A complex history of the Paleocene–Eocene Thermal Maximum in the NE Atlantic

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The Paleocene–Eocene Thermal Maximum (PETM; 55.8 Ma) is the most prominent of a number of global transient warming events during the Paleocene and Eocene epochs. This so-called hyperthermal has been studied in numerous deep and shallow marine sediments as well as in terrestrial archives. Nearly all of them show indications of substantial warming and a pronounced negative $\delta^{13}C$ excursion. However, only few detailed deep-sea records exist from the North Atlantic region. In the Bay of Biscay at DSDP Site 401 a fairly thick sequence of clay-rich PETM-related sediments have been recovered providing a well preserved planktic and benthic foraminiferal fauna.

Geochemical studies of foraminiferal test carbonate reveal a complex history for the PETM in the NE Atlantic region. All studied taxa (benthic *N. truempyi*, thermocline dwelling subbotinids and surface dwelling morozovellids) display a discrete negative $\delta^{13}C$ excursion (CIE) followed by a synchronous recovery phase. By contrast, the $\delta^{18}O$ data of planktic and benthic foraminifera are decoupled during the recovery phase. This suggests different temperature histories for the different water-masses with a post-CIE cooling for bottom waters while surface waters remained warm, or alternatively, changes in the deep-water source. Mg/Ca data of these taxa show a different picture. All three records show the PETM warming at the base of the CIE, but the benthic foraminiferal record does not recover as expected by the $\delta^{18}O$ data suggesting no major change in bottom water temperature. Planktic foraminifera show a decline in Mg/Ca indicating a decrease in water temperature, while $\delta^{18}O$ values stay low. This suggests that the $\delta^{18}O$ anomalies during the PETM recovery phase likely represent a geochemical change characterizing different water masses rather than a predominant temperature signal.
In addition, He isotope data suggest a major input of terrestrial material and an increase in sedimentation rate starting with the onset of the CIE. These changes are in agreement with the clay-rich, extended sequence representing the PETM at DSDP Site 401. An increase in terrestrial ^{3}He is subsequently followed by a pronounced pulse of kaolinite deposition, which persists for several hundred thousand years after the termination of the CIE. The prolonged period of clay deposition implies that the PETM fundamentally altered both weathering conditions and sediment supply long after the end of the climatic transient.