How Hot is Hot? Palaeotemperatures in the Eocene Indo-Pacific Warm Pool

Supervisors

Main supervisor: Prof Paul Pearson (Cardiff University)
Co-supervisor: Dr Tom Hill (Natural History Museum)

Project enquiries - Email: pearsonp@cardiff.ac.uk
Supervisory team:
Prof Rich Pancost (University of Bristol)
Dr Dan Lunt (University of Bristol)

Host Institution: Cardiff University

Project description

Peak sea surface temperatures (SSTs) in the open ocean occur mainly in the Indo-Pacific Warm Pool because of the prevailing direction of the Pacific trade winds. Climate models indicate that this was also the case in the greenhouse world of the Eocene, but whereas SSTs today rarely exceed 30^{o}C it is likely they were considerably higher during the Eocene (Figure 1). However significant uncertainties remain about peak temperatures. It has been suggested that various negative feedback processes involving clouds, ocean currents and storms may limit the extent of warming in the tropics which climate models may not fully represent.

Reliable palaeotemperature proxy data from the predicted area of the Eocene Warm Pool are virtually non-existent. The aim of this project is therefore to generate new palaeo-SST estimates based on a combination of oxygen isotopes and trace metals from planktonic foraminifera (using facilities at Cardiff) and analysis of lipids using the TEX-86 proxy (at Bristol with co-supervisor Pancost; see papers in Ivany et al., 2012, for explanation of these methods). The time interval of interest spans the entire Eocene epoch (generally considered a time of relatively high atmospheric CO_2), encompassing the Paleocene /Eocene Thermal Maximum and subsequent 'hyperthermal' events, plus the long-term cooling trend that culminated in major glaciation on Antarctica in the earliest Oligocene.

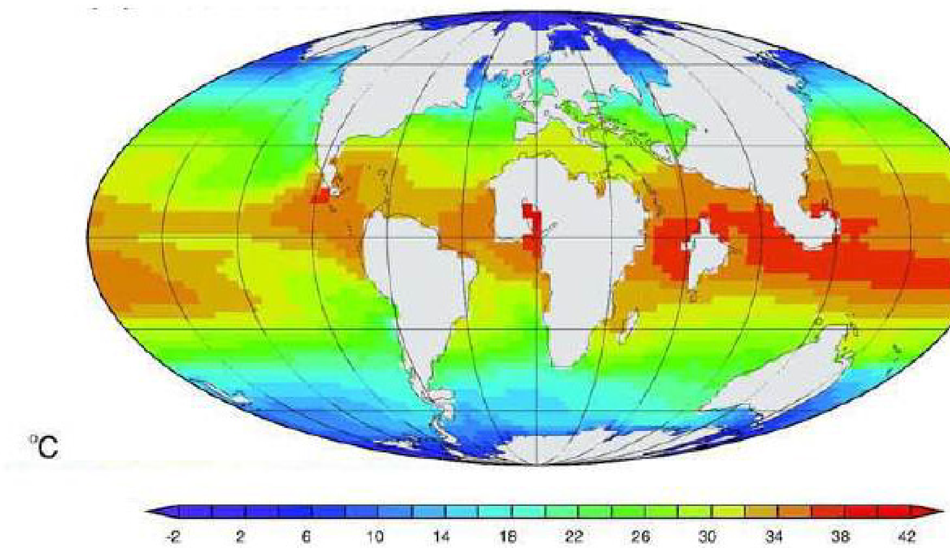
Reliable foraminiferal palaeotemperature data depend on exceptional preservation of carbonate microfossils, usually from clay rich hemipelagic sediments. Fortunately such preservation is known from the area and may be quite common when fully investigated. Samples will come from three principal sources: 1) cores previously obtained by the lead supervisor from Nanggulan in Java; 2) a thorough evaluation and targeted sampling of the Former British Petroleum microfossil collection and core samples held at the Natural History Museum (see http://www.nhm.ac.uk/research-curation/collections/our-collections/micropalaeontology/foraminifera/ former-bp-collection/index.html) with co-supervisor Hill; 3) New field collection working from the Cardiff University Field Centre at Danau Girang, Malaysia.

The data will be vital for determining how hot the tropical SSTs can get under extreme climatic conditions. In combination with similar data from other areas, the date will constrain estimates of global average surface temperatures in the Eocene. The reconstructed spatial variability of SSTs in the Eocene will be compared with the output of state-of-the-art climate model reconstructions (co-supervisor Lunt) to assess how well the models reconstruct the Eocene warm pool.

Ivany, L. C., and Huber, B.T. (eds.) 2012. Reconstructing Earths Deep-Time Climate The State of the Art in 2012. *Paleontological Society Papers*, 18.

Tindall, J. et al. 2010. Modelling the oxygen isotope distribution of ancient seawater using a coupled ocean-atmosphere GCM: implications for reconstructing early Eocene climate. *Earth and Planetary Science Letters*, 292, 265-273.

Figure 1. Reconstruction of Eocene SSTs using a coupled ocean-atmosphere General Circulation Model (Tindall et al., 2010).



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