

# ALBIAN – EARLY MIOCENE FORAMINIFERAL ASSEMBLAGES OF THE MAGURA NAPPE (POLISH OUTER CARPATHIANS)

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**Abstract:** Foraminiferal studies carried out in of the Polish part of the Magura Nappe revealed the presence of twenty three characteristic assemblages that document the Albian - Lower Oligocene and Lower Miocene age of the investigated deposits. Deep-water agglutinated foraminifers (DWAF) are the most common and autochthonous group among other taxa. The calcareous foraminifers are more numerous in the youngest marly deposits as well as in the slump deposits. Among autochthonous assemblages three biofacies of DWAF were recognised: slope, flysch-type and abyssal.

**Key words:** Magura Nappe, Albian - Early Miocene small foraminifers, DWAF assemblages, slope, flysch-type, abyssal biofacies

## Introduction

The Magura basin was created during Late Jurassic and up to Albian it formed a uniform paleogeographic zone with Pieniny sedimentary area with deep-water and pelagic sedimentation (Oszczypko, 1992). The Cenomanian -Turonian time was the period of unification of the sedimentary conditions in the whole basin of the Outer Carpathians marked by the sedimentation of green shales with radiolarians and radiolarite beds followed by variegated shales. The period of pelagic and hemipelagic sedimentation in the Magura basin was followed by the gradual differentiation of the facies in the late Senonian - Palaeocene due to the development of the turbiditic sedimentation. The Eocene was a period of conspicuous facies differentiation connected with the northward progradation of the fan-lobe system of the Magura Sandstone Fm. (Oszczypko, 1992; 1999). At the turn of the Eocene the bottom of the Magura basin was partly inversed as the result of submarine folding of the more southern part of the basin as well as of the global fall of the sea level (Oszczypko et al., 1999). This was followed by subsidence and intensive deposition in the northern part of the basin. The Magura Nappe is regarded as an Oligocene accretionary wedge overthrust onto an Early/Middle Miocene accretionary wedge of

the Moldavian nappes (Oszczypko, 1992; 1999). During the overthrust movements the Magura Nappe was completely uprooted from its substratum mainly along the Upper Cretaceous variegated shales. The Albian-Cenomanian deposits are locally preserved at the southern margin of the Mszana Dolna tectonic window. More or less complete sections of the oldest pelagic and hemipelagic deposits are known only from that part of the Magura basin which was incorporated into the Pieniny Klippen Belt and described as the Grajcarek Unit (Birkenmajer, 1977).

### **Foraminiferal Assemblages**

The foraminiferal studies were carried out on a few hundred samples collected in 41 sections situated in four facies-tectonic subunits namely Krynica (*Ks*), Bystrica (*Bs*), Rača (*Rs*) and Siary (*Ss*) along the whole Magura Nappe in Poland (Fig. 1).

Agglutinated taxa are dominating, autochthonous group of the foraminifera in the Albian - Late Eocene/Early Oligocene deposits of the Magura Nappe. About 170 species belonging to 53 genera were recognised in the studied material. Among them twenty five species are characteristic for the Cretaceous and thirteen species are known from the Eocene. The Paleocene/Early Eocene turnover is marked by the extinction of sixteen species which commonly occur in the Late Cretaceous - Paleocene assemblages. The majority of the occurring taxa represent the long-ranging and cosmopolitan forms.

The calcareous benthic as well as planktonic foraminifera are also present in the studied material though they are very often connected with the reworked sediments.

The autochthonous calcareous assemblages occur only locally in the Late Eocene/Early Oligocene and Early Miocene deposits of the Magura Nappe. More than 130 species representing 70 genera were recognised among the benthic calcareous forms. Most of them are connected with the Palaeogene deposits while in the Upper Cretaceous sediments only single specimens of seven genera were noticed. Planktonic foraminifera are represented by more than 80 species. Four of them are Cretaceous taxa, eleven are characteristic for the Early Miocene and the rest are Middle-Late Eocene forms.

The agglutinated taxa occurring in the Magura Nappe deposits represent deep water-agglutinated foraminifera (DWAF). Among the DWAF assemblages six biofacies were described by Kuhnt, Kaminski and Moullade, 1989. The autochthonous foraminiferal assemblages found in the studied deposits represent mainly flysch-type DWAF biofacies which is characterised by the common presence of tube-like

morphotypes as well as other siliceous agglutinating taxa. Taxonomic composition and diversity of these assemblages depend on the sedimentary conditions. The presence of calcareous agglutinating foraminifers or single specimens of calcareous forms, highly resistant to dissolution, in such siliceous-dominating assemblages is indicative for the proximity of the local CCD. Mixed assemblages with varying amount of calcareous benthic and planktonic foraminifers can be assigned to the slope DWAF biofacies (low and mid-latitude sensu Kuhnt et al., 1989). The entirely agglutinated assemblages consisting of tiny specimens with some admixture of the "Krashenninikov" fauna show some analogy to the abyssal DWAF biofacies (Krashenninikov, 1973, 1974).

Taxonomic diversity of assemblages varies and it was qualified as the low (number of species  $\leq 12$ ), medium (with 13 - 25 species) and high (with more than 26 species). The following characteristic assemblages were recognised in the studied material:

- 1. Assemblage with *Plectorecurvoides alternans*, *Hippocrepina depressa* and *Pseudonodosinella troyeri* (Albian-Cenomanian)** - purely agglutinated assemblage of low to medium diversity; most species represented by single specimens; flysh-type DWAF biofacies.
- 2. Assemblage with *Bulbobaculites problematicus*, *Plectorecurvoides irregularis*, *Gerochammina stanislavi* (Cenomanian-Turonian)** - purely agglutinated assemblage of medium diversity; flysch-type DWAF assemblage.
- 3. Assemblage with *Uvigerinammina jankoi* i *Trochammina gyroidinaeformis* (Turonian - Santonian)** - exclusively agglutinated fauna of medium to high species diversity with numerous *U. jankoi* Majzon; tiny to medium-sized specimens; this assemblage corresponds to abyssal DWAF biofacies; elements of "Krashenninikov" fauna are present such as: *Praecystammina globigerinaeformis* Krashenninikov, *Pseudobolivina cuneata* Krashenninikov, and *P. munda* Krashenninikov.
- 4. Assemblage with *Uvigerinammina jankoi* and *Rzehakina inclusa* (Santonian)** - purely agglutinated assemblage of medium species diversity with abundant *U. jankoi*; specimens smaller in numbers but bigger in size than in the previous assemblage; flysch - type DWAF biofacies assemblage.
- 5. Assemblage with *Gerochammina lenis*, *G. obesa* and *Uvigerinammina jankoi* (?Santonian - Early Campanian)** - *Gerochammina* relatively abundant, *U. jankoi* represented by single forms; agglutinated foraminifers dominate the medium diversity

assemblage; calcareous benthic and calcareous agglutinating are rare or absent; medium abundance; flysch-type DWAF biofacies.

**6. Assemblage with *Caudammina gigantea* and *Caudammina ovulum***

**(?uppermost Santonian - Campanian -**: purely agglutinated fauna of the low to high diversity with numerous index taxa; calcareous agglutinating sporadic; numbers of specimens medium to high; flysch - type DWAF biofacies.

**7. Assemblage with *Rzehakina inclusa* and *Hormosina excelsa* (Campanian - Maastrichtian)** - agglutinated foraminifers dominate the medium diversity

assemblage; calcareous taxa and calcareous agglutinating forms rare or absent; single specimens of planktonic taxa were also noticed; *R. inclusa* represented by single specimens *H. excelsa* relatively abundant; numbers of specimens vary from low to high; flysch-type DWAF biofacies.

**8. Assemblage with *Remesella varians* (Late Maastrichtian–Paleocene)** -

calcareous agglutinating index taxon accompanied by agglutinated siliceous foraminifers that dominate the medium to high diversity assemblage with varying number of specimens, calcareous benthic rare or absent; flysch-type DWAF biofacies.

**9. Assemblage with *Glomospirella grzybowskii* and *Rzehakina fissistomata***

**(Paleocene)** - agglutinated foraminifers dominate the medium to high diversity assemblage; calcareous benthic and calcareous agglutinating rare or absent; assemblages with medium to high numbers of specimens; flysch-type DWAF biofacies.

**10. Assemblage with numerous *Glomospira charoides* & *Glomospira gordialis***

**(Early Eocene)** - purely agglutinated assemblage of the low diversity; medium to high numbers of specimens; flysch-type DWAF biofacies connected with hemipelagic sedimentation in well-oxygenated environment.

**11. Assemblage with *Saccamminoides carpathicus* (Early Eocene)** - purely

agglutinated assemblage of the medium diversity with more numerous index taxa in the hemipelagic deposits and less abundant in turbidites; flysch - type DWAF biofacies.

**12. Assemblage with *Gerochammina conversa* i *Karrerulina coniformis***

**(?Early/Middle Eocene)** - index taxa relatively numerous; purely agglutinated assemblages of the medium diversity; specimens medium to high in numbers; flysch - type DWAF biofacies;

**13. Assemblage with *Nuttallides truempyi* (Early-Middle Eocene)** - mixed assemblage with dominating agglutinated foraminifers of the low to medium diversity; calcareous benthic as well as badly preserved planktonic forms are sometimes present; medium number of specimens; slope DWAF biofacies.

**14. Assemblage with *Reticulophragmium amplexans* (Middle Eocene)** - either purely agglutinated assemblages with numerous index taxa of the medium diversity or assemblages with less abundant and less diversified agglutinated foraminifers with minor admixture of calcareous forms; flysh-type DWAF biofacies grading into slope DWAF biofacies.

**15. Assemblage with *Acarinina bullbrooki* (Middle Eocene)** - mixed assemblage of the medium to high diversity with calcareous benthic and planktonic foraminifers; slope DWAF biofacies sedimentation above foraminiferal lysocline (FL); among accompanying taxa genus *Abyssammina* was present.

**16. Assemblage with *Ammodiscus latus* (upper Middle – lower Late Eocene)** - either purely agglutinated assemblage or mixed with dominating agglutinated foraminifers; medium taxonomic diversity; flysh-type DWAF biofacies grading into slope biofacies.

**17. Assemblage with abundant *Sphaerammina subgaleata* (?Middle – Late Eocene)** - purely agglutinated assemblages of the low diversity; sometimes pyritized *Chilostomella* present; flysch-type DWAF biofacies, sedimentation in slightly oxygen-deficient conditions.

**18. Assemblage with *Haplophragmoides walteri* and/or *Haplophragmoides parvulus* (Late Eocene)** - index taxa relatively numerous; agglutinated assemblages of the low diversity with rare calcareous, poorly preserved foraminifers; *H. parvulus* Bläicher seems to prefer conditions of higher calcareous content and lower sedimentary rate; flysch-type DWAF biofacies.

**19. Assemblage with *Chilostomella* div.sp. (Late Eocene)** - index taxon belonging to calcareous benthic foraminifers is relatively abundant but always occurs in a form of pyritized moulds; low taxonomical diversity; accompanying agglutinated taxa not characteristic and in small numbers; facies-related assemblages; slope DWAF biofacies.

**20. Assemblage with *Pararotalia lithothamnica* and/or *Asterigerina rotula* (Late Eocene)** - calcareous assemblages of medium to very high diversity characteristic for

the slump deposits; foraminifers representing different environments from shelf to slope; primary sedimentation above FL.

**21. Assemblage with *Globigerina ampliapertura* and *Globorotalia cocoaensis* (uppermost Priabonian)** - mostly mixed assemblages with considerable amount of calcareous benthic and planktonic foraminifers; taxonomic diversity high; both agglutinated and calcareous benthic foraminifers of deep-water character.

**22. Assemblage with *Tenuitella liverovskae* and *Tenuitella munda* (lower part of Oligocene)** - mixed or calcareous assemblages of medium diversity; specimens not numerous; calcareous foraminifers relatively small in size; slope DWAF biofacies.

**23. Assemblage with *Globorotalia praescitula* i *Globoquadrina dehiscens* (Early Miocene (N5))** - mixed assemblages with majority of reworked specimens; autochthonous planktonic foraminifers point to the pelagic sedimentation above FL.

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**Figure 1:** Position of the studied sections of the Magura Nappe against the background of the tectonic-sketch map of the Polish Carpathians

