Geophysical Research Abstracts, Vol. 7, 06131, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06131

Geochemical and Stable Isotope Data for Reconstruction of Nutrient Distribution and Oxidation State in Upper Cretaceous Oceanic Red Beds

S. Neuhuber, M. Wagreich
Institute of Geological Sciences, University of Vienna, Austria

1 Objectives

The mechanisms of deposition in an Upper Santonian pelagic ultrahelvetic succession are investigated mineralogically and geochemically. The investigated profile constitutes of red and white to light grey marls, which alternate regularly and lies within the total range zone of Dicarinella asymetrica.Stable isotope analysis on foraminifer shells and bulk geochemistry combines the information from surface water and early diagenetic processes in the sediment porewater after deposition. A combination of this information should reveal the conditions of sediment deposition and allow speculation on the mechanisms that resulted in this distinct facies.

2 Methods

The carbonate fraction was selectively dissolved in pH 5-buffered acetic acid. Main elements and accessories were determined by ICP-MS.

δ^{18}O and δ^{13}C was determined on tests of foraminifer from different size fractions, and in bulk samples. Element plots of δ^{18}O and δ^{13}C and Mn/Sr versus δ^{13}C (Jacobson & Kaufman 1999) reveal no diagenetic alteration of the initial isotope signal.

3 Results and Discussion

Abundant minerals investigated by XRD in both the red and white marls are calcite, quartz, muscovite, chlorite, and kaolinite. Most likely, feldspar weathering under humid conditions resulted in the formation of kaolinite. In general, the mineralogical composition stays constant over the profile. This indicates the same source area for terrigenous input over time. The carbonate content of the white layers (80%) is generally higher than in the red layers (50-70%). Hematite reflexes could be identified in the terrigenous residue of two thirds of the red marls.

The carbonate fraction of the red marls is enriched in Ba, P, Cu, and Zn. P is a limiting nutrient in today's ocean. Cu and Zn are trace elements, which are necessary for phytoplankton growth and Ba is attached to calcitic tests and cycles similar to nutrients in the water column (Lea and Boyle, 1989). In a broad sense these elements indicate higher release of nutrients preserved in the red layers.

The white calcareous marls are enriched in Fe, U, Cd, V, and Sr. Since only Fe^{2+} can substitute for Ca^{2+} in carbonates and iron can only diffuse in reduced form, the redox conditions at the time of formation of these carbonates were at least suboxic. This implies, that parts of the calcite fraction formed postdepositionally under reducing conditions during early diagenesis and is by no means a primary signal from the upper water column.

The mechanism of release of Fe^{2+} from Fe^{3+} minerals is governed by the rate of bacterial organic matter respiration.

The foraminifer assemblages constitute of red and white tests, which show slightly different stable isotope distribution. Red tests tend to have a higher δ^{18}O compared to white tests. This points towards higher temperatures during secretion of the tests. White tests represent generally lower temperatures.

White tests also tend to have a higher δ^{13}C content. This may indicate that the white tests were sequestered under high productivity conditions.

In conclusion, the red layers represent time periods with higher terrigenous input where a sufficient oxygen supply resulted in a complete oxidation of organic matter within the water column. The white layers represent suboxic conditions with less terrigenous input but higher organic matter respiration within the lower water column or postdepositionally in the carbonaceous ooze.

4 References

Lea D.W, Boyle, E.A. (1989) Barium content of benthic foraminifera controlled by bottom water composition. Nature 338 751-753.

Jacobsen, S.B., Kaufman A.J. (1999) The Sr, C and O isotopic evolution of Neoproterozoic seawater. Chemical Geology 161 37-57.