



Cretaceous – Neogene Calcareous Nannofossils from Transylvania, Romania: Evolution and Palaeoecological Data

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Several representative sections from the Cretaceous, Paleogene and Neogene of the Transylvanian depression have been investigated, concerning the calcareous nannofossils. The assemblages have been studied especially in the sections which are present between Petrestii de Jos and Surduc, for the Cretaceous – in the northern part of the Trascau Mountains; for the Paleogene - between Cluj and Turda, and between Huedin and Hodis, on the border of Gilau Massif (Apuseni Mountains); for the Neogene - between Cluj and Turda, and Dej and Bistrita respectively.

The results of the previous studies concerning the calcareous nannofossils of other Cretaceous, Paleogene and Neogene sections of Transylvania are integrated in the current investigation, too.

The nannofloras of the Lower Cretaceous: e.g. Barremian/Aptian boundary show a sharp decrease in abundance of nannoconids. New nannofossil species belonging to *Braarudosphaera* have their FO within the Early Aptian from the Romanian Carpathians bend area. *Nannoconus* species are very common at this boundary, while at the upper part of the boundary sections they become very rare, in a succession approximately corresponding to the “nannoconid crisis”. It was considered that “the nannofloral turnover” started, at least in the Carpathian area, earlier than previously presumed, during the latest Barremian, instead of the earliest Aptian. Some nannofloral events characterize the Turonian – Coniacian interval in Romania. The nannoflora assemblages identified in the Romanian Carpathians were considered typically for low and middle latitudes.

In the Petresti – Borzesti area, the calcareous nannofossil assemblages of Lower Cretaceous age, with *Assipetra terebrodentarius*, *Zeugrhabdotus embergeri*, *Eprolithus cf. antiquus*, *Micrantolithus obtusus*, *Lithraphidites moray-firthensis*, *Cretarhabdus cf. conicus*, *Nannoconus cf. elongatus*, *Cylindralithus cf. nudus*, *Rhabdophidites cf. parallelus*, *Isocrystalithus cf. compactus*, and *Watznaueria barnesae*, indicate the Hauterivian – Albian time interval. They are more similar and can be better integrated to the boreal zonation of Bown et al., 1998. Other studies in the area indicated also the presence of the Upper Cretaceous, too (Upper Campanian – Lower Maastrichtian).

Previously, it was remarked that the forms that are favoured by epicontinental and large shelf areas are: *Nannoconus* spp., *Lithraphidites bolli*, and *Micrantolithus obtusus* a.o. Oceanic assemblages characterise areas remote from the continents, which include *Watznaueria barnesae* a. o. species. The extinctions at the Cretaceous/Tertiary boundary, which is considered, generally, the most dramatic and global event in the group's history, was remarked in the Eastern Carpathians.

The Paleogene deposits occur mainly in the north-western Transylvania, on the border of the Gilau, Meses and Preluca massifs. Representative sections for the Paleogene and for the Eocene/Oligocene boundary are Mera section which was studied also previously concerning the calcareous nannofossils, and Hodis.

The calcareous nannofossils assemblages of the Mera section indicate the NP22 and NP23 zones. For the lower part of Rupelian (corresponding to Merian, the zones are NP21 partim (*Ericsonia subdisticha* Zone), NP22 (*Helicosphaera reticulata* Zone) and NP23 partim (*Sphenolithus predistentus* Zone). At Hodis, nearby Huedin, are present all the terms of the Eocene - Oligocene from Transylvania. The most rich and diversified calcareous nannofossils assemblages are from Brebi (NP21, NP22) and Mera formations (NP22, NP23).

During the Eocene – Oligocene, calcareous nannofossils evolution show that in the Lutetian, Bartonian and Priabonian the assemblages are very scarce and an increasing in diversity was remarked in the upper Priabonian and Rupelian.

Generally, the evolution lines of *Discoaster*, *Sphenolithus*, *Helicosphaera*, important and frequent taxa in Miocene, are considered to be understood, but the filogenetic relationships between their species are not completely elucidated (e.g. *Discoaster druggi*, characteristic for the Early Miocene, is considered to stand at the basis of the evolution of *D. exilis* from the Middle Miocene). In the Early Miocene, among the discoasterids, the forms with 6 bifurcate rays (*Discoaster druggi*, *D. variabilis*) dominated. For the upper part of the Middle Miocene (Sarmatian), discoasterids are less significant. The star-shape discoasters are specific for the Middle and Late Miocene.

Helicospheres are very frequent and diversified especially during the Middle Miocene (Early Badenian), e. g. *Helicosphaera walbersdorfensis* (known from NN5 Zone in the Transylvanian Basin and from NN6 Zone in Subcarpathians), then *H. carteri*, *H. wallichii*, *H. minuta*, *H. orientalis*, *H. waltrans*, *H. stalis*, *H. obliqua*.

Middle Miocene (Badenian – Sarmatian) rhabdolith species appear only in the Central Paratethys (*Rhabdosphaera pannonica*, *R. poculi*).

Reticulofenestrids are frequent and present particularities concerning the dimensions and structure during Miocene.

Detailed observations were made especially for the Badenian (Moravian, Wielician and Kosovian) of the intra- and extra – Carpathian area from Romania.

The characteristics of the the Sarmatian nannofossils consist of the explosive development of some species, which present also smaller global dimensions, belonging to the genera *Calcidiscus* (*C. leptoporus* – with numerous morphotypes, with different configurations of the central area, *C. macintyrei*), then *Braarudosphaera bigelowii*, *Reticulofenestra pseudoumbilicus*, *R. gelida*, *R. minuta*., *Rhabdosphaera pannonica* and *R. poculi*.

At the beginning of the Pannonian time, pronounced changes in the evolution of the calcareous nannofossils were remarked. The salinity decrease in the environment caused the transformations of the Prinsiaceae, widespread in the Sarmatian deposits, into Noelaerhabdaceae, thus determining the endemic character of the Pannonian nannofossil assemblages. These endemic nannofossils show specific features in their evolution. The early form, *Praenoelaerhabdus banatensis* from the Early Pannonian retain characters of the *Reticulofenestra pseudoumbilicus* species. During the Middle Pannonian were individualized *Noelaerhabdus bozinovicae*, *N. bekei*, *N. tegulatus*, *N. jerkovici*, *Bekelithella echinata*, possesing prominent Noelaerhabdaceae features. The morphological intraspecies variability of the *Noelaerhabdus* genus is very reduced in the Late Pannonian, when new species, like *N. bonagali*, *N. mehadicus* occur.