Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08484, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08484
EGU General Assembly 2008

Absence of anoxic conditions during OAE 2 in the Helvetic realm?

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The Cretaceous is characterized by short periods during which widespread oceanic anoxic conditions developed, documented by the extensive deposition of organic carbon–rich sediments (Schlanger and Jenkyns, 1976). Amongst these periods the Cenomanian-Turonian boundary interval (oceanic anoxic event 2: OAE 2) represents the one which is most intensely studied (Schlanger and Jenkyns, 1976; Jenkyns, 1980; Jenkyns et al., 1994; Strasser et al., 2001; Leckie et al., 2002; Caron et al., 2006; Mort et al., 2007).

In the helvetic zone of the northern Alps, which documents a fully pelagic outer-shelf zone of the northern Tethyan margin, sediments coeval with OAE 2 are rather exceptional in that organic carbon-rich layers have not been observed. In our study, we aim at verifying if changes in nutrient levels and oxic conditions can be geochemically traced in this zone. We selected an expanded section through the OAE-2 time interval at Chrummflueschlucht (E of Euthal, Ct Schwyz) and carried out biostratigraphic (planktonic foraminfera), chemostratigraphic (C and O stable isotopes on bulk rock) and geochemical analyses (total phosphorus and trace-metal contents).

Using thin sections, we were able to determine - with some remaining uncertainties - the different planktonic foraminiferal biozones characteristic of the Cenomanian-Turonian boundary interval (*Rotalipora reicheli*, *Rotalipora cushmani*, *Whiteinella*

archeocretacea zone and *Helvetoglobotruncana helvetica* zones).

In the first part of the section (*R. cushmani* zone) the whole-rock δ^{13}C curve shows a long-term increase. Within sediments attributed to the *W. archeocretacea* zone, the values reach a maximum of 3.30‰. Consequently the values decrease and increase again to arrive at a plateau with high δ^{13}C values of around 3.10‰. At the top of the section, in sediments belonging to the *H. helvetica* zone, the δ^{13}C record decreases to post-OAE values (approximately 2.25 ‰). The extinction of *R. cushmani* is observed just above the positive shift of δ^{13}C that characterizes OAE 2.

The average redox sensitive trace element contents (U, V, As, Co, Mo and Mn) remain low along the entire section and appreciable trace-metal enrichments have not been observed for the sedimentary interval corresponding to OAE 2.

Phosphorus (P) contents display small variations along the section with a long-term decreasing trend towards the top. Superimposed on this trend, P values reach a maximum in sediments at the transition of the *R. cushmani* and *W. archeocretacea* zones. This is coeval with the onset of the anoxic event. During the OAE 2, P values remain low and show a small increase at the end of the positive shift in the δ^{13}C record (in the *H. helvetica* zone).

Our results show that the section of Chrummflueschlucht corresponds to one of the most complete sections for the Cenomanian-Turonian boundary interval in the helvetic realm. The evolution of P contents suggests increased nutrient input at the onset of the anoxic event. However, the trend in TM contents suggests that the Helvetic realm has not been affected by strong oxygen depletion during OAE 2, despite its pelagic position. Anoxic conditions were, however, identified in deeper, outer-shelf and slope segments along the northern Tethyan margin (Grosheny et al., 2006, Wagreich et al., submitted).

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