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The third Early Eocene Thermal Maximum: Characteristics, Timing, and Mechanisms of the "X" Event

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Prominent, widespread dissolution horizons in deep-sea carbonates (e.g., the horizon formed during the Paleocene-Eocene thermal maximum, PETM), may have been caused by significant CH_4 – CO_2 input into the ocean-atmosphere system and thus correspond to abrupt climate events. Dissolution horizons signifying repeated, abrupt shoaling of the lysocline and CCD, however, are characteristic features of deep-sea sections and commonly attributed to Milankovitch forcing because of their diagnostic frequencies. The question thus arises whether significant dissolution horizons in upper Paleocene - early Eocene sediments similar to the PETM and the ELMO layer (Lourens et al., 2005; Nature) were also formed as the result of greenhouse gas input, suggesting a similar, Milankovitch-modulated cause for all such events, or whether they were related to cumulative effects of periodic changes in ocean chemistry and circulation. We document a 3rd thermal maximum in lower Eocene (about 52 Ma) sediments (ODP Leg 208, SE Atlantic Ocean). The prominent clay layer, named the "X" event, occurs in planktonic foraminifer Zone P7 and calcareous nannofossil Zone CP10 at four Walvis Ridge Transect Sites (water depth range of 2000 m), and was also identified at Shatsky Rise (ODP Leg 198) sites. Benthic foraminifera have low diversity and high dominance, and are dominated by small individuals of *Nuttallides truempyi* and various abyssaminids (*Abyssamina incisa* at Sites 1262 and 1263,

with the related species *Quadrimorphina profunda* also abundant at Site 1262), resembling the post PETM extinction assemblages, with more severe effects at deeper sites. Calcareous nannofossil assemblages show similar trends to the PETM, with major changes in the genera *Discoaster* and *Zygrhablithus*, but with differences in magnitudes and fluctuations. High-resolution bulk carbonate stable isotope values at relatively shallow Site 1265 show a rapid, 0.6 per mille drop in δ^{13}C and δ^{18}O, followed by an exponential recovery to pre-excursion values, a pattern similar to that of the PETM and ELMO. Planktonic foraminiferal δ^{13}C values (*Morozovella subbotina*, *Acaranina soldadoensis*) in the deepest Site 1262 decrease by 0.8 to 0.9 per mille, those of the benthic foraminifera *Nuttalides truempyi* by 1 per mille. We are evaluating mechanisms for the widespread change in deep-water chemistry, its connection to the surface-water response, and the temporal relation of the event, as well as the PETM and ELMO, with current astronomical solutions.