SPREAD OF PHOTIC ZONE EUXINIA DURING THE PALEOCENE EOCENE THERMAL MAXIMUM (PETM)

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Introduction

During the Paleocene Eocene Thermal Maxima (PETM) deep-sea environments experienced only a minor deoxygenation (1). However, there is evidence of water column anoxia in some restricted basins and from marginal sites (2). Moreover, PETM photic zone euxinia (PZE) has previously been reported, but only in some marginal settings: Tadjik depression (Kurpai), Arctic Ocean (IODP Site M0004); North Sea (Fur and Store Bælt); West Siberian Sea (well 10) and Gulf Coastal Plain (Harrell Core). In addition to changes in oxygenation, the PETM is also associated with an overall increase in marine algal productivity (3), alongside evidence for warming (2), increased precipitation and continental erosion (11). Based on these observations, the PETM has similarities with the Mesozoic OAEs (9), in which warming-induced changes in hydrology and erosion brings about increased nutrient inputs to the marine realm, higher productivity and anoxia. Understanding those climatic and biogeochemical interactions and feedbacks across the PETM, however, requires a better understanding of PETM anoxia, especially on the shallow shelf of the Peri-Tethys Ocean where anoxia appears to have been particularly pronounced but where data remain sparse.

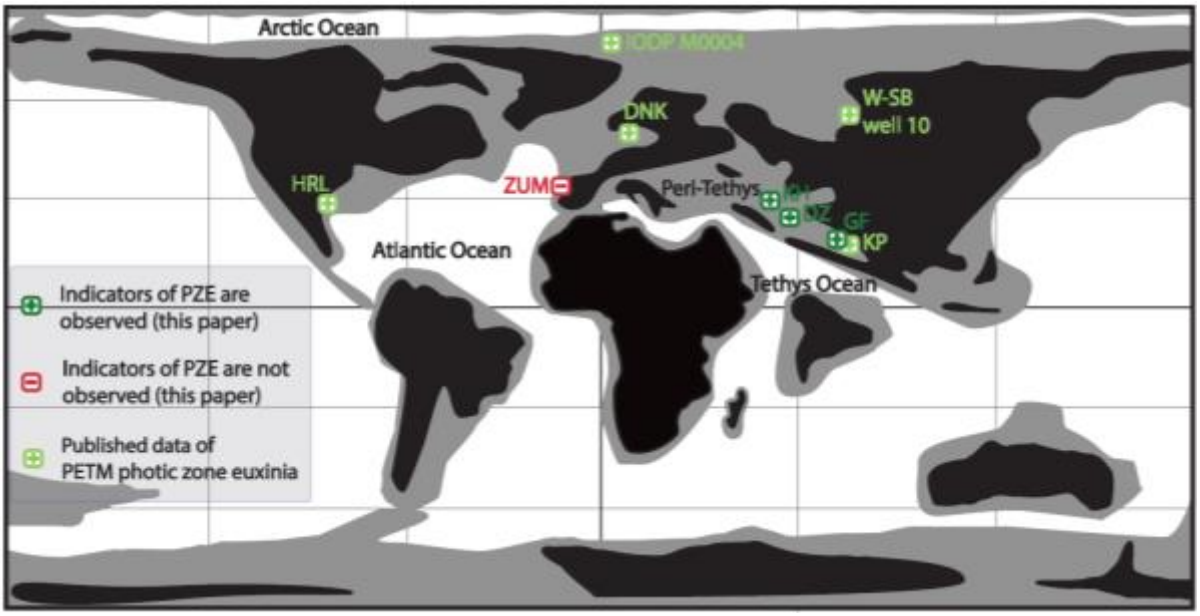

Figure 1 *Occurrence of isorenieratane during the PETM. PETM sediments from Dzhengutay (DZ), Guru Fatima (GF) and Kheu River (KH) contain isorenieratane, suggesting the presence of photic zone euxinia (PZE) (dark green marks). Isorenieratane was not observed in Zumaia (ZUM), (red mark). Published data on PZE during the PETM (discussed in the text; bright green marks): HRL (Gulf Costal Plain); IODP Site M0004 (Arctic Ocean); DNK (North Sea); W-SB, well 10 (West Siberian Sea), KP (Tadjik depression). Note that in all cases,*

isorenieratene derivatives occur only in PETM sediments and not in over- our underlying horizons). Paleogeographic reconstruction from www.scotese.com.

Results and Conclusions

We analyses a wide range of biomarkers, but focus here on the spread of PZE during the PETM using the presence/absence of the biomarker isorenieratane (8). We analyzed sediments from the margins of northern Peri-Tethys (Central Asia: Guru-Fatima, Kheu River, and Dzhengutay) and North Atlantic (northern Spain: Zumaia section) (Figure 1). Our results demonstrates that during the PETM, isorenieratane and hence photic zone euxinia was widespread in the northern Peri-Tethys continental shelf (from the east toward west: Guru-Fatima, Dzhengutay, and Kheu River). However, the PZE was episodic and is not present in all sediments that span the PETM interval, highlighting changes in oxygenation during the event. This episodic nature of PETM anoxia has been previously reported (2) and is attributed to episodic water column ventilation (7). Although the changes in trace fossil assemblage (benthic foraminifera turnover) indicates a decline in oxygen levels in Zumaia PETM section (9), molecular evidence of photic zone euxinia (isorenieratane) was not observed in the northern Atlantic margin site, Zumaia, located on the continental slope and in the less restricted N Atlantic. Collectively, these data suggests that photic zone euxinia during the PETM only developed in restricted continental shelf basins but not in open marginal settings. This is likely driven by the morphology of the restricted basins, acting as nutrient traps that increased productivity and intensified anoxia.

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