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Carnian black shale events triggered by Cimmerian-Eurasian collision?

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Introduction

Well known as the “Raibl Event” or “Reingraben Turnover” (Schlager and Schöllnberger 1974) the sudden anoxic event followed by strong terrigenous influx is noted on top of Carnian carbonate platforms, intraplatform basins and in the Hallstatt continental margin area. Outcrops near Bad Dürrnberg (Salzkammergut, Austria) and near Lunz (Lower Austria) allowed an investigation of continuous sections including the Carnian Turnover.

By using lithologic and microfacies analyses, bed to bed sampling and analysis of conodont faunas, we found out a biostratigraphic graduation in conodont zones and, therefore, an approximate temporal attribution of the lithological units. The identified sequences of an anoxic event, which is followed by strong terrigenous input, might be explained by changes of oceanic and climatic circulations forced by coincident Cimmerian orogeny.

The Carnian in the Salzkammergut and Lower Austria

A) Lithology

The sequences outcropping in the Freygutweg section and the Jakobberg gallery (near Bad Dürrnberg, 2 km SSW Hallein) can be combined to a more or less complete but condensed standard section including the uppermost Langobardian to lower Lacian with a lithostratigraphical succession as follows: (**1)** Thick bedded grey limestones can be classified as burrowed biogenic packstones with both detritical reefal ("Tubiphytes", peloids, ostracods, gastropods, etc.) as well as pelagic components (e.g. filaments). (**2)** Thinly bedded greenish marly limestones, followed by (**3)** an alternation of ochre-coloured limestones and marls (calciclastic and thrombolite bindstones). After a very distinct sedimentary boundary, the latter unit is followed by (**4)** dark grey to black-coloured Reingraben Shales containing calcareous intercalations (bioturbate pelagic packstones at the base developing into unfossiliferous thinly laminated limestones towards the top). After a thin bedded reworked horizon, (**5)** well bedded red nodular/flaser limestones (filament-, crinoid-, and radiolarian packstones with solely pelagic microfauna) lead over to **6)** bedded light-coloured limestones anew showing "regular" mixture of both reefal and pelagic components.

The lithology of the Reingraben Turnover in the Reifling Basin (shelf area) has slight differences to the Hallstatt facies belt. The Polzberggraben section (4 km NE Lunz) exposes the boundary between upper Reifling limestones and the Göstling black limestones. Latter were covered by dark Reingraben Shales.

Due to their classification as biogenic packstones containing both reefal and pelagic components, the uppermost Reifling Limestones should be compared to the thick bedded grey limestones from the Salzkammergut area. The dark greyish-coloured, thinbedded Göstling Limestones describing fine laminated radiolarian limestones with rare conodonts and diminished microfauna, were overlain by dark unfossiliferous Reingraben Shales. They include in their lower part – analogical to the Salzkammergut section –few calcareous intercalations.

B) Biostratigraphy

Dating of the sections has to be based on conodonts as megafossils are completely missing. A detailed Lower Carnian conodont zonation has been proposed by Krystyn in Gallet et al. (1994). This zonation, however, is based on species (i.e. *G. auriformis, "E." carnica*) which are missing in the Salzkammergut section. The limestones below and within the Reingraben Shales have delivered a depauperate faunule of *G. polygnathiformis* and *Gl. tethydis* allowing only a general age assignment of middle to late Lower Carnian (*aonoides* to *austriacum* ammonite zone resp. *tethydis* conodont zone).

Stratigraphically important is the disappearance of *Gl. tethydis* on top of the shales. This proofs the exclusive Lower Carnian age of the Reingraben terrigenous interval in the Hallstatt facies of Berchtesgaden and most probably elsewhere.

During the first phase of field work at the Polzberggraben section, 0,75 m or 11 beds around the lithological boundary between the Reifling and Göstling Limestones were sampled and checked for their conodont content. Only two layers, the uppermost one of the Reifling Limestones and bed 9 of the Göstling Limestones (0,35 m above base) yielded conodonts. *G. polygnathiformis* and *Gl. tethydis* occur in the uppermost Reifling beds, both of limited biostratigraphic use as mentioned above. The Göstling sample contained "*Epigondolella" carnica*, a stratigraphically important species characterising a short-termed horizon of a few 100 ka within the upper Lower Carnian. The onset of the Göstling Limestone can thus be dated exactly in the topmost *aonoides* Zone and according to data from other sections is an isochronous event within the Reifling basin (Krystyn, unpublished data).

Discussion

At least three lithological turnovers are notable in the Hallstatt basinal succession: (**1)** the ochre-coloured limestones (thrombolite bindstones) on top of the lower thick bedded grey limestones with reefal detritus, (**2)** the very distinct insertion of black Reingraben Shales and siltstones and (**3)** the sudden change between black shales and nodular red flaser limestones. The events point to a major reorganisation in the Western Tethyan deep water circulation.

Because of the synchrony of Wetterstein carbonate platforms, "intrabasinal" Reifling Limestones and basinal thick bedded grey limestones, we presume the contemporaneity of the black Göstling Limestones and the ochre-coloured limestones in the Hallstatt basin ("Göstling Event"). According to the conodont data, this turnover was settled around the boundary between the *Aonoides* and the *Austriacum* Zone. The subsequent black shale event, namely the insertion of Reingraben Shales (basinal: "Reingraben" Event, "Raibl" Event in the shelves) should be settled in the lower *austriacum* ammonite zone representing late Lower Carnian. The paralic "Lunz" Event (terrigenous influx of siliciclastics) in the eastern and western Northern Calcareous Alps might be traceable in the silty calcareous interbeds at the top of the Reingraben Shales (upper *austriacum* ammonite zone representing Julian 2/II, see also Tollmann 1976:136).

What are the regional and superimposed mechanisms controlling the abrupt changing in lithology and (micro)palecology? As it was shown by Reijmer and Everaars (1991) for the Rhaetian, also the Carnian basins were profoundly conditioned by the development of adjacent carbonate platforms and shelves. The boundary (**1)** between biogenous limestones with reefal detritus and ochre-coloured thrombolite limestones

without reefal detritus might be initiated by a sudden breakdown of the carbonate factory of the adjacent Wetterstein shelf (drowning). Within a starved basin, the rate of sedimentation was rather diminished, the setting turned from aerobic to dysaerobic (unburrowed thrombolite bindstones). At boundary (**2)**, the system collapses under anaerobic setting and stopped circulation. The sharp boundary (**3)** to the red limestones might be explained with a recovered bottom water circulation and aerobic setting.

As for the same time span strong tectonic movements - the Cimmerian-Eurasian collision - are known from the eastern northern Tethys margin, it is assumed that both, the changes in oceanic circulation and terrigenous sediment supply are triggered by this orogeny. As a consequence of the Cimmerian-Eurasian collision, large areas have been elevated along the northern Tethyan margin forcing the monsoonal climate circulation.

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