Global change during the Jurassic; applying multiproxy studies to outcrop and cores

Supervisors

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Project description

The Jurassic was a dynamic time in Earth's history. Despite intense study of both marine and terrestrial sections, much remains to be discovered regarding the coupling between climate and carbon cycle during this enigmatic period. However, for this purpose we need a robust orbitally-tuned age model on which to hang other geochemical, sedimentological, and palaeontological data.

This project will use multi-proxy techniques, such as X-ray fluorescence, carbon-isotope stratigraphy and palaeomagnetic analysis. We will study outcrop of European basins, such as those in Germany France and the UK, as well as accessing the significantly underused UK borehole archive at the British Geological Survey (BGS). These boreholes have yielded a detailed underpinning stratigraphy, but they have only been subject to limited additional analysis. Advances in stratigraphical techniques and new data show that cores thought to be devoid of a primary remnant magnetisation still carry a weak signal, and allow high-resolution age models to be constructed for for the first time. Additionally, new data will shed light on major environmental change events from this interval, notably expressed as black shales in the Sinemurian and at the Sinemurian-Pliensbachian boundary. In these examples, the stratigraphical records show close similarities to the well-known palaeoenvironmental changes at the Triassic-Jurassic boundary and during the Toarcian Oceanic Anoxic Event, but the intensity and duration remain mysterious. Data will be interpreted in the context of these larger perturbations to the Earth system and used to test hypotheses that link palaeoenvironmental change to either

long-periodicity orbital variations or large igneous provinces.

The student will be embedded within the Deep Time Global Change group at the University of Exeter, and will gain experience with project partners at BGS and Oxford. Combining fieldwork and borehole studies, along with a multi-proxy approach, will ensure excellent employability and training in technical and research skills.

Measurements on cores will be carried out at the BGS in Keyworth. In addition to a programme of non-destructive XRF and magnetic susceptibility measurement the student will take oriented core samples for analysis in the Oxford Palaeomagnetism Laboratory, and a series of smaller bulk rock and macrofossil samples for generation of a high-resolution work using facilities at Exeter.

Riding, J.B., Leng, M.J., Kender, S., Hesselbo, S.P., Feist-Burkhardt S., 2013, Isotopic and palynological evidence for a new Early Jurassic environmental perturbation. Palaeogeography, Palaeoclimatology, Palaeoecology, v. 374, p. 16–27; Korte, C. & Hesselbo, S.P. 2011. Shallow-marine carbon- and oxygen-isotope and elemental records indicate icehouse-greenhouse cycles during the Early Jurassic. Paleoceanography v. 26, PA4219

Cores through classic Jurassic successions such as that seen at outcrop in Robin Hood's Bay represent a hugely under-used treasury of geological data that can be applied to understand the history and processes of global environmental change through Mesozoic greenhouse times.