Can the PETM events be recognized in the geochemical compositions of phosphatic fossils of Morocco?

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Fossil rich shallow marine phosphorites are widespread along the western coast of Morocco. They were deposited during the late Cretaceous-early Eocene in three, first order transgressive-regressive cycles, with main discontinuities between them. The ages of these series are Maastrichtian, Danian-Thanetian and Ypresian based on the abundant selachian fauna[1]. These sediments give the opportunity to investigate the major global changes (e.g. K/T and P/E transitions) in this shallow marine milieu and to verify if the characteristics of these events are preserved and/or identifiable.

Here we focus on the early Paleogene beds and the Paleocene-Eocene transition. During comprehensive fieldwork marine fossils, mainly shark teeth and coprolites were collected bed by bed in the Ouled Abdoun Basin at Sidi Chenanne quarries. These fossils were analyzed for stable isotope ($\delta^{18}O$, $\delta^{13}C$) and trace element compositions to better assess paleoenvironmental conditions and to test whether these fossils reflect any of the early Paleogene climatic events and the related negative carbon isotope excursions[2].

The phosphate oxygen isotope compositions of shark teeth vary a lot across the entire series, which partly relate to the habitat of the sharks. Despite the large variation, a general isotope trend is apparent with decreasing $\delta^{18}O_{PO4}$ values from the Danian till the Ypresian, which shift can be linked to the globally recognized Early Eocene Climatic Optimum[2].

The carbon isotope composition of shark teeth enameloid have mostly positive $\delta^{13}C$ values, which might relate to dissolved inorganic carbon (DIC) in seawater at the time. Dentine, bones and coprolites always yielded negative $\delta^{13}C$. Coprolites vary the most, reflecting the burial environment, where the pore-fluid's DIC was dominated by intensive organic matter recycling. Bone-beds show larger variations in $\delta^{13}C$ values that could be caused by reworked specimens and by possible enhanced oxidation in these levels. From the base of the Ypresian the relatively more negative $\delta^{13}C$ values are compatible with global observation[2]. Some of the lowest $\delta^{13}C$ values appear in the intercalary bed between the phosphorite beds II and I, which might relate to the Paleocene-Eocene boundary event, in agreement with selachian faunas, although gap in sedimentation between these levels makes very tentative any interpretation here.

The trace element data revealed the general fossilization patterns of biogenic apatite with enhanced rare earth element (REE) concentration linked to the early diagenetic environment. All the fossils shows very alike REE pattern that mimic modern seawater composition with negative Ce-anomaly and heavy REE enrichment. A gradual shift towards more pronounced Ce-anomaly from older to younger beds is evident, which may relate to changes in seawater depth and/or influx of more oxygenated seawater in the basin.

Additionally, preliminary data from the Paleocene-Cretaceous beds of the Ganntour Basin is also presented as an extension of the Ouled Abdoun dataset.

[1] Noubhani A., Cappetta H. (1997). *Les Orectolobiformes, Carcharhiniformes et Myliobatiformes (Elasmobranchii, Neoselachii) des bassins à phosphate du Maroc (Maastrichtien-Lutétien basal). Systématique, biostratigraphie, évolution et dynamique des faunes.* Palaeo Ichthyologica, Volume 8, 327 p.

[2] Zachos J. C. *et al.* (2003). *An early Cenozoic perspective on greenhouse warming and carbon-cycle dynamics*. Nature, n°451, pp 279-283.