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Oligocene paleogeography and nannofossil paleoecology of the Magura Basin (Western Carpathianns)

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Abstract: As a result of the Priabonian folding in the southern part of the Magura Basin (Krynica and Bystrica subunits), a kind of submerged plateau was formed which divided the Magura Basin from the fore-arc Podhale flysch basin. After the deposition of the Globigerina Marls and their equivalents (Priabonian/ Early Rupelian) the Oligocene deposition in the Magura Basin was dominated by two distinctive litofacies. The Krynica, Bystrica and partly Rača zones were occupied by Menilite Shales and followed by Malcov lithofacies, whereas in the Siary, there was a deposition of thick-bedded glauconite sandstones and marls.

Key words: paleogeography, paleoecology, nannofossil, Oligocene, Magura Basin

Introduction

The Eocene paleogeography of the Magura Basin was controlled by the SE source area as well as by the progressive growth of the Magura accretionary prism. This caused a subsidence and a northward migration of depocenters, which was characterised by the progradation of the fan-lobe system of the Magura Sandstone Fm (Oszczypko, 1992). During Late Eocene there was a distinct change in paleogeography in the Outer Carpathian Basin. This was caused by a global and regional conditions. The global changes were related to a 1000 m drop in CCD and a 100 m fall of the sea level (Van Couvering et al., 1981). The regional changes were controlled by a southward subduction of the thinned crust of the Magura Basin beneath the Pieniny Klippen Belt/ Central Carpathian Block. This was accompanied by the cessation of the South Magura source areas and a submarine folding of the southern part of the Magura Basin (Krynica and Bystrica subunits). This part of the basin, together with Pieniny Klippen Belt, formed a kind of submerged plateau which divided the Magura Basin from the fore-arc Podhale flysch basin.

Paleogeography

In the Pieniny Klippen Belt and southern part of the Magura Basin the transition from variegated shales with *Reticulophragmium amplectens (* Magura Fm.) to Submenilite Globigerina Marls (SGM) of the Malcov Fm reveal a Priabonian change in paleogeography. In the Leluchów section SGM are represented by green marly shales and soft, red and green marls up to 4 metres thick (Birkenmajer & Oszczypko, 1989). The rate of sedimentation of the green shales (NP 19-20) is 2,4 m/ma[1], whereas the rate of sedimentation of the red and green marls is 1,5 m/ma (NP 21-22). Such low rates of sedimentation indicate a very low subsidence in the southern part of the Magura Basin during Late Eocene through to Early Oligocene. In the Leluchów section SGM are covered by a 19 m of dark Menilite-like shales (NP 23, Oszczypko-Clowes, 1998). The lowermost portion of this member reveal a marly development with a few tuffite intercalations and a thin (2-5 cm) intercalation of hornstones at the top. The upper portion of the Menilite Shales belongs to black noncalcareous, bituminous shales with a few layers of coarse-grained, thick-bedded sandstone. The uppermost part of this section is represented by 25 metres of massive thick-bedded sandstones, passing upwards into thin-bedded turbidites of the Malcov Fm. The rate of sedimentation of the Menilite Shales reaches 8 m/ma. Similar profiles of the Menilite Shales are also known in many localities from the Krynica zone in Eastern Slovakia (Leško & Samuel, 1968).

In the Rača zone the Priabonian and Early Oligocene are represented by thick-bedded sandstones of the Magura Fm, derived from SE and E. The deposition was related to the terminal stage of the Magura Sandstone fan development. The rate of sedimentation varies from 162 m/ma during the Late Eocene (NP 18-NP21) to at least 177 m/ma in the Early Oligocene (NP23).

During Early Oligocene the northern part of the Magura Basin (Siary zone) was occupied by the deposition of the glauconite sandstones of the Wątkowa Beds (Oszczypko-Clowes, 1999).These sandstones are underlain by variegated shales of the Łabowa Fm (Lower-Upper Eocene) and by thin-bedded turbidites and marls belonging to the Sub-Magura Beds (NP 19/20 to NP21). The thickness of these beds varies from a few metres up 150 m. The Wątkowa Sandstone is composed of thick-bedded glauconitic, medium to very coarse-grained sandstones with sporadic intercalations of dark turbiditic marls up to a few meters in thickness. The thickness of the Wątkowa Sandstone varies from 600 m (W) to 1200 m in

[1] the rates of sedimentation without backstripping

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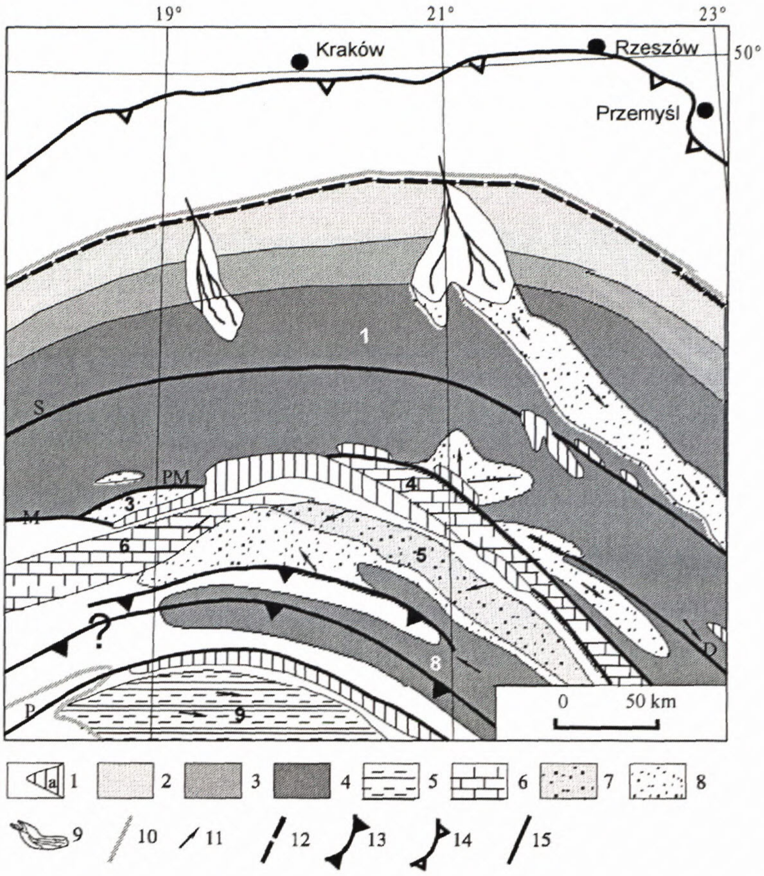

Fig. 1. Early Oligocene paleogeography of Polish Outer Carpathians (partly after Książkiewicz, 1962)
1-emerged land, a - islands, 2 - littoral facies, 3 - shelf and slope facies; basinal facies: 4 - bitouminous shales, 5 - thin and medium-bedded turbidites, 6 - siliciclastic-carbonate turbidites, 7 - thick-bedded glaukonitic turbidites, 8 - thick-bedded turbidites, 9 - delta, 10 - shore line, 11 - paleocurrent direction, 12 - zero line of Viese's vectors, 13 - tectonic margins, 14 - present-day front of the Carpathians, 15 -northen limit of Silesian (S), Dukla (D), Fore-Magura (PM), Magura (M) and Pieniny Klippen Belt (P) facies. Lthostratigraphic subdivisions: 1 - Menilite Shales, 2 - Kliwa, Magdalena and Gródec sandstones, 3 - Cergowa Sandstones, 4 - Sub-Grybów Marls, Grybów Shales and Duląbka Beds, 5 - Wątkowa Sandstone, 6 - Budzów Beds, 7- Magura Fm., 8 - Malcov Fm., Szaflary and Zakopane Beds.

the Małastów section (E). These sandstones revealed the paleotransport direction from the NE. The rate of sedimentation varies from 31 to 240 m/ma from west to east, respectively. At that time the Fore-Magura sedimentary area (Grybów and Jasło subbasins) was occupied by the deposition of turbidite marls, whereas the remainder of the Outer Carpathian Basin was dominated by black shales of Menilite Beds, with intercalations of quartz-rich Kliwa sandstones. In the Dukla and Silesian sedimentary areas clastic material was transported from the SW and W, which is the opposite direction than in the Magura Basin. This suggests that the Magura and Dukla-Silesian areas were divided by the uplifted Silesian ridge (Fig. 1, see also Książkiewicz., 1962, Leszczyński, 1997).

The Late Oligocene deposition in the Magura Basin was dominated by Malcov and Budzów (Supra-Magura) lithofacies. The Malcov lithofacies occupied the southern part of the basin (Krynica, Bystrica (?) and Rača zones), whereas Budzów lithofacies were characteristic for the northern part of the basin (Siary zone). The flat-laying Krosno-like deposits of the Malcov Fm. are represented by dark-grey, marly shales with intercalations of thin bedded, cross-laminated calcareous sandstones. The rate of sedimentation reached at least 21m/ma and 24 m/ma in the Krynica and Rača zones, respectively. In the Siary zone the deposition of the Budzów Beds pass upwards into the Supra Magura Beds (Budzów Fm), which are turbiditic marls with intercalations of glauconitic sandstone. The thickness of these beds is at least 400 m, whereas the rate of sedimentation reached at least 110 m/ma (NP24).

During Late Oligocene the sedimentary areas located north of the Magura Basin were occupied by the deposition of the Krosno Beds (Fig. 1).

After the Late Oligocene folding, the Magura Nappe was thrust northwards onto the residual Krosno flysch basin (Oszczypko, 1999), and during Burdigalian its front reached the S part of the Silesian basin. During the course of the Burdigalian transgression, part of the Magura Basin was flooded and the sea-way connection with the Vienna Basin via Orava was probably established (Oszczypko et al. 1999). In the Nowy Sącz Basin the Zawada Fm. was deposited. These folded deposits are represented by medium - to thick-bedded glauconitic sandstones with intercalations of thick-bedded marls and they probably overlap the Malcov Fm.

Paleoecology

The analysis of nannoplankton assemblages enable the possibility to follow the paleoecological changes in the Magura Basin through Late Eocene to Oligocene. In comparison with middle Eocene the amount of nannoplankton species in Late Eocene decreases considerably. The Early Oligocene is characterised by the lowest nannofossil diversity. According to Haq (1973) and Bukry (1978) this low diversity is associated with a colder temperature and vice versa. The assemblages consist mostly of medium (e.g. *Dictyococcites bisectus, Cyclicargolithus floridanus, Coccolithus pelagicus, Coccolithus eopelagicus*) and cold-water taxa (e.g. *Isthmolithus* *recurvus, Reticulofenestra callida, Reticulofenestra lockerii, Reticulofenestra ornata*) whereas the amount of warm-water taxa (e.g. *Discoaster barbadiensis, Discoaster saipanensis)* decreases between Late Eocene and Early Oligocene. The last warm-water taxa, *Ericsonia formosa*, became extinct by the end of NP21 zone. Further events were also recorded in Zone NP23. The assemblage of this zone is characterised by the occurrence of *Transversopnotis fibula* and abundant *Reticulofenestra ornata*. Such an association is believed to be indicative of brackish water and restricted to the Paratethys region (Nagymarosy & Voronina, 1992).

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