Competition-funded NERC PhD project

ROYAL HOLLOWAY UNIVERSITY OF LONDON

An innovative isotopic approach to investigating the pre-Cambrian carbon cycle

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Background
The burial of organic matter in the ocean is a major component of the global carbon cycle, which impacts on global climate. The isotopic composition of the trace element cadmium may be capable of recording variations in marine organic matter burial in the past. However, it is unclear how accurately this new geochemical proxy may record carbon cycle variations in the pre-Cambrian world, when ocean chemistry was rather different to the present day. In this PhD project you will assess the ability of cadmium isotopes to trace organic carbon burial in the late Paleoproterozoic to early Neoproterozoic using a suite of samples ranging from 1.8–0.8 billion years old. You will use your observations to understand the operation of the cadmium cycle in the Proterozoic, and to test important hypotheses on the history and evolution of Earth's environmental and biotic systems.

Methodology
You will trace the ancient cadmium cycle using the isotopic composition of cadmium in marine sediments and minerals. Much of the sample material available for the project is already held by the supervisory team but there may be opportunities to participate in fieldwork to collect fresh samples. You will generate Cd isotope data using ultra-clean laboratory facilities and multi-collector mass spectrometry and complement these data with trace element and mineralogical data to interpret ancient depositional conditions, and hence, infer ancient ocean chemistry. The project has the potential for a significant modelling component, which would involve the use of Python and/or Matlab.

Training
You will receive training in sediment sampling, the preparation of isotopic samples in ultra-clean laboratory conditions, the measurement of isotope samples using Multi-Collector Inductively Coupled Mass Spectrometry (MC-ICP-MS), as well as data processing and modelling techniques. You will also benefit from the advanced research skills training courses offered by Royal Holloway. You will be embedded in the new Royal Holloway Centre of Climate, Ocean and Atmosphere with the chance to interact and learn from researchers studying in related fields.

Person specification
You should have a background in Earth Sciences, Geology, Physical Geography or Chemistry and be interested in isotope geochemistry and environmental change.

References
1) Bryan, A.L., Dickson, A.J., Dowdall, F., Homoky, W., Porcelli, D. and Henderson, G.M. (2021), Controls on the cadmium isotope composition of modern marine sediments. Earth and Planetary Science Letters 565, 116946.
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Mo-, U-, Cd- and Zn-isotope compositions of lower Jurassic organic-rich sediments. Geology 50, 598–602.
3) Poulton, S.W., Fralick, P.W. and Canfield, D.E. (2004), The transition to a sulfidic ocean ~1.84 billion years ago. Nature 431, 173¬–177.
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