Geophysical Research Abstracts, Vol. 9, 00373, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00373

What do black shales and red beds have in common?

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So-called Cretaceous Oceanic Red Beds (CORBs) frequently follow periods of black shale deposition. This, in turn, has led to some suggestions that the two are somehow causally related. This presentation is a speculative look at the geochemical pathways that may connect CORBs and black shales and what may cause one to lead to the other.

Drawing on a geochemical study focusing on OAE 2, we are able to construct a plausible mechanism that causally links these phenomena given the similarities between the phosphorus and iron (Fe) cycles. Phosphorus mass accumulation rates (P MARs) in Tethyan and Western Interior realms peak at the onset OAE 2's δ^{13}C positive isotope excursion. This is possibly due to the mechanical reworking of continental margins during a period of maximum sea-level transgression. A subsequent decrease in P MARs before the isotope plateau was probably caused by 1) capping of drowned sediments and 2) decreased oxygen availability in pore waters reducing the ability of the sediments to retain phosphorus.

If we assume that bottom oxygen levels were the primary control on P burial, it would be logical to predict an increase in P MARs at the end of OAE 2. We present evidence for this in an Egyptian section. Although more sections need to be analyzed we can confidently say that, given the redox links between P and Fe, the Fe cycle should behave in a similar way. If Fe accumulation increases after OAE 2, it is likely to be for the same reason(s) that drove the increase in P. Therefore the formation of black shales and red beds can be seen as a series of redox thresholds where P and Fe are in

dynamic equilibrium with oceanic and atmospheric O_2 content.

A second aspect of this presentation illustrates how red bed formation maybe diachronous, even if they were caused by the same event. The gradual extinction of certain species of planktonic foraminifera clearly shows that the expansion of the oxygen minimum zone, during OAE 2, was not geologically instantaneous (i.e. it occurred over some 10's of ka). If Fe is controlled by bottom water O_2 content then it is possible that the stepwise expansion and contraction of the OMZ affected environments at different times. This may explain why differences in the age estimates for the onset of CORB deposition occur. Conflicting ages could be reconciled with a deeper appreciation of how a sections paleodepth affects the timing of geochemical pore-water changes.