Geophysical Research Abstracts, Vol. 8, 08468, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08468

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_{carb} and C_{org} isotope records (Scopelliti et al., this volume).

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

References

Nederbragt et al., 2004. J. Geol. Soc. (London), 161, 721-728.

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