

The role of volcanism in the genesis of Early Cenozoic global warming events

Supervisor(s): *Dr Alex Dickson*

Project Description:

One approach to understanding the causes and consequences of rapid global warming is to study geological warming events – called ‘hyperthermals’ – that repeatedly punctuated the very warm climate state of the early Cenozoic Era (~60–52 Ma). One hypothesis for a control on the occurrence of hyperthermals is that they were triggered by volcanism associated with the North Atlantic Igneous Province (NAIP) in the interval ~60–50 Ma. These volcanic pulses could have delivered CO₂ to the atmosphere and oceans either by direct outgassing, or by the thermal alteration of organic-rich rocks by magmatic intrusions. Although these relationships have been tested for the largest Eocene hyperthermal, the Paleocene–Eocene Thermal Maximum (PETM), the relationship between magmatic intrusions, thermogenic CO₂ release, and the genesis of the many subsequent Early Eocene hyperthermal events remains untested. Knowing whether volcanism was responsible for triggering hyperthermals is an important task, to quantify the amount of CO₂ released during each event; and to quantify the relationship between CO₂-forcing and temperature change (climate sensitivity).

Research methodology

This PhD project will apply cutting-edge proxy-data techniques for recognizing volcanism in the geological record, to a series of globally distributed sedimentary successions recording Early Eocene hyperthermal events. Sedimentary mercury concentrations will be used to reconstruct a history of volcanism associated with the NAIP from ~60–52 Ma. Secondly, the osmium-isotope composition of marine rocks will be used to trace the global geochemical fingerprint of volcanic-derived Os on ocean chemistry.

Training

The student will obtain material from marine sediment cores and samples held by the International Ocean Discovery Programme, Shell and GNS Sciences, and will receive training in how to handle, store and prepare these samples for geochemical analyses. They will receive training in the purification of osmium isotopes from geological samples, and in making isotopic measurements using multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS) and thermal ionisation mass spectrometry (TIMS). The student will be trained in mercury concentration analyses at Oxford University, and in organic carbon analyses at Plymouth.

Person specification

This project is suitable for someone with a background in chemistry, Earth Sciences or Physical Geography. Some experience in lab-based geochemistry is desirable but not essential as these skills will form part of the specialised training offered to the successful candidate.

References:

Dickson, A.J., Cohen, A.S., Coe, A.L., Davies, M., Shcherbinina, E.A. and Gavrillov, Y. (2015), Evidence for weathering and volcanism during the PETM from Arctic Ocean and Peri-Tethys osmium isotope records. *Palaeogeography, Palaeoclimatology, Palaeoecology* 438, 300–307.

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Aze, T., Pearson, P., Dickson, A.J., Bown, P.R., Badger, M., Pancost, R.D., Gibbs, S.J., Huber, B.T., Leng, M.J., Coe, A.L., Cohen, A.S. and Foster, G. (2014), Extreme warming of tropical waters during the Paleocene – Eocene Thermal Maximum. *Geology* 42, 739–742.

This project has been shortlisted for funding by the ARIES NERC Doctoral Training Partnership. Undertaking a PhD with ARIES will involve attendance at training events.

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Applicants from quantitative disciplines who may have limited environmental science experience may be considered for an additional 3-month stipend to take appropriate advanced-level courses.

Usually only UK and EU nationals who have been resident in the UK for 3 years are eligible for a stipend. Shortlisted applicants will be interviewed on 26th/27th February 2019.

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Please contact the Postgraduate Programmes Co-ordinator, if you have additional questions about the department or application procedures (email: pgadmin@es.rhul.ac.uk; tel: 01784-443581).

Applicants are requested to send an additional copy of their CV directly to the lead supervisor of the project in which they are interested. Please also contact the supervisor if you have any questions about the project itself