Early evolution of the calcareous nannofossil during the Upper Triassic, in the Neo- and Palaeo-Tethys Oceans

Isaline Demangel

Department of Geology, Lund University, Sweden. isaline.demangel@geol.lu.se

Sylvain Richoz

Department of Geology, Lund University, Sweden

Silvia Gardin

Center for Research on Palaeobiodiversity and Palaeoenvironments, Sorbonne University, Place Jussieu, 4, 75252 Paris, France

Eugen Grădinaru

Department of Geology, Faculty of Geology & Geophysics, University of Bucharest, Romania

The first occurrence of the calcareous nannofossils and especially coccolithophorids were the scopes of several studies, reporting the oldest coccoliths in the Rhaetian. This project focuses on the early calcareous nannoplankton during the Upper Triassic (Norian-Rhaetian; 227-201.3 Ma) with the aim to understand their impact on the ocean chemistry during this time interval. We investigated their emergence and evolution in terms of abundance and spreading throughout the different latitudes and environments. The sediments analysed cover different palaeolatitudes with sections from the Western and Southern Neo-Tethys Ocean as well as from the Palaeo-Tethys Ocean where no calcareous nannofossil was previously recorded. To tackle the problem of diagenesis and poor preservation often impacting the Upper Triassic sediments and calcareous nannofossil, we used different methodology according to the lithology. Both soft and hard calcareous lithologies were analysed directly using a scanning electron microscope, while for the soft lithologies, the standard smear slides were observed under a light microscope.

Our study reports the first coccoliths, not identified at a species level, in the middle Norian (Alaunian 3; ~215 Ma). The oldest coccolith species identified is *Crucirhabdus minutus*, observed in the upper Norian (Sevatian), followed by *Archaeozygodiscus koessenensis*. *Crucirhabdus primulus* first occurred in the lower Rhaetian. These occurrences suggest *C. minutus* as the ancestor of the coccolithophorids and a slow temporal evolution. *C. primulus* occurred ~ 4.2 Myr after the ancestor *C. minutus*, and the evolution of the new genus *A. koessenensis* takes around 0.35 Myr. Detailed microscopic investigations detected two different inner structures of the conical Rhaetian forms belonging to the *Eoconusphaera*. Based on this, a new species, *E. hallstattensis* was described and *E. zlambachensis* was emended. In the Western Tethys, those two species represent new biostratigraphic markers for the Rhaetian with short and specific occurrence intervals. Those *Eoconusphaera* species present some similar characteristics to the other Mesozoic conical form, i.e. *Mitrolithus*, *Calcivascularis*, and *Conusphaera*, classified nowadays as coccolith. Throughout the Rhaetian, *P. triassica* is affected by biological and environmental stress conditions. First, with the occurrence of Eoconusphaeraceae introducing competition between the *P. triassica* and the Eoconusphaeraceae, and, second palaeoenvironmental changes alter its calcification potential, leading to a size decrease from the lower Rhaetian. These two species, *P. triassica*, and *E. zlambachensis* were observed for the first time in Romanian sections (North Dobrogea) located in the Palaeo-Tethys Ocean during the Late Triassic and are common, if present.

During the Upper Triassic, calcareous nannofossils are observed in both hemispheres but are restricted to the shallow and proximal environment. The *incertae sedis*, *Prinsiosphaera triassica* dominates the assemblage throughout the Upper Triassic. The calcareous nannofossil increase slightly in abundance during the lower and middle Rhaetian and reaches maximum abundance in the upper Rhaetian. However, the comparison between quantification data and calcium isotope measurements does not show any evidence for a significant influence of those calcifiers on the geochemical composition of the Western Neo-Tethys Ocean.