Progress in integrated Late Triassic stratigraphy of the Northern Calcareous Alps

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During the Late Triassic, despite new important originations a general decline in biodiversity was marked by a series of steps between the Carnian and the Rhaetian, with the T-J boundary event as final strike. The Reingraben Event and the Julian-Tuvalian boundary are two first massive turnovers; the Carnian-Norian boundary records a major vertebrate turnover, the early to middle Norian boundary comes up with a turnover in both the reefal and pelagic fauna and the most dramatic loss (70%) in biodiversity among Late Triassic molluscs. Around the Norian-Rhaetian boundary, the pelagic fauna of higher trophic level starts declining, whereas the reefs show a blooming time. A refined stratigraphy and a construction of a well-calibrated carbon isotope reference curve are necessary to decipher between gradual environmental changes and abrupt or even catastrophic events during the Late Triassic.

A first step was the formalization of the Late Triassic stages. The base of the Carnian and Hettangian are now formally defined, the base of Norian is still under discussion and the Rhaetian's base is proposed at Steinbergkogel, Austria. Its newly accepted definition is based on the FO of the conodont species Misikella posthernsteini, close to the FO of the ammonoid Paracochloceras suessi, of a radiolarian turnover and of the extinction of most species of the bivalve Monotis. The oldest stratigraphic record of reliably identified coccolithophores lies just below the FO of M. posthernsteini, whereas the FO of the coccolith Crucirhabdus minutus is recorded slightly above. This first appearance takes place along with a discernible increase in abundance of the nannolith Prinsiosphaera triassica, the most important Rhaetian pelagic carbonate producer. These bio-events represent the initiation of the pelagic carbonate production. It is interesting to notice that they occur together with a major turnover in the pelagic fauna of higher trophic level (ammonoids, conodonts, bivalve Monotis) and the beginning of a flourishing time for the reefs.

Improvement in the Upper Triassic delta13Ccarb curve shows that after a gentle increase until the base of the Carnian, the early Carnian records three negative excursions of 2 to 3‰ amplitude. The two first excursions rebound to previous values, whereas the third negative excursion, at the Julian-Tuvalian boundary, is followed by a positive excursion up to +5‰. The remaining upper Carnian displays stabile values around 2‰. The Carnian-Norian boundary interval is marked by a minor increase of less than 1‰. The early to middle Norian crisis is marked by a turning point from lower Norian slowly increasing carbon isotope values to gradually decreasing ones. In the late Norian the isotopic values are relatively stable around 2.5‰, before increasing again in the early Rhaetian and reaching a maximum around the lower-upper Rhaetian boundary. The isotopic record remains constant until the top of the Rhaetian with its significant negative shift identified in a number of marine sections in close proximity to the extinction event.

From an isotopic point of view, only the two lower Carnian excursions, the early-late Carnian boundary and the Triassic-Jurassic boundary can be interpreted as events, whereas other biotic crises of the Late Triassic seem to have occurred during periods of gradual changes in the carbon isotopic composition of seawater.