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From grey to red pelagic sediments during the Turonian – A benthic foraminifera perspective

Ines Wendler[1]; J. Wendler[1] & M. Wagreich[2]

1University of Bremen, Fachbereich 5 - Department of Geolocial Sciences, Postfach 330440, 28334 Bremen, Germany - flatter@uni-bremen.de
2 University of Vienna, Department of Geolocial Sciences, Althanstrasse 14, A-1090 Wien, Austria

While the Early Cretaceous was characterized by periods of marine black shale deposition, widespread deposition of marine red beds in pelagic as well as in shallow water environments started in the Turonian, with apparent peak abundances in the Santonian to early Campanian and late Campanian to Maastrichtian. Red colored marine sediments form when Fe is oxidized and bound in iron oxides. This chemical reaction is only possible under absence of larger amounts of organic carbon, as organic matter degradation leads to reducing conditions precluding the formation of iron oxides. Oxidation of organic carbon is mainly controlled by (1) the amount of available oxygen in the bottom- and sediment pore water, (2) the amount of organic carbon (C_{org}-flux) and (3) the oxygen exposure time (dependent on the sediment accumulation rate). Thus, the syn-sedimentary and early diagenetic redox conditions are the result of the interplay of these three factors which, in turn, are modulated by the global changes of ocean circulation and climate. The general global cooling and reorganization of the ocean circulation in the Late Cretaceous certainly are major factors which must have had an influence on the oxygenation of the deep water. However, detailed concepts for the explanation of the formation and distribution of marine red-beds in the Upper Cretaceous are still not available.

The studied Buchberg section is part of the Ultrahelvetic units of Upper Austria which represent sedimentation on the European passive continental margin during the Cretaceous. The 7 m long profile comprises a succession of planktonic foraminifera-rich marls and limestone with a transition from grey to red colors, and was studied at high resolution for the content on benthic foraminifera as well as the mineralogical composition. The section can be assigned to nannofossil standard zones CC10 to CC12 (UC3 – UC8a). *Helvetoglobotruncana helvetica* is present in the grey to red transitional interval and gives evidence for an early to middle Turonian age of the marine red beds. Strontium isotope stratigraphy also confirms a Turonian age of the succession. The red sediment color is restricted to discrete beds pointing to a syn-depositional to early diagenetic formation. It is interesting to note that the oxic conditions which lead to the red sediment color must have established in several steps.

The Buchberg section exposes alternations between red and grey marls as well as between red and grey limestone, indicating that sedimentation rate and productivity are most probably not the only factors controlling the color distribution and that the oxygen content of the bottom water must have changed several times during this period. This can also be inferred from the changing vertical distribution patterns of benthic foraminifera in relation to the sediment color. Very high abundance of species which are regarded to be typical for increased organic matter flux rates to the sea floor and slightly reduced oxygen levels such as *Tappanina laciniosa* and *Praebulimina elata* (Kuhnt & Wiedmann, 1995. *American Association of Petroleum Geologists Studies in Geology*, *40*: 213-231; Friedrich & Erbacher, in press. *Cretaceous Research*) occurs just before the changes from grey to red colors and is followed by peaks of pyrite, iron-hydroxides and iron-oxides. This indicates that the deposits reflect changing conditions at the sea floor which could have led to the preservation of early diagenetic redox fronts in the sediments.

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