Element chemostratigraphy across the Paleocene-Eocene thermal maximum at Demerara Rise, Central Atlantic

Peter Schulte[1], Christian Joachim[2], Hans-Jürgen Brumsack[3], Jörg Mutterlose[2]

[1] GeoZentrum Nordbayern, University Erlangen, D-91056 Erlangen, Germany
[2] GMG, Ruhr-Universität Bochum, D-44801, Bochum, Germany
[3] ICBM, Oldenburg University, D-26111 Oldenburg, Germany

Changes of redox conditions during the Paleocene-Eocene thermal maximum (PETM) are currently investigated to constrain the spatial and water depth-dependent pattern of warming, carbon input, and O_2 deficiency in the global ocean [e.g., 1,2]. Here, we are reconstructing paleoredox changes across the PETM in the tropical, western Atlantic (ODP Leg 207, Demarara Rise) by a set of stable isotope and element geochemical data. In addition, we address changes in the detrital flux. Generally, the PETM record on the Demerara Rise shows a pronounced and sharp lithologic change from calcareous chalks to laminated, clay-rich beds present in several drill sites across a depth transect. Herein, we report a first dataset from the deepest site 1258 (lower-bathyal to upper-abyssal paleodepth, ~2000 m).

The typical stable isotope pattern anomaly across the PETM is somewhat disturbed at this site since carbon isotopes show a negative anomaly with values as low as -10‰ and oxygen isotopes reveal a positive excursion. These isotope signatures are indicative for the formation of ^{13}C-depleted carbonates in the claystone from early diagenesis at the seafloor. However, calcareous nannofossil faunal assemblages (Joachim et al., this volume) and the $CaCO_3$ distribution both show typical PETM patterns similar to other deep-sea sites. A strong drop in Si/Al ratios concomitant to the onset of the PETM points either to (i) reduced Si input derived from silicic organisms (e.g., radiolarians) or (ii) lowered input of (aeolian?) quartz since most other element/Al ratios indicative for the siliciclastic fraction do not change (K, Na, Ti, Fe, Rb, Zr). However, Mn/Al ratios and bulk Mn enrichment factors (EF) compared to crustal values show a substantial drop during the PETM onset, followed by a gradual recovery to pre-event values. In contrast to the depletion of Mn, other typically redox-sensitive elements (e.g., V, Cr, Co) or element /Al ratios show no major change across the PETM, and U as well as Mo are close to the detection limit. These results indicate that W Atlantic deep waters were oxygenated before and after the PETM, but lower in dissolved oxygen content during the onset of this hyperthermal event, suggesting a considerable vertical expansion of the oxygen minimum zone correlative to carbonate dissolution.

References:

[1] Nicolo, M.J. et al., 2010, Paleoceanography, 25, PA4210
[2] Chun, C.O.J. et al., 2010, Paleoceanography, 25, PA4202