Euxinia During the Paleocene-Eocene Thermal Maximum

LEILA BEHROOZ[1], B. DAVID NAAFS[1], FANNY MONTEIRO[2], ANN PEARSON[3] & ALEXANDER J. DICKSON[4], RICHARD D. PANCOST[1]

[1]Organic Geochemistry Unit, School of Earth Sciences and School of Chemistry, University of Bristol, Bristol, UK (Corresponding author: r.d.pancost@bristol.ac.uk)

[2]BRIDGE, School of Geographical Sciences, University of Bristol, Bristol, UK

[3]Dept of Earth and Planetary Sciences, Harvard University, Cambridge, USA

[4]Dept of Earth Sciences, Royal Holloway University of London, London, UK

Determining the cause(s) of marine anoxia is crucial to or wider understanding of the ancient and modern Earth system. It appears that widespread ocean anoxia is associated with warm climates, but the mechanisms for this remain debated. Highlighting this is the fact that Mesozoic warming events are often associated with widespread anoxia (oceanic anoxic events, OAEs), likely due to warming-induced weathering and nutrient feedbacks, but the pronounced (~5ºC) global warming of the Paleocene Eocene Thermal Maximum (PETM) was not. It has been argued that similar feedbacks occurred for the PETM but that the anoxia was restricted to enclosed basins, such as the Arctic Ocean and Peri-Tethys Basin, or other marginal marine sites. Indeed, previous work by us and others revealed the deposition of extensive black shales in the Peri-Tethys associated with changes in trace metal and nutrient cycling. Here, we explore the extent of that anoxia and the degree with which it was biogeochemically similar to parts of Mesozoic OAE oceans. The Guru-Fatima, Kheu River, and Dzhengutay sections were all deposited in the large, shallow epicontinental northern Peri-Tethys Ocean. The PETM at all sites is represented by a carbon isotope excursion that co-occurs with a sapropelic bed of varying thickness and total organic matter contents (i.e. at KR, TOC increases from <0.5% to ~8%). All sapropels are associated with dramatic changes in biomarker assemblages, reflecting the change in terrestrial and marine inputs as well as the overall preservation of organic matter. At all three sites, but not at sites in Spain, lycopane and isorenieratane occur during sapropel deposition, providing direct evidence for water column anoxia and that euxinia extended into the photic zone, respectively. Other features, including a pronounced decease in $\delta^{15}N$ values, indicate a change in nutrient cycling similar to what has been observed during OAEs. Crucially, intermediate complexity models (i.e. CGENIE) reproduce our observations that the semi-restricted Peri-Tethyan realm was highly sensitive to changes in the ocean nutrient inventory.