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Detection and characterization of early Eocene hyperthermals using benthic foraminiferal associations and stable isotopes at DSDP Site 401, Bay of Biscay, North East Atlantic

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A series of brief periods (<200 kyr) of extreme global warming, also known as hyperthermals, was superimposed on the early Paleogene warm climate mode. The most prominent and best-documented hyperthermal is the Paleocene-Eocene Thermal Maximum (PETM or ETM-1; ∼55.5 Ma), which left a major mark on the biogeospheric evolution. In the early Eocene, two further events, H1 (ETM-2; ELMO) and K (ETM-3; X-event), have primarily been recorded by means of their isotopic signature and physical properties. Yet, H1 and K are largely unexplored with respect to their biotic aspects. Because of this lack of documentation, it is difficult to assess to what extent H1, K and other isotopic excursions bear similarity with the PETM. By studying these non-catastrophic hyperthermals, the sensitivity of early Eocene benthic communities towards changes in temperature, circulation, stratification, pH and organic fluxes can be assessed.

Here, we present quantitative benthic foraminiferal (>63 μm) and benthic foraminiferal δ^{18}O and δ^{13}C data from lower Eocene deep-sea sediments from DSDP Site 401. Site 401 (paleodepth ∼2000 m) represents one of the most northern scientific drill sites to provide pelagic carbonates of Paleocene to middle Eocene age. The stratigraphic framework is based on calcareous nannofossil biostratigraphy and X-ray fluorescence (XRF) core scanning data, which have been correlated to DSDP Site 550 (Westerhold *et al.,* 2009). A well-developed cyclicity in sediment color and carbonate content is visible during calcareous nannofossil Zone NP11; four darker, marly horizons stand out in the otherwise greyish-brown calcareous chalky lithology. In order to obtain reliable high-resolution δ^{18}O and δ^{13}C records, analyses on well-preserved *Nuttallides truempyi* and *Oridorsalis umbonatus* and on bulk material were carried out on ∼50 samples. Besides the 2‰ drop across the PETM interval, these records also show four negative excursions of up to ∼0.85‰ throughout NP11. These excursions coincide with the drops in carbonate content (largest drop from ∼80% to ∼50%).

Preliminary results also show that, in several horizons, there is a clear drop in diversity and buliminid taxa. The assemblages in the marly horizons are dominated by small *Nuttallides sp.1* species and various abyssaminid taxa (*Abyssamina poagi*, *A. quadrata* and *Quadrimorphina profunda*). Right above the isotope excursions *Globocassidulina subglobosa*, *Tappanina selmensis*, *Aragonia aragonensis*, *Nonion havanense* and several pleurostommelid taxa increase in abundance. These faunal changes show strong similarities with PETM assemblages at Site 401 and other deep-sea sites, indicating similar depositional conditions. Based on the faunal data, the isotopic record and the stratigraphic position, the largest two excursions within NP11 possibly represent the paired carbon isotope excursions H1 and H2.

Reference:

Westerhold, T., Röhl, U., McCarren, H.K., Zachos, J.C. (2009) Latest on the absolute age of the Paleocene-Eocene Thermal Maximum (PETM): New insights from exact stratigraphic positions of key ash layers +19 and -17, Earth and Planetary Science Letters, doi: 10.1016/j.epsl.2009.08.027