PROJECT TITLE: **Seafloor nutrient factories: The use of silicon and germanium isotopes to investigate early marine sediment diagenesis**

DTP Research Theme: Changing Planet

Lead Institution: University of Bristol
Lead Supervisor: Katharine Hendry, University of Bristol, School of Earth Sciences
Co-Supervisor: Jeffrey Krause, Dauphin Island Sea Lab (DISL)/University of South Alabama
Co-Supervisor: Morten Andersen, Cardiff University, School of Earth and Ocean Sciences
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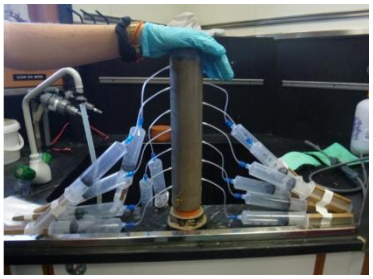
Project keywords: marine nutrient cycling, isotope geochemistry, sediment diagenesis

Megacorer for sediment collection at sea



Extracting pore waters from a sediment push core

## Project Background

The release of elements from shallow sediments through dissolution and other chemical reactions is an important source of key nutrients into the marine system that are essential for supporting biological production and carbon cycling. Dissolved silicon (Si) is one such nutrient, which is critical for the growth of diatoms, an important group of algae that are responsible for a significant proportion of organic carbon production in the oceans. Shallow sediments contain various reactive pools of silica and are an important source of dissolved silicon to overlying waters in various marine settings (e.g. Michalopolous & Aller, 2004), especially in areas lacking significant fluvial silicon input. Germanium (Ge) is the 'chemical twin' of Si, and its stable isotopes could be used together with Si isotopes to investigate these previously under-explored reactive silica pools, associated with non-biological and redox-sensitive oxides and hydroxides, as well as biological silica within continental margins and shelf-seas (Baronas et al., 2019; Guillermic et al., 2017; Ng et al., 2019; Pokrovsky et al., 2014).

## Project Aims and Methods

The overall aim is to use paired silicon and germanium isotopes to investigate active processes within shallow sediments from continental shelves, to better understand the release of dissolved Si from sediments into overlying waters, and to better constrain the marine Ge budget. The specific objectives will include refining Ge isotope measurements for seawater, porewater, and sediment leach analyses using cutting-edge plasma mass spectrometry methods within the Bristol Isotope Group; analysis of Ge isotopes within samples reacted under controlled laboratory experiments carried out in collaboration with Jeffrey Krause at DISL; analysis of Si and Ge isotopes as well as inorganic macronutrients, and trace metals (e.g. iron and manganese) in natural sediment samples from contrasting high and low-latitude continental shelf seas. There is flexibility within the project to focus on specific aspects of Ge/Si analytical method development, laboratory or field analyses of a wider range of redox-sensitive isotope systems (e.g uranium isotopes, measured at Cardiff University), or geochemical modelling.

## Candidate Requirements

The successful candidate will have a Masters in Earth Sciences, Environmental Geosciences, Oceanography, or related subject.

### Collaborative Partner

The student will be trained at PML by Malcolm Woodward in high-quality inorganic nutrient analysis by segmented-flow autoanalyser (SEAL AA3).

### Training

The PhD student will have the opportunity to train in a number of laboratory skills, including ultra-clean sample preparation, trace-element and isotope mass spectrometry in the Bristol Isotope Group, laboratory diagenesis experiments in the US (DISL), and inorganic nutrient analyses in Plymouth (PML). The student will receive training in science communication - both academic and public outreach - including participation in an international conference (e.g. AGU Ocean Sciences 2024; Louisiana, USA). The student will likely have an opportunity to take part in an ocean-going expedition.

### References / Background reading list


- Baronas, J. J., Hammond, D. E., Rouxel, O., & Monteverde, D. R. (2019). A first look at dissolved Ge isotopes in marine sediments. Frontiers in Earth Science, 7, 162.
- Guillermic, M., Lalonde, S. V., Hendry, K. R., & Rouxel, O. J. (2017). The isotope composition of inorganic germanium in seawater and deep sea sponges. *Geochim. et Cosmochim. Acta*, 212, 99-118.
- Michalopoulos, P., & Aller, R. C. (2004). Early diagenesis of biogenic silica in the Amazon delta: alteration, authigenic clay formation, and storage. *Geochim. et Cosmochim. Acta*, *68*(5), 1061-1085.
- Ng, H-C., Cassarino, L.C., Pickering, R.A., Woodward, E.M.S., Hendry, K.R. (under revision) Sediment efflux of silicon off coastal Greenland and implications for the marine silicon cycle. *Earth and Planetary Science Letters.* Manuscript available upon request.
- Pokrovsky, O. S., et al. (2014). Germanium isotope fractionation during Ge adsorption on goethite and its coprecipitation with Fe oxy (hydr) oxides. *Geochim. et Cosmochim. Acta*, 131, 138-149.


## Useful links

### Links:

School URL – http://www.bristol.ac.uk/earthsciences/courses/postgraduate/

### NERC GW4+ DTP Website:

For more information about the NERC GW4+ DTP, please visit http://nercgw4plus.ac.uk/

### Bristol NERC GW4+ DTP Prospectus:

http://www.bristol.ac.uk/study/postgraduate/2020/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 1600 hours GMT Monday 6 January 2020 and interviews will take place between 10 and 21 February 2020**

### General Enquiries:

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