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High resolution study on planktonic foraminifera across the Paleocene-Eocene thermal maximum in the expanded Tethyan Forada section (Italy): paleoecological and paleoenvironmental implication

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The Forada section in the Venetian Pre–Alps represents an expanded record of the Paleocene-Eocene Thermal Maximum (PETM) at a depositional paleodepth of about 1 km$\pm$0.5 km with an available sound chronologic model (Giusberti et al., 2007). High-resolution planktonic foraminiferal analysis, in a time interval of approximately 1.2 Myr across the PETM, reveals striking faunal changes that allow the identification of seven phases (a-g). These phases indicate a complex paleoenvironmental evolution in the western central Tethys across the PETM. A marked drop in abundance of the specialized, oligotrophic morozovellids and a significant increase of dissolution suggest that unstable environmental conditions start well before the onset of PETM ($>$ 100kyr).

The dominance of acarininids is a global feature detected in coincidence with the main body of the CIE, both in high- and low-latitude sections. At Forada, we observed two striking spikes in abundance of this group before the onset of the CIE (ca. 30 kyr), and thus heralding the onset of the PETM.

The Forada section is characterized by a huge terrigenous input in correspondence with the main body of the CIE, resulting in an impressive five-fold increase in bulk sediment accumulation rates. This increase in the terrigenous supply is triggered by the PETM supergreen-house conditions, enhancing the hydrological cycle during the event. The augment in weathering and runoff should have produced an increase in nutrient availability in sea surface waters. The high abundance of radiolarians and the sharp decrease exhibited by the calcareous nannofossil oligotrophic taxa appear

consistent with this scenario of enhanced eutrophic conditions (Agnini et al., 2007). Accordingly, the supremacy of acarininids in the lower part of the CIE (ca. 14 kyr) is interpreted as a consequence of the extreme warmth coupled with eutrophic conditions characterizing the Forada section at that time. The recovery in abundance of the specialized morozovellids and of the other planktonic foraminiferal groups (e. g., biserial, globanomalinids, igorinids, planorotalids, pseudohastigerinids) occurring in the middle part of the CIE (ca. 30 kyr after the onset of the PETM) indicates an initial re-establishment of the pre-event conditions. A new stable state is definitely reached in the upper part of the Forada section where the relative proportions of the main component of planktonic foraminiferal assemblages move towards values similar to those of the pre-PETM conditions. These changes coincide with the onset of the CIE recovery interval (ca. 105 kyr after the onset of the PETM), suggesting a decrease in temperature as well as a progressive stratification of the water-column structure, evidenced also by the increasing number of ecological niches occupied. However, the perturbation during the PETM produced significant changes in the ocean geochemistry that endured after the PETM as testified by the prominent high carbonate dissolution characterizing the marly levels and the large variability in the relative abundance among the different components of the assemblage. These striking oscillations were not present in the late Paleocene.

The PETM is characterized by the temporally constrained planktonic foraminifera excursion taxa (PFET), which specifically include *Acarinina sibaiyaensis, A. africana* at Forada. The morphological similarity between the these peculiar species and the radially elongated chambered forms characterizing the Cretaceous anoxic evens supports the hypothesis that their conspicuous occurrence are probably related with a depletion of oxygen in the upper water column. The PETM, albeit representing a prominent environmental perturbation, did not produce significant crisis/extinction on the planktonic foraminifera. On the contrary, it had positive effects on planktonic foraminifera diversity stimulating speciation. Several planktonic foraminiferal lowest and highest occurrences has been identified and may give the opportunity for future finest biostratigraphic subdivisions of this crucial interval.

References

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