



Biostratigraphy and strontium isotope stratigraphy of Austrian CORB

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Late Cretaceous oceanic red beds (CORBs) occur in the Austrian-Bavarian part of the Eastern Alps within a palaeogeographic north-south transect from the southern margin of the European Plate (Helvetic/Ultrahelvetic domain) to the Penninic Ocean (Rhenodanubic Flysch Zone) and the Austroalpine microplate to the south, including the Northern Calcareous Alps.

The oldest occurrences of CORB are reported from the Northern Calcareous Alps. Here, the middle/upper Aptian *Hedbergella*-limestone marks the boundary between Aptian limestones and the overlying shales of the Tannheim Formation. These limestones constitute a condensed facies extremely rich in planktonic foraminifera of the genus *Hedbergella* and other non-keeled genera. First strontium isotope data confirm a Late Aptian age.

In the Rhenodanubian Flysch Zone the lowermost interval of red shales (Untere Bunte Schiefer) has been dated as latest Albian to lower Cenomanian. In the Oberaschau section (Upper Austria) an 18 m thick interval of alternating red and grey shales and marlstones with minor sandstones is present. Dinoflagellate cyst assemblages indicate the *Litosphaeridium siphoniphorum* Zone. The concurrent presence of *Litosphaeridium siphoniphorum* and *Ovoidinium verrucosum* in all samples allows a correlation to the lower part of this zone. Based on foraminifera the red beds can be assigned to the topmost *Rotalipora apenninica* Zone and the *Rotalipora globotruncanoides* Zone due to the presence of small morphotypes of the index taxa. Nannofossils indicate standard zone CC9/UC0 throughout the red interval, defined by the first occurrence of *Eiffellithus turriseiffelli*, and UC1 above the red shales. Higher up in the section, CORB occur in the Coniacian-Early Campanian (Seisenburg Formation) and in the

Late Campanian (Perneck Formation, nannozone CC22). CORBs in the Rhenodanubian Flysch Zone are mainly controlled tectonically by low clastic input and low turbidite frequencies.

In the Helvetic (shelf) and Ultrahelvetic (slope) part of the European margin, the proportion of CORBs within the Upper Cretaceous successions increases significantly with increasing water depth and increasing pelagic character of the marls and limestones. Within the outer shelf pelagic grey limestones of the Seewen Formation (Seewerkalk) of Vorarlberg red intervals are generally rare. A few tens of centimeters thin reddish intercalations are present in the Turonian and Santonian. Further downslope, in the Ultrahelvetic realm (Liebenstein Nappe, Vorarlberg) red intervals increase and are present both in the Liebenstein limestone (Turonian-Santonian) and the Leimern Formation (mainly Campanian). In the Ultrahelvetic units of Upper Austria (Rehkogelgraben, Buchberg) CORB define a continuous red interval from the early Turonian (*Helvetotruncana helvetica* Zone; nannofossil zones CC11/UC7 - FO of *Quadrum gartneri*) to the lowermost Campanian (*Dicarinella asymetrica* – *Globotruncanita elevata* Zone and lowermost part of *Globotruncanita elevata* Zone, CC17b/UC13). The onset of CORB deposition in the Ultrahelvetic Zone seems to correspond to a major change in paleoceanographic conditions from anoxic during the Late Cenomanian OAE 2 to highly oxic during the early to middle Turonian. The end of CORB deposition in the Ultrahelvetic realm seems to be controlled mainly by increasing clastic input and a shallowing of the basin.

In the Austroalpine Northern Calcareous Alps, after tectonism during Cenomanian-Turonian times, CORB occur from the middle Santonian onwards within the upper parts of transgressive sequences of the Gosau Group, e.g. in the Tiefenbach section (Brandenberg; *D. asymetrica* Zone) and the Gosau section (early Campanian, *Dicarinella asymetrica* – *Globotruncanita elevata* Zone). In areas where clastic input was low, CORB deposition continued up into the Maastrichtian, e.g. in the Postalm section. Strontium Isotope Stratigraphy has been applied to these sections. Based on these data a peak of oceanic red beds is inferred for the middle Santonian - Early Campanian.