Decoupled phosphorus and organic-carbon cycles in anoxic sediments: new data from Italian Bonarelli Levels (C/T boundary)

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During the Cretaceous Period, marine environments were characterized, for short time intervals and on a global scale, by massive accumulation of organic carbon ($C_{org}$) with a concomitant positive shift in carbon-isotope values of both marine carbonate and marine/terrestrial organic matter. The mechanisms causing these episodes, named oceanic anoxic events (OAEs), remains uncertain and the main causes invoked imply ocean stagnation and/or the enhanced surface-water productivity. To explain the substantial positive shift in $\delta^{13}C_{org}$ and $\delta^{13}C_{carb}$, another model was proposed (van Cappellen and Ingall, 1994) based on, as positive feedback, the decoupling of the phosphorus and organic carbon cycles in organic-rich sediments. More effective regeneration of organic phosphorus under anoxic conditions can lead to an increase in dissolved oceanic phosphate, which in turn stimulates surface-water productivity. This model is consistent with a variable $C_{org}$:$P_{tot}$ ratio dependent on prevailing environmental conditions. In particular, this ratio increases at the base of the $\delta^{13}C_{org}$ excursion probably as a consequence of the phosphorus regeneration, amplifying enhanced productivity and $^{12}C$-enriched organic-carbon burial.

In this work, we investigate the $C_{org}$:$P_{tot}$ ratio variations in three Italian Bonarelli Levels (sedimentary expression of Cenomanian–Turonian OAE2; Bottaccione, Novara di Sicilia, and Calabianca sections) comparing them with the Tarfaya section (Morocco; data from Nederbragt et al., 2004) in which the authors applied a two-box model for the carbon and phosphorus fluxes. The investigated sections have been
previously correlated using biostratigraphic data and $C_{\text{carb}}$ and $C_{\text{org}}$ isotope records (Scopelliti et al., this volume).

Our preliminary data indicate, in all investigated sections, increased $C_{\text{org}}:P_{\text{tot}}$ ratios coeval with the $\delta^{13}C_{\text{org}}$ and $\delta^{13}C_{\text{carb}}$ positive excursions, suggesting that phosphorus regeneration may have been significant in promoting continuous high productivity during the Cenomanian–Turonian Oceanic Anoxic Event.

References