fees, living expenses at the UKRI standard rate, and an allowance towards research expenses. Scholarships do not cover visa or NHS surcharge costs. See links above for details.

Application deadline: Monday 19th January, 2026 , 23.59 GMT
(Interviews are expected to take place in mid/late February)

Application

During application select "**University of Bristol Scholarship**" for funding source and "**Geology (PhD)**" for programme. If you are applying this specific project upload this PDF as the "research statement". All studentships must have a September 2026 start date.