Multiple environmental perturbations in the Nile Basin, Egypt: expressions of hyperthermals?

Peter Stassen[1], Etienne Steurbaut[1,2], Jorinde Sprong[1], André Bornemann[3], Tanja Kouwenhoven[1], Peter Schulte[4], Mohamed Youssef[5], Etienne Steurbaut[1,2], Robert P. Speijer[1]

[1] Dept. of Earth and Environmental Sciences, K.U.Leuven, Leuven, Belgium
[2] Dept. Paleontology, Royal Belgian Institute of Natural Sciences, Brussels, Belgium
[3] Institut für Geophysik und Geologie, Universität Leipzig, Leipzig, Germany
[4] GeoZentrum Nordbayern, Universität Erlangen–Nürnberg, Erlangen, Germany
[5] Geology Department, Faculty of Science, South Valley University, Qena, Egypt

Since the recognition of the Paleocene-Eocene thermal maximum as a global hyperthermal event, focus has shifted to the periods following and preceding the PETM in order to assess whether the PETM was a unique biotic event, or rather just one in a succession of early Paleogene hyperthermals, albeit the most severe one. We discuss data of three environmental perturbations that have been linked to hyperthermals, namely the Latest Danian Event (LDE, Qreiya section), PETM (Dababiya section) and Eocene thermal maximum 2 (ETM-2, Dababiya section), comparing these to the long term regional trend (Aweina section). High-resolution observations show remarkable similarities between the three event deposits with respect to lithologic and paleoecologic disruptions. This points to similar processes operating in the Nile Basin and seems to suggest the occurrence of at least two hyperthermal events mimicking the PETM.

The lower event beds of the LDE and PETM are dark organic-rich marls and shales with abundant coprolites and fish remains. In their lower part, these beds are laminated and devoid of benthic life, pointing to severe oxygen deficiency at the sea floor. In the succeeding beds, pioneering faunas consisting of recolonizing opportunistic species (respectively *Neoeponides duwi* and *Anomalinoides aegyptiacus*) represent repopulation associated with ameliorating conditions at the sea floor. $\delta^{13}C_{org}$ isotope records reveal the well-known rapid 3‰ negative excursion at the PETM, whereas the LDE shows a 1‰ negative excursion, followed by a short-lived 3‰ positive excursion. In contrast, ETM-2 event beds are brownish shales with few fish remains and with no indications for severe oxygen deficiency. The absence of pioneering fauna suggests that no complete collapse of the ecosystem occurred, although biotic shifts are present. ETM-2 corresponds to a short-lived 3‰ positive $\delta^{13}C_{org}$ excursion followed by a gradual 6‰ negative excursion. The recovery phases of all three events are associated with calcarenitic limestones suggesting periods of condensation during the recovery phases of the carbon cycle perturbation and the ecosystem.

During all three events, benthic foraminiferal turnovers and associated anomalous planktic foraminiferal assemblages (*Acarinina* blooms) indicate transient environmental anomalies, disrupting the ecosystems of the entire water column. In comparison to long term ecologic trends, these events represent unique biotic reactions. These periods appear to be associated with rapidly rising sea levels, fluctuating sedimentation rates and higher organic carbon fluxes. The positive isotope excursions may reflect the effect of water-mass stratification under high productivity regimes. In summary, the local paleoenvironmental changes during all three events were similar but different in magnitude and are probably related to changes in productivity and sea level.