Shelf ecosystems prior and during the PETM along the US Atlantic Coastal Plain

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During the early Paleogene, Earth's climate was characterized by a long-term warming trend that was punctuated by short-term global warming events known as hyperthermals. These climate events are recognized by negative $\delta^{18}O$ and $\delta^{13}C$ excursions, and environmental perturbations, with the Paleocene-Eocene Thermal Maximum (PETM) being the most pronounced one. The PETM in the subsurface of the US eastern coastal plains is marked by the widespread distribution of fine-grained sediments, probably related to a regional intensification in river outflow, contrasting with the Paleocene sediment-starved setting. Recent stable isotope data show an additional small, but distinct, $\delta^{13}C$ excursion in a more clayey interval below the onset of the PETM, coined the POE, or "pre-onset excursion" (as represented in Fig. 1.) The relationship with the PETM is still unclear, but the POE may indicate that latest Paleocene climate was not as stable as previously assumed, but exhibited a more gradual change towards the PETM onset.

Our study focuses on the recognition of paleoenvironmental changes prior to the PETM, using various drill cores retrieved from the US Atlantic Coastal Plain. The South Dover Bridge (SDB) core serves as the reference site, as the Paleocene-Eocene transition is stratigraphically confined by nannoplankton zones, and the POE and PETM are lithologically well-expressed in respectively the top part of the Paleocene Aquia Formation and the Marlboro Clay. In addition, the SDB site is presumed to be situated in a shallow marine setting near the paleo-Potomac River outflow system in a comparable setting as the New Jersey Coastal Plain, thus allowing for an insight into regional variations in the hydrological cycle (Self-Trail et al., 2012). Here we present our preliminary interpretation of paleoenvironmental changes during the late Paleocene and earliest Eocene, as expressed in the biotic, geochemical and lithological records.

Three main biofacies are presented based on the relative abundances of four recognized benthic foraminiferal species associations. Biofacies A is present in the upper Paleocene glauconitic fine sands. This biofacies contains a mixture of the foraminiferal Ia association, consisting of e.g. *Epistominella minuta* and *Paralabamina lunata*, and the Ib association of *Anomalinoides midwayensis* and *Cibicidoides alleni*. Both are associated with a middle neritic depositional setting and stable, well-oxygenated oligo- to mesotrophic bottom water conditions. This biofacies includes the POE, marked by more silty sediments and a negative stable carbon excursion at SDB. It is hypothesized that the POE corresponds to a regional pulse in fluvial sediment discharge preceding the PETM. The second Paleocene biofacies (B), which is characterized by increased abundances of *E. minuta* and *P. lunata*, is present in the interval between the top of the POE and the base of the PETM. These species indicate an episodic supply of organic flux to the sea floor in the aftermath of the POE. Across the onset of the PETM, the diversity of the foraminiferal fauna decreases noticeably, pointing towards a drastic change of living conditions. Biofacies C is restricted to the PETM and therefore reflects the specific environmental conditions associated with the widespread deposition of the Marlboro clay. This biofacies contains characteristic PETM-related foraminiferal association III such as *Anomalinoides acutus* and *Pulsiphonina prima*. Other associated taxa, e.g. *Bulimina virginiana* or *Spiroplectinella laevis* are also considered more stress-tolerant species (association II), and were already present during the Paleocene. Similar to the New Jersey Coastal Plain setting (e.g. Stassen et al., 2015), the global warming conditions resulted in an intensified fluvial influence of the region, causing annual to periodically dysoxic bottom water conditions. Remarkably, the topmost PETM foraminiferal assemblage indicates sustained high food levels and increasing oxygen levels, related to a decrease in river-induced stratification. This tendency towards more silty and less clayey sediments is linked to renewed bottom current activities and winnowing, although sediment accumulation rates remained high. As comparable regional data on the POE, PETM and younger intervals become available, we will be able to establish the strength of river influence, paleodepth variations and distance to shore during the latest Paleocene and earliest Eocene.

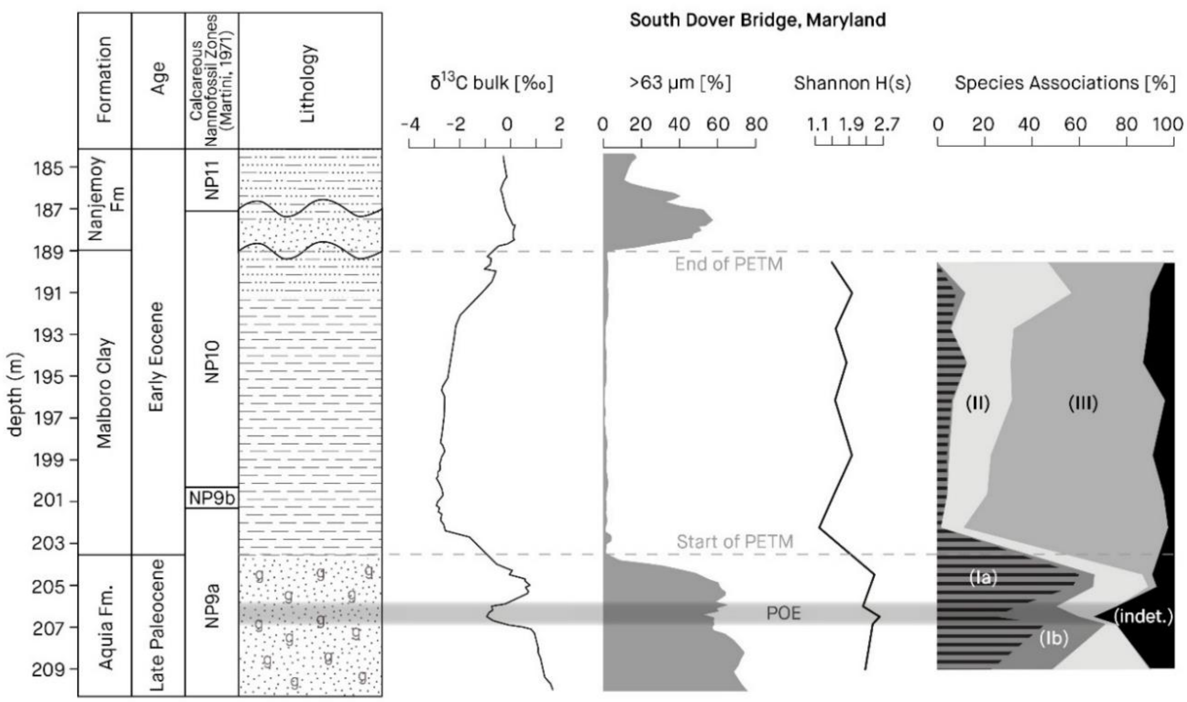

Figure 1. δ^{13}C bulk carbonate (Self-Trail et al., 2012), grain size (>63 µm) and foraminiferal abundance data (species associations I (a+b), II and III, black: undetermined individuals and least abundant species) across the Paleocene-Eocene boundary. Gray interval corresponds with POE, dashed lines indicate beginning and end of the PETM interval.

References

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