Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9743

Global deep ocean circulation through the early Eocene Climatic Optimum - a neodymium isotope perspective

PHOEBE I ROSS[1], TINA VAN DE FLIERDT[1], DAN J LUNT[2], SEBASTIAN STEINIG[2], PHILIP SEXTON[3] AND SAMANTHA J HAMMOND[3]

[1]Imperial College London
[2]University of Bristol
[3]The Open University

Presenting Author: p.ross19@imperial.ac.uk

The early Eocene Climatic Optimum (EECO) (~49–53 Ma) presents an ideal test bed to explore climate interactions in a high CO_2 world (pCO_2 > 1000 ppm [1]). Here we investigate deep ocean circulation during the EECO, employing the Nd isotope fingerprint of water masses as reconstructed using fish debris and foraminifera, at sixteen global DSDP, ODP and IODP sites. Our data reveal a distinct dichotomy between the Atlantic and the Pacific Oceans in both average $\varepsilon_{Nd(t)}$ and time-dependent variability. Pacific data disclose relatively constant site-specific signatures, suggesting that the observed latitudinal trend constitutes a long-term feature of the EECO. Through comparison with existing data, we note a latitudinal gradient towards more radiogenic signatures from the south to the north ($\varepsilon_{Nd(t)} =$ -4.6 ±0.3, DSDP Site 287 24°4S and $\varepsilon_{Nd(t)}$ = -1.9 ± 0.4, ODP Site 883 [2], 38°9N). Although this observation alone is inconclusive in distinguishing between North and South Pacific deep-water formation/export, the data strengthen the notion of a Pacific sector Southern Ocean deep-water source [3].

In contrast, Atlantic Ocean signatures display time-dependent variability throughout the EECO. South Atlantic signatures largely reflect Southern Ocean export, characterised by Nd isotope values between -10.4 ± 0.4 and -8.6 ± 0.3 in the Atlantic and Indian sector. The observed amplitude of change in South Atlantic sites is 1.2 epsilon units, which is insufficient to explain large variability in Nd isotope signatures observed within the North Atlantic. DSDP Site 549 reveals a shift from -6.6 ± 0.2 [4] to -10.3 ± 0.2 between ~53.9 and 47.6 Ma, possibly due to a significant change in weathering inputs. Whether transient or long-term, strengthened export of highly unradiogenic Baffin Bay outflow water offers a feasible explanation for these North Atlantic observations.

We will furthermore interrogate whether our new data support multiple, separate, Southern Ocean deep water sources during the EECO and potential export from the North Atlantic.

[1] Anagnostou, E. *et al*. (2020) *Nature Communications* **11** 1-10. [2] Hague, A. *et al*. (2012) *Geology* **40** 527-530. [3] Thomas, D. *et al*. (2014) *Paleoceanography* **29** 454-469. [4] Thomas, D. *et al*. (2003) *EPSL* **209** 3-4.