The Paleocene/Eocene boundary and emendation of the NP9/NP10 zonal boundary of Martini (1971)

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The reference section for the Paleocene/Eocene boundary (GSSP: Global Standard Stratotype-section) is the Dababiya quarry near Luxor in Egypt. This section is considered the most complete Upper Paleocene to Lower Eocene sequence representative of this boundary with a 2.83 m PETM (Paleocene-Eocene Thermal Maximum) interval (core and phase I intervals according to Röhl et al., 2007). A new analysis of this section based on 56 samples was undertaken in 2022. Samples were collected at 2 cm, 5 cm, and 10 cm by Khozyem et al. (2014). Samples were processed for calcareous nannofossils and prepared on glass slides according to the method (settling technique) described by De Kaenel & Villa (1996). Preservation of nannofossils is exceptionally good except for a 52 cm-thick dissolution interval (devoid of nannofossils) at the base of the PETM. Nannofossil simple diversity varies between 50 and 123 species below and above the barren interval. A total of 180 species were identified from the upper Paleocene to lower Eocene. No reworking was observed.

According to the standard nannofossil zonation of Martini (1971), the NP9/NP10 boundary is placed at the LO (lowest occurrence) of *Tribrachiatus bramlettei* and is usually used to approximate the Paleocene/Eocene boundary. Noting the exact position of the LO of *T. bramlettei* is problematic because of the difficulties in distinguishing specimens of genus *Tribrachiatus* (a triradiate structure superimposed on another trigonal structure) from those of the genus *Rhomboaster* (a cubic/rhombohedral form albeit a flattened or misshapen one) at the top of the PETM core/base recovery phase I intervals. Detailed observations of the structure and geometry of the inter-arms regions between spines are used here to distinguish these two genera, but do not allow precise placement of the NP9/NP10 boundary.

In the literature, the NP9/NP10 is placed within the PETM interval (e.g. Menini et al., 2022), at the base of the genus *Rhomboaster* (e.g. Bybell & Self-Trail, 1997) or well above the PETM interval (Aubry et al., 2000). Discrepancies are related to the position of the LO of *T. bramlettei* and the individual workers method for making (or not making) a distinction between it and *Rhomboaster*. In the Dababiya section, we observed the LO of the genus *Rhomboaster* (small cubic *R. cuspis*) at the base of the NCIE (negative carbon isotope excursion) and therefore at the Paleocene/Eocene boundary and the LO of the genus *Tribrachiatus* at the top of the NCIE. In order to clarify the position of the NP9/NP10 boundary, the following changes to the standard nannofossil zonation of Martini (1971) are introduced:

NP9 – *Discoaster multiradiatus* Zone - emended

Definition: Interval from the LO of *Discoaster multiradiatus* to the LO of the genus *Rhomboaster*.

Authors: Bramlette & Sullivan (1961) emended De Kaenel, Bord & Pospichal.

NP10 – *Tribrachiatus contortus* Zone – emended

Definition: Interval from the LO of the genus *Rhomboaster* to the LO of *Tribrachiatus contortus*.

Authors: Hay (1964) emended De Kaenel, Bord & Pospichal.

These emendations will resolve discrepancies of the position of the NP9/NP10 and bring consistency among biostratigraphers working on the PETM interval. This boundary will be easier to recognize and would unify the stage and biozone boundaries.

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