

Sea level changes during Earth's Greenhouse-Icehouse Transition: A combined data and modelling approach

Supervisors:

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Hosting institution: Cardiff University

Project description: The aim of the project is to increase our understanding of the processes that led to the first establishment of the Antarctic ice sheet, about 34 million years ago, utilising new deep ocean cores with unprecedented high resolution and preservation, and state-of-the-art modelling tools. The primary cause of this major transition is unknown. Declining atmospheric CO₂ was perhaps associated with increased oceanic export production. The role of ocean circulation in changing heat transport or nutrient utilisation remains an open question. The first North Atlantic deep-water sediment drifts are dated to the Eocene-Oligocene Transition, but until now there have been no deep-water North Atlantic records through the event.

This project has two components. The first will generate benthic foraminiferal trace metal records (Mg/Ca, Li/Ca, B/Ca, U/Ca) through the transition from a new high-resolution North Atlantic Site (IODP Site 1406). This work capitalises on advances in the applications of trace metal proxies combined with excellent foraminiferal preservation. The Mg/Ca temperature records will be combined with paired stable isotope data to provide a high-resolution record of seawater $\delta^{18}\text{O}$ (a measure of continental ice volume). This will be combined with published $\delta^{18}\text{O}$ records to generate spatial maps of $\delta^{18}\text{O}_{\text{sw}}$ variability.

The second phase will use $\delta^{18}\text{O}$ -enabled climate models to simulate the transition, thereby aiding the interpretation of the records developed in the first component in terms of global sea level. This combined data-model approach will produce insights into the magnitude and timing of the event and the role of ocean circulation in Earth's Greenhouse-Icehouse Transition.

Training opportunities: This is an interdisciplinary project. The student will develop an excellent understanding of the benefits and limitations of both palaeo-data production and interpretation, and gain experience and understanding of climate modelling. It is expected that this rather unique combination of expertise in data and modelling will greatly increase the future employability of the student in this field.

Specific Training Elements:

Cenozoic Palaeoclimatology and Palaeoceanography (Cardiff PACS group)

Benthic foraminiferal taxonomy (Cardiff)

Binocular Microscopy (Cardiff)

Scanning Electron Microscope (Cardiff)

Trace metal sample preparation in a clean lab (including COSHH) (Cardiff)

Trace metal analysis by HR-ICP-MS (Cardiff)

Climate modelling training (Bristol)

Attendance at MSc unit in 'Past and future climate simulation' (Bristol)