

# CALCAREOUS NANNOFOSSILS OF THE MIDDLE MIOCENE DEPOSITS IN THE CARPATHIAN FOREDEEP, CZECH REPUBLIC

L. ŠVÁBENICKÁ

<sup>1</sup>Czech Geological Survey, Klárov 131/3, P.O.Box 85, CZ-118 21 Praha, Czech Republic; [svab@cgu.cz](mailto:svab@cgu.cz).

**Abstract:** Two nannoplankton horizons were recognized in the Middle Miocene (Lower Badenian) deposits of the Carpathian Foredeep in the territory of the Czech Republic: 1. Horizon with *Helicosphaera waltrans* characterized by prevailing occurrence of other helicoliths indicating shallow epicontinental sea. 2. Horizon with *Sphenolithus heteromorphus* where influx of Miocene nannoflora is evident. It indicates deepening of the depositional area and open-sea conditions and reflects the Lower Badenian transgression.

**Key words:** Carpathian Foredeep, Middle Miocene, Lower Badenian, calcareous nannofossils, biostratigraphy, paleoecology.

## INTRODUCTION

Calcareous nannofossils were studied in the Middle Miocene deposits of the Carpathian Foredeep, Moravia, Czech Republic in view of their use in biostratigraphy and paleoecologic interpretations. The aim of the study was to analyse nannofossil assemblages and changes in their character within the Lower Badenian. (Moravian).

## MATERIAL AND METHODS

Nannofossils were studied from the clays and siliciclastic sediments of the Grund Formation where planktonic foraminifers *Globigerinoides bisphericus* Todd, *Praeorbulina* ex gr. *glomerosa* and *Orbulina suturalis* Brönn. appear (sensu Cicha 2001) and overlying Lower Badenian basal and marginal siliciclastic sediments and clays (“tegel”) that are characterized by occurrence of benthonic species *Vaginulina legumen* (Linné) and Lanzendorf microfauna (Čtyrská & Švábenická 2000). Deposits were sampled in the territory of southern and central Moravia exclusively.

Suspension slides were prepared using a decantation method (separated fraction of 3-30 µm in the following procedure: the heavy fraction was allowed to settle for 3 minutes in a 45-mm water column, the fine fraction for 45 minutes). Slides were inspected with a Nikon light-microscope at

1000x magnification. Biostratigraphic data are compared with the standard nanoplankton NN zones of Martini (1971).

## RESULTS

Based on calcareous nanofossils two distinct horizons can be recognized within the Lower Badenian (Moravian) deposits in Moravia:

### 1. Horizon with *Helicosphaera waltrans*.

Sediments yield medium well or poorly preserved nanofossils. Mechanical damage to coccoliths and etching are apparent making identification of some specimens difficult. Assemblages are represented by high number of helicoliths (*Helicosphaera carteri* and *H. waltrans* prevail; *H. ampliapertura* occurs rarely), and are complemented by small placoliths of family Prinsiaceae (*Reitulofenestra pseudoumbilicus*, *R. haqii*) and occasional occurrences of species *Discoaster exilis*, *Calcidiscus premacintyreii*, *Pontosphaera multipora* and *Sphenolithus heteromorphus*. Taphocoenoses are characterised by high number of reworked Upper Cretaceous and Paleogene nanofossils. Miocene specimens form about 10-20 %. Horizon was observed in the Grund Formation and basal Lower Badenian deposits.

### 2. Horizon with *Sphenolithus heteromorphus*.

Nanofossils form a significant component in sediment and specimens are moderately well preserved. Nevertheless, large placoliths and helicoliths (>10µm in long axis) occur mostly in fragments and the distal rays of discoaster are broken or etched. Assemblages are characterized by high species diversity and show following attributes:

- presence of *Sphenolithus heteromorphus*
- absence of *Helicosphaera waltrans*
- genus *Helicosphaera* is represented by common *H. carteri*. Species *H. walbersdorfensis* has been observed only occasionally, but in higher numbers
- high number of small placoliths of family Prinsiaceae including species *Reticulofenestra minuta*, *R. haqii* and *R. pseudoumbilicus* (forms <5µm and >5µm).

Assemblages are complemented mostly by species *Pontosphaera multipora*, *Umbilicosphaera rotula*, *Calcidiscus premacintyreii*, *C. macintyreii*, *C. leptoporus*, *Discoaster exilis*, *D. variabilis*, large forms of *Coccolithus miopelagicus* (>10µm in size), *Rhabdosphaera* ssp. (sensu Young 1998) including *R. sicca* etc.

In some deposits (probably going with the upper part of horizon), oval forms of species *Coronocyclus nitescens* appear, along with 5-rayed symmetrical discoasters and enigmatic specimens of genus ?*Catinaster*.

Compare to underlying deposits and horizon with *H. waltrans* respectively, nannofossil taphocoenoses are characterized by increasing number of Miocene specimens forming about 50-70%. Reworked coccoliths are mostly of the Upper Cretaceous and Middle Eocene age. Horizon was observed in the Lower Badenian clays.

## DISCUSSION

The more precise correlation of the above mentioned nannofossil horizons with the chronostratigraphic scale is problematic, remains obscure and has already been discussed in work by Švábenická (2002). The horizon with *Helicosphaera waltrans* was delimited in the Moravian part of Carpathian Foredeep within the upper part of Grund Formation and Lower Badenian basal and marginal sediments. Cicha (2001) gives the Karpatian-Lower Badenian boundary within the Grund Formation on the basis of microfauna. Other authors compare the first occurrence of *H. waltrans* with the middle part of zone NN5 and correlate it within the middle part of Lower Badenian in Central Paratethys (Andreyeva-Grigorovich et al. 2001) and with the upper part of Langhian (Fornaciari et al. 1996) or with the uppermost Langhian and lowermost Serravalian (Young 1998) in Mediterranean area respectively.

Next problem to be solved is the joint presence of *Helicosphaera waltrans* and *H. ampliaperta* accompanied by only occasional occurrence of *Sphenolithus heteromorphus*. There are two explanations: 1. All the above mentioned species are components of autochthonous assemblage and give evidence for the paracme zone S. heteromorphus MNN4b (Fornaciari et al. 1996) that is correlated with the lower part of Langhian. In this case we have to give the careful consideration, if the first occurrence of *H. waltrans* is diachronous first appearing in the Central Paratethys. 2. Specimens of *H. ampliaperta* were reworked from the older strata and paleoenvironment (especially water depth) was under conditions not favourable for the life of sphenolith-producing Coccolithophores. With respect of the occurrence of *H. waltrans* this horizon may be correlated with zone MNN5. This phenomenon was reported from the Carpathian Foredeep and has not been recorded in other basins of Central Paratethys either in territory of Austria (Coric, pers. commun.) nor Slovakia (Andreyeva-Grigorovich et al. 2001).

The enigmatic specimens of ?*Catinaster* sp. could be explained also as a central part of discoaster, for instance *Discoaster musicus*, that is reported from zone NN5. Nevertheless, specimens of *D. musicus* has not been found in studied material.

Important marker species for the next biostratigraphic correlations seems to be elliptical forms of *Coronocyclus nitescens*. Stratigraphic range of these coccoliths is diagrammatically expressed by Young (1998) in Serravalian. It concerns also 5- rayed symmetrical discoasters the first occurrence of them is reported from zone NN8 (Young l.c.).

Character of nannofossil assemblage may be an important phenomenon for the paleobathymetric interpretation of the Carpathian Foredeep depositional area.

The prevailing occurrence of helicoliths complemented by rare discoasters and other coccoliths in clays and siliciclastic sediments of the Grund Formation and basal siliciclastic sediments of the overlying Lower Badenian indicate a shallow epicontinental sea and probably a beginning of transgression. The distinct change in quality and quantity of assemblages, that is high number of discoasters and coccoliths recorded in the Lower Badenian clays indicates the deepening of the depositional area and open-sea conditions and reflects the Lower Badenian transgression.

## CONCLUSIONS

Two nannoplankton horizons were recognized in the Middle Miocene (Lower Badenian, Moravian) deposits of Carpathian Foredeep in the territory of southern and central Moravia, Czech Republic:

1. horizon with *Helicosphaera waltrans* characterized by prevailing occurrence of helicoliths.
2. horizon with *Sphenolithus heteromorphus* characterized by influx of Miocene nannoflora.

High number of helicoliths indicates a shallow epicontinental sea and occasional occurrence of other coccoliths probably a beginning of transgression.

The change in quality and quantity of nannofossils assemblages, that is enrichment in discoasters and coccoliths gives evidence for the open-sea conditions and reflects transgression in the Lower Badenian. This change coincides with the last occurrence of *Helicosphaera waltrans*.

## References

- Andreyeva-Grigorovich A.S., Kováč M., Halášová E. & Hudáčková N. 2001: Litho- and Biostratigraphy of the Lower and Middle Miocene sediments of the Vienna basin (NE part) on the basis of calcareous nannoplankton and foraminifers. *Scr. Fac. Sci. Nat. Univ. Masaryk. Brun., Geol.* 30, 2000, 27-40.
- Cícha I. 2001: Outline of the stratigraphy of the Middle Miocene in the Alpine-Carpathian foredeep (Lower Austria, Moravia). *Scr. Fac. Sci. Nat. Univ. Masaryk. Brun., Geol.* 30, 2000, 23-26.
- Čtyroká J. & Švábenická L. 2000: Biostratigraphic evaluation of Badenian deposits on the Olomouc map-sheet (Foraminifers and Calcareous Nannofossils). *Zpr. Geol. Výzk. v roce 1999*, 17-20 (in Czech with English abstract).
- Fornaciari E., Di Stefano A., Rio D. & Negri A. 1996: Middle Miocene quantitative calcareous nannofossil biostratigraphy in the Mediterranean region. *Micropaleontology* 42, 1, 37-63.
- Martini E. 1971: Standard Tertiary and Quaternary calcareous nannoplankton zonation. I: Farinacci A. (Ed.): Proceedings II. Planktonic Conference, Roma 1970. *Edizioni Tecnoscienza*, 2, 739-785.
- Švábenická L. 2002: Calcareous nannofossils of the Upper Carpathian and Lower Badenian deposits in the Carpathian Foredeep, Moravia, Czech Republic. *Geol. Carpathica* 53, 3, 1-14.
- Young J.R. 1998: Neogene. In: Bown P.R. (Ed.): *Calcareous Nannofossil Biostratigraphy*. Cambridge University Press, 225-265.