

Foraminiferal assemblages of the Magura nappe (Polish outer Carpathians) and their Paleobathymetrical implications

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Abstract. The oldest assemblage of agglutinated foraminifera (Late Albian-Cenomanian) represents *Plectrocurvoides alternans* and *Bulbobaculites problematicus* zones, the youngest is the calcareous assemblage of the Early Miocene *Globoquadrina dehiscens* zone. The mean proportion of agglutinated genera to calcareous were calculated for individual lithological units. The assemblages with purely agglutinated taxa indicate deposition below local CCD (pelagic and hemipelagic variegated deposits of the Albian-Campanian and Eocene). The considerable amount of calcareous taxa points to deposition well above CCD (Eocene/E. Oligocene pelagic malrs and Early Miocene marly turbidites). The agglutinated assemblages with minor admixture of calcareous genera can indicate close proximity of the CCD (most of the Maastrichtian – Early Oligocene turbidite deposits). The sedimentological features and foraminiferal assemblages indicate the greatest depth (about 3000 m) of the Magura basin during Late Albian–Turonian.

Key words: Biostratigraphy, Foraminifera, Deep-water conditions, Magura basin, Outer Carpathians

Introduction

The Magura basin was created during Late Jurassic but during the overthrust movements its deposits were completely uprooted from their substratum along Upper Cretaceous variegated shales. The older deposits are preserved only locally at the southern margin of the Mszana Dolna tectonic window.

Sedimentation in the Magura basin was characterized by unifaciation of facies during Albian-Campanian (period of pelagic and hemipelagic deposition), followed by gradual differentiation in the Late Senonian-Paleocene connected with the development of turbiditic stage; Eocene was a period of conspicuous facies differentiation and diachronous boundaries due to the northward progradation of the fan-lobe system of the Magura Sandstone Fm. (Oszczypko, 1992; 1999).

The biostratigraphical studies of the Magura Nappe were carried out in the area of the Beskid Żywiecki (BZ) in the west, through Beskid Średni (BSR), Gorce (G), Beskid Wyspowy (BW), Nowy Sącz area to Beskid Sądecki in the east (Fig. 1). In these regions four facies-tectonic subunits namely Krynica (*Mk*), Bystrica (*Mb*), Raca (*Mr*) and Siary (*Ms*) are represented. So far, the oldest recognized deposits are Late Albian-Cenomanian in age and the youngest Early Miocene. About 180 foraminiferal assemblages, whose age and taxonomical composition were clear, were chosen for taxonomical analysis. The majority of the lithological units distinguished in the Polish part of the Magura Nappe were examined in relation to the foraminiferal content. The lithostratigraphic units used in this paper follow the proposition of Oszczypko et al., (1999).

The flysch-type deep-water agglutinated foraminifera (DWAF) (Kuhnt & Kaminski, 1989) are the main component of the foraminiferal assemblages. Their abundance and diversity vary through time and facies, though generally, they are of lower diversity and less numerous than equivalent assemblages from the other nappes. The oldest assemblages are devoid of calcareous taxa. The calcareous benthonic and planktonic foraminifera first appeared in the late Senonian. In most cases they are poorly preserved and represented by single specimens. The calcareous taxa are the most numerous in the youngest, marly facies as well as in the marly, slump deposits (Fig. 2).

The age determinations were based on the index species and the overall character and composition of the foraminiferal assemblages. Most of the zones proposed recently by Olszewska (1997) were recognised in the Magura Nappe though some endemism is also observed.

Paleobathymetric analysis was based on the assumption that purely agglutinated foraminifera occurring in the non-calcareous sediments indicate deposition well below local CCD; agglutinated assemblages with rare calcareous taxa (benthonic, planktonic as well as agglutinated with calcareous cement) can point to a depth close to CCD; mixed assemblages or those with majority of calcareous foraminifera indicate deposition well above local CCD (Kennett, 1982). The numbers of genera occurring in all analysed samples were counted and divided into two groups (agglutinated and calcareous). Then, the mean value for each studied lithological unit was calculated. The author is aware that presented analysis is not quite objective as it did not consider the number of specimens and that the amount of samples for each lithological unit used in the calculations was not equal.

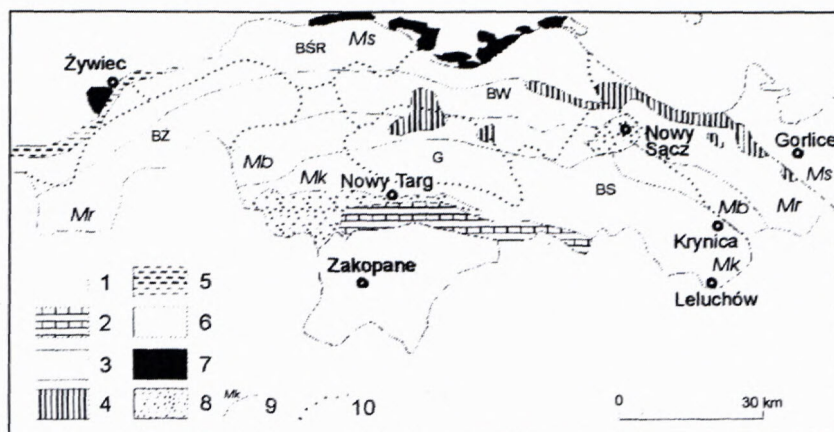


Fig. 1. Tectonic position of the Magura Nappe in Poland (after Oszczytko et al., 1999, simplified). 1 – Tatra Mts. & Podhale flysch, 2 – Pieniny Klippen Belt, 3 – Magura Nappe: Mk – Krynica Subunit, Mb – Bystrica Subunit, Mr – Raca Subunit, Ms – Siary Subunit, 4 – Grybów Unit, 5 – Fore-Magura Unit, 6 – Silesian Unit, 7 – Subsilesian Unit, 8 – Miocene deposits upon the Carpathians, 9 – boundaries of the Magura subunits, 10 – boundaries of the Beskidy Ranges.

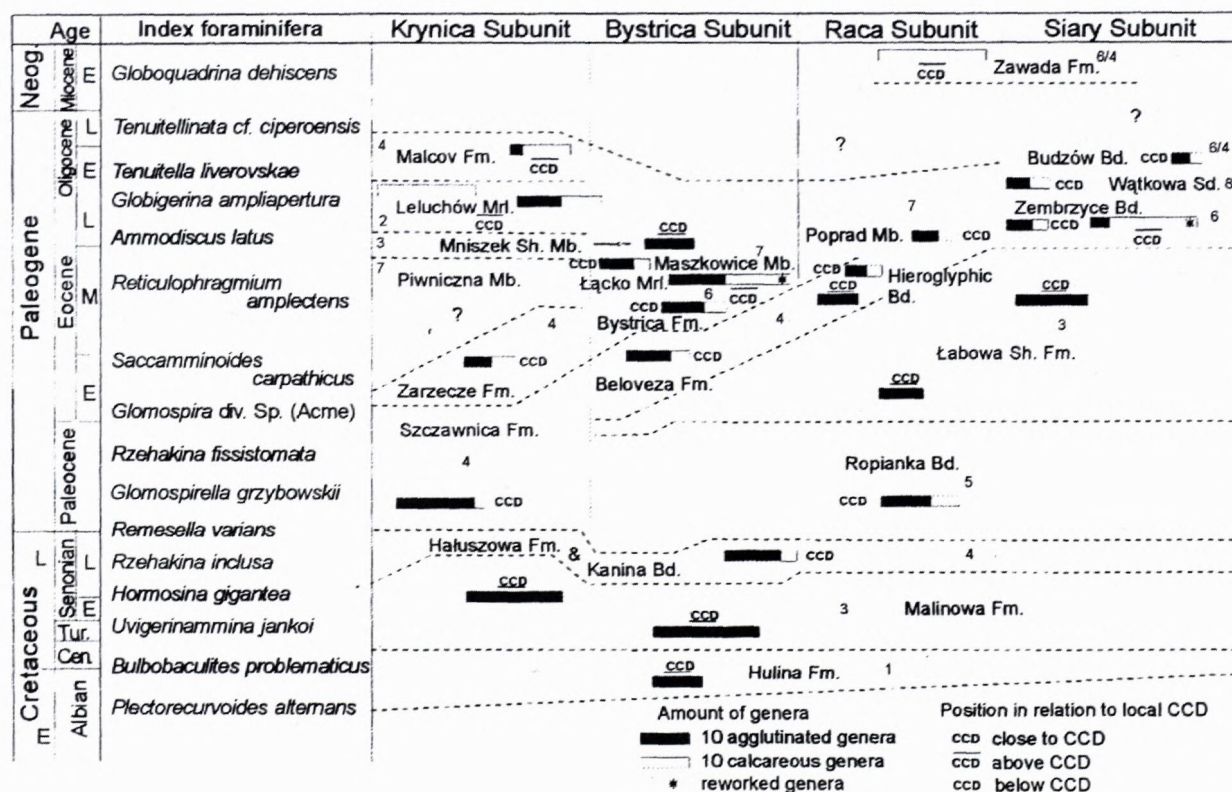


Fig. 2. Foraminiferal assemblages composition (at generic level) and their suggested position in relation to local CCD against simplified lithostratigraphy (after Oszczytko et al., 1999).

Results

Exclusively agglutinated foraminiferal assemblages indicating deposition below local CCD were found in the green, spotty, pelagic shales of the Hulina Fm (Late Albian-Cenomanian), red hemipelagic shales of the Malinowa Fm. (Turonian-Campanian), variegated hemipelagic shales of the Łabowa Fm. (Early-Middle Eocene) and in the variegated shales of the Mniszek Mb (Middle/Late Eocene) (Fig. 2). The calcareous foraminifera dominate assemblages from the upper part of the

pelagic Leluchów Marls (Late Eocene/Early Oligocene, distal marly turbidites of the Malcov Fm. (Early Oligocene) and medium to thick-bedded calcareous turbidites of the Zawada Fm. (Early Miocene). The considerable amount of planktonic foraminifera and the character of benthonic species suggest deposition above CCD at the bathyal depths. The calcareous foraminifera prevail also in the reworked assemblages. Such assemblages are more often found in the upper Middle and Late Eocene deposits (Łącko Marls of the Żeleznikowa Fm, Zembrzyce Fm). The foraminiferal assemblages with dominating aggluti-

nated taxa and with varied admixture of calcareous benthic and planktonic foraminifera were found in the other Late Senonian-Early Oligocene turbidite deposits (Fig. 2). They can suggest close proximity of CCD and if they are found alternating with purely agglutinated assemblages, local fluctuation of CCD can be suggested.

The assemblages displaying the highest diversity at the generic level indicate the most favourable environmental conditions in the basin for the development of foraminifera (Malinowa Fm., Szczawnica Fm., Ropianka Beds, Middle Eocene Łabowa Sh. Fm., Leluchów Marls and Zawada Fm.).

An attempt to estimate the real depths of the basin is much more difficult task. Some global phenomena are reflected in the studied sediments but the position of the Magura basin within the Western Carpathian domain at NW periphery of the Neothethys Ocean and its individual evolution are very important factors in the paleoenvironmental analysis and conclusions (Oszczypko, 1999). The character of sediments and foraminiferal assemblages indicate the greatest depth during the sedimentation of the oldest deposits. Considering that the Middle Cretaceous position of global CCD was quite shallow (less than 3000 m), and that through the Late Cretaceous it gradually deepened (Kennett, 1982) the depths below 3000 can be suggested for the sedimentation of the Hulina and Malinowa formations. During the Paleogene the Magura basin must have had varied bottom configuration. The Eocene

variegated shales were deposited in the deepest part of the Magura basin. Their wide distribution in the Early Eocene time coincided with global sea level rise. The sedimentation of the Leluchów Marls reflects global drop in CCD at the Eocene/Oligocene boundary to about 4500 m, but the position of the local CCD in the Magura basin due to its own evolution and configuration must have been shallower. The Early Miocene Zawada Fm developed in the open marine conditions probably at upper bathyal depths.

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