Cretaceous anoxic and oxic marine depositional intervals in the Romanian Carpathians: causes and consequences

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A significant change, from a Lower Cretaceous anoxic setting to an Upper Cretaceous oxic one, reflected in the deposition of red shales, took place in the Eastern Carpathians. This change might be related to the important palaeogeographic modifications, initiated by Albian tectonics, leading to a shift of the restricted circulation that characterized the anoxic basins of the Moldavian Trough to an open circulation among these semi-isolated basins.

The red shales (Cretaceous Oceanic Red Beds – CORB, Wagreich, 2009) are known to occur from the Lower-Upper Cretaceous boundary interval in the Tethyan and Boreal realms; in some areas, including the Romanian Carpathians, their deposition lasted up to end of the Cretaceous. Some of CORBs are seen as a consequence of the Lower Cretaceous anoxic events, which the appearance changed the geochemistry of the world ocean. Even the overall Upper Cretaceous marine setting was supposed to be oxic, temporally it was disrupted by the occurrence of thin rich-organic black shales, associated with high TOC content and enclosing significant excursion of the isotope $\delta^{13}C$, overprints of the Oceanic Anoxic Events (Jarvis *et al*., 2006).

Several OAEs are pointed out in the Eastern Carpathian Moldavide nappes, including the OAE1d (the Albian-Cenomanian Boundary Event) and the OAE2 (the Cenomanian-Turonian Boundary Event) in a depositional interval supposed to be an oxic one. This sandwiched occurrence probably mirror significant climate modifications, such as periodically and frequent replacement of the greenhouse related to the OAE setting by a cold climate of CORB intervals. This hypothesis may be true for deep marine basins, where red shales sedimented below the CCD. In such a setting, the oxic bottom conditions may be jointly caused by active bottom ocean circulation and modification in the ocean-atmosphere oxygen content. In contrast, some of the Upper Cretaceous CORBs were deposited in shallow water, well above CCD (*i.e*., within the Santonian-Campanian interval of the western Southern Carpathians); there, their presence suggests a warm arid climate, implying accumulation of red soils on emerged coastal plains, redeposited by transgressions in a marine environment. To conclude, the transition from an anoxic depositional regime to an oxic one seems to be a mid-Cretaceous worldwide event, but besides global changes, regional modifications may have a significant contribution.

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REFERENCES

Jarvis, I., Gale, A.S., Jenkyns, H.G., Pearch, M.A., 2006. Secular variations in Late Cretaceous carbon isotopes: a new $\delta^{13}C$ carbonate reference curve for the Cenomanian–Campanian (99.6–70.6 Ma). *Geological Magazine* 143 (5), 561–608.

Wagreich, M., 2009. Stratigraphic constraints on climate control of Lower Cretaceous oceanic red beds in the Northern Calcareous Alps (Austria). *SEPM Special Publication* 91, 91–98.