

Development of early calcareous nannoplankton in the Northern Calcareous Alps (Austria) in the Late Triassic

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Coccolithophorids are among the most productive calcifying organisms on Earth and therefore play an important role in the modern and ancient marine carbon cycle, as a biological pump and as a regulator of surface ocean alkalinity. Though the significance of coccolithophorids in the modern ocean is well constrained, fundamental knowledge gaps still persist regarding the emergence and the early evolution of the calcareous nannofossils in the ancient marine ecosystem, which shifted the major carbonate production from the shallow seas to the open marine realm during the Late Triassic period. The Northern Calcareous Alps (Austria) represent a key study site to tackle the evolution of calcifying plankton throughout the Late Triassic. In this study, the Steinbergkogel section, a candidate for the Global Stratotype Section and Point (GSSP) for the Norian–Rhaetian boundary, and the Zlambach section were investigated for their calcareous nannofossils content using both Scanning Electron Microscopy and Optical Microscopy. These sedimentary successions were deposited either on a topographic (hemipelagic) high or in a toe-of-slope paleo-environment, and are only slightly affected by post-depositional (e.g. diagenetic) overprinting. The studied sections record the dominance of the nannolith, *Prinsiosphaera triassica*, which is known from different other locations worldwide since the early Norian. This species increases slightly in abundance toward the early Rhaetian, reaching rock-forming abundance in the late Rhaetian. The evolution of *P. triassica* is seemingly affected by the occurrence of a second nannolith, from the *Eoconusphaeraceae* family, in the early Rhaetian, which is traceable slightly before the onset of the Zlambach Formation. The latter nannolith is appearing in the upper *Paracochloceras suessi* (early Rhaetian) Zone. The coccolithophorids are present in low abundance throughout in the studied sections, increasing slightly in the middle Rhaetian. Coccoliths were recorded for the first time from the middle Norian (Alaunian). The oldest *Crucirhabdus minutus* and *Archaeozygodiscus koessenensis* were observed in the late Norian (Sevatian) and the First Occurrence Datum (FOD) of *Crucirhabdus primulus* was ascertained in the early Rhaetian. These observations suggest a rather slow temporal diversification of the first coccolithophorids, with millions of years from the ancestor *C. minutus* to *A. koessenensis* and then *C. primulus*.