

Paleocene evolution of the Order Discoasterales (Coccolithophore): biostratigraphic and paleoceanographic implications

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We have investigated the nannofossil- and stable isotope ($\delta^{13}\text{C}_{\text{org}}$, $\delta^{13}\text{C}_{\text{carb}}$, $\delta^{18}\text{O}_{\text{bulk}}$) stratigraphy of the Qreiya section (Eastern Desert, Egypt) across the Danian-Selandian (Middle Paleocene) interval. The 20 m thick section consists for the most part of homogeneous grey mudstones, and spans upper Zone NP4 and lowermost Zone NP5. A 31 cm thick interval of claystone and organic-rich shale constitutes a typical succession that can be traced regionally and is known as the Neo-Duwi Event. We document the appearance ~2 m below the base of the the Neo Duwi record of the hitherto undescribed calcareous nannoplankton genus *Diantholitha* Aubry and Rodriguez, and its diversification (3 species) in a 3 m interval. This taxon, clearly related to the first true Cenozoic genus *Biantholithus*, illuminates the evolution of the Paleocene genera of the Order Discoasterales Hay emend Aubry, and leads us to reconsider the taxonomy of the fasciculiths, which we interpret as representing three evolutionary events, each originating from *Biantholithus*. These are the rise of *Gomphiolithus* Aubry and Rodriguez (e.g., *G. magnus*), *Lithoptychius* Aubry and Rodriguez (e.g., *L. ulii*) and *Fasciculithus* emended Aubry and Rodriguez (e.g., *F. tympaniformis*). These events, which occur, respectively, ~3 m below, 2 m below and 9 m above it, are not related to the Neo-Duwi event. The latter is marked by pronounced positive (~2‰) excursions of the $\delta^{13}\text{C}$ of bulk organic matter and $\delta^{13}\text{C}$ of the bulk carbonates. The former is indicative of high productivity, the latter of reservoir effect as a result of high productivity. Poor preservation (dissolution) and low abundance of coccoliths in this interval hampers satisfactory documentation of the remarkable radiation of *Lithoptychius* (often referred to as the second radiation of the fasciculiths). There are no other isotopic signatures in the vicinity of the evolutionary events. Our study shows that the establishment of major lineages of Paleocene coccolithophores was not directly related to the Neo-Duwi event. In addition, the introduction of new taxa helps improve the stratigraphy of the Danian-Selandian interval.

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