

## Lithofacies and micropaleontological data of the Upper Cretaceous deposits of the Subsilesian Unit in the Sułkowice tectonic window (Outer Carpathians, Poland)

MAREK CIESZKOWSKI<sup>1</sup>, ANNA WAŚKOWSKA-OLIWA<sup>2</sup> & ELŻBIETA MACHANIEC<sup>3</sup>

<sup>1,2,3</sup> Institute of Geological Sciences, Jagiellonian University, Oleandry 2a, 30-063 Kraków, Poland;  
e-mail: <sup>1</sup>mark@ing.uj.edu.pl; <sup>2</sup>oliwa@ing.uj.edu.pl; <sup>3</sup>ella@ing.uj.edu.pl

**Abstract:** Foraminifera assemblages of the Turonian to the Maastrichtian age were studied in the Subsilesian Unit in the Sułkowice tectonic window. Following lithofacies were distinguished in the Ubionka section: red shales, variegated marls and grey marls. In these sediments, three different assemblages have been recognized according to the taxonomic composition which suggests gradual shallowing trend.

**Key words:** Late Cretaceous, Subsilesian Unit, Sułkowice tectonic window, variegated marls, small foraminifera

### Studied area

In the Polish Flysch Carpathians the Subsilesian Unit appears in front of the Silesian Nappe and along its southern margin in several tectonic windows, known as the Lanckorona-Żegocina tectonic zone. One of the windows, in which Upper Cretaceous pelagic deposits occur, is located in the Sułkowice area (about 30 km SW from Cracow). Section studied is exposed along the Ubionka creek (tribute of the Harbutówka stream) in Sułkowice (Fig. 1).

So far, the most complex research of these deposits was carried out by Liszkowa and Książkiewicz (1967).

14 foraminiferal samples were collected from the shales and marls. All samples were prepared using the standard micropaleontological techniques.

### Lithological and biostratigraphical data

Within the Upper Cretaceous sequences investigated three lithofacies were distinguished.

The sequence begins with soft red shales (samples No: 1/257, 2/258, 3/260) (Fig. 1). The Turonian age of sediments was established by agglutinated foraminifera, which are typical for the *Uvigerinamina jankoi* Zone (Olszewska's zonation, 1997). In the samples studied abundant *Recurvoides* and *Thalmanamina* (40 % of foraminiferal assemblages) occur, and single *Bulbobaculites problematicus* (Neagu) accompany index taxon.

Above the red deposits there are variegated marls (samples No: 4/259, 5/253, 6/252, 1/53, 7/254, 9/255) which are represented by red shales and marls intercalated by grey-greenish marls (Fig. 1). In the higher part grey

marls are more frequent. The assemblages of foraminifera from the variegated marls lithofacies are characteristic of the *Spiroplectinella costata* Zone and the lower part of the *Hormosina gigantea* Zone (Olszewska's zonation, 1997) of the Coniacian - Early Campanian age. Beside the index species, calcareous agglutinating form of *Goesella rugosa* (Hanzlikova) is present, as well as calcareous benthic *Aragonia ouezanensis* (Rey) and *Pullenia cretacea* Cushman. Planktonic foraminifera are represented by single specimens of *Globotruncana cf. arca* (Cushman) and *Heterohelix* sp.

Grey marls represent the next lithofacies distinguished. At the base, the marls are soft and green-grey in colour, higher up they are grey and harder, at the top they

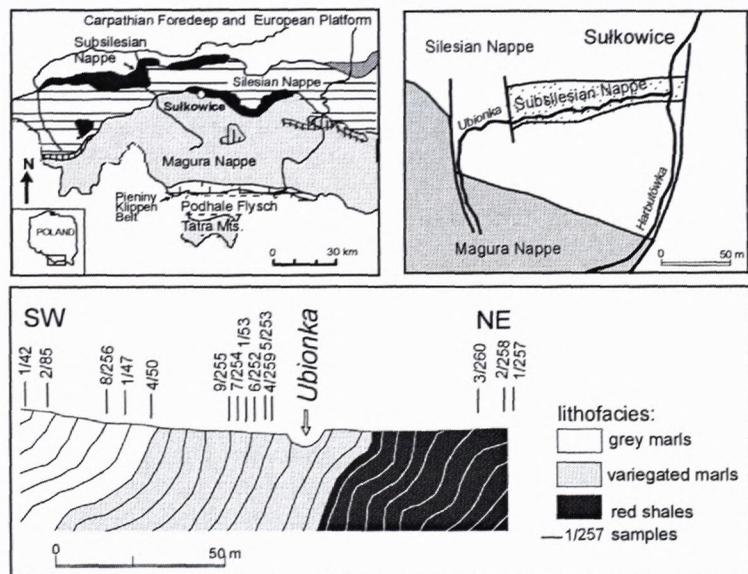


Fig. 1. Geological setting.

are stratified and frequently bioturbated. The assemblages of foraminifera from the lower part (samples No: 4/50, 1/47, 8/256) consist of agglutinated, calcareous benthic and planktonic taxa. Agglutinated foraminifera indicate the *Hormosina gigantea* Zone (zonation of Olszewska, 1997) of Campanian age.

The planktonic foraminifera are represented by: *Dicarinella asymetrica* (Sigal), *Globotruncana arca* (Cushman), *G. linneni-ana* (d'Orbigny), *Globotruncanella havanensis* (Voorwijk), *G. petalloidea* (Gandolfi), *Hedbergella holmdelensis* Olson, *Heterohelix globulosa* (Ehrenberg), *H. pulchra* (Brotzen), *Marginoglobotruncana coronata* (Bolli). This association is indicative for *Dicarinella asymetrica* and *Globotruncanella elevata* zones (*sensu* Caron, 1985).

Numerous specimens of the *Reusella szajnochae* (Grzybowski) - 21 % of all foraminifera are present in these assemblages. It seems to be a characteristic feature of the variegated marls of the Subsilesian Unit (Geroch *et al.*, 1967).

In the highest part despite of agglutinated assemblages characteristic for *Rzehakina inclusa* Zone (*sensu* Olszewska, 1997), single forms of *Rzehakina fissistomata* (Grzybowski), *Hormosina excelsa* (Dylażanka), *Haplophragmoides mjatliukae* Masłakowa and *Spiroplectamina spectabilis* (Grzybowski) are present. The Late Maastrichtian age is confirmed by planktonic foraminifera representing the *Gansserina gansseri* and *Abathomphalus mayaroensis* zones (zonation after Caron, 1985).

### Palaeoecology

According to Sliter & Baker (1972) based on their palaeobathymetrical model, Turonian foraminiferal fauna (species and genera) are characteristic of the lower/ middle part of the slope, close to the local CCD. During the Coniacian - Early Campanian foraminiferal assemblages indicate a higher position on the slope. The Late Campanian - Maastrichtian foraminiferal taxa are typical of the upper part of the slope above the foraminiferal lysocline. Similar palaeobathymetrical changes were observed by Gasinski (1998), Gasinski *et al.* (1999).

The distribution of agglutinated and calcareous foraminifera confirm the palaeobathymetrical changes. The Turonian assemblages are dominated by agglutinated taxa. In the Coniacian - Early Campanian, the assemblages contain an amount of calcareous benthic foraminifera, which increases to 20% indicating a higher position on the slope (Fig. 2). The Late Campanian - Maastrichtian assemblages consists of more numerous calcareous benthic foraminifera (up to 45%) and the amount of planktonic forms is rather variable (from 1 to 85%).

The results of morphogroup analysis of benthic taxa, according to the model proposed by Jones & Charnock (1985), suggest that the conditions in the basin supported

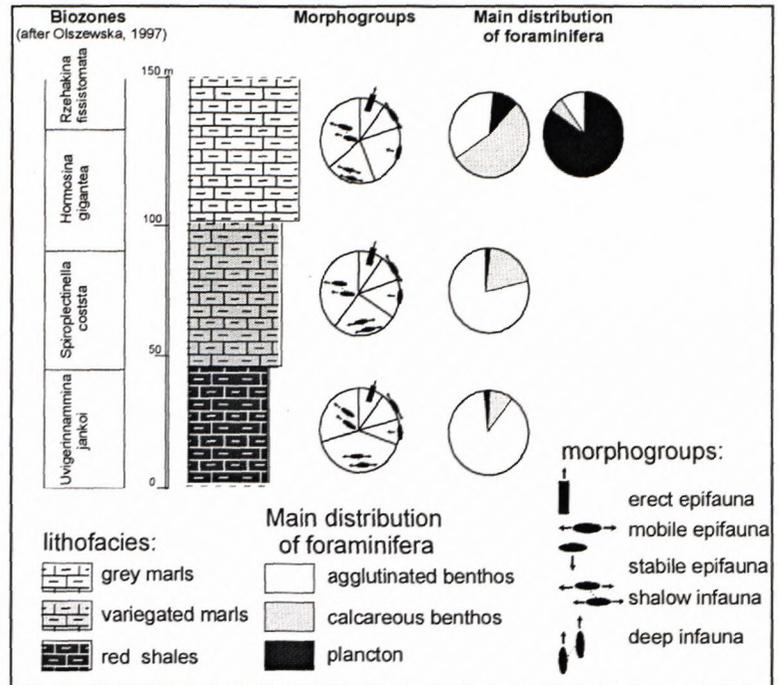


Fig. 2. Main distribution of foraminifera groups against lithostratigraphic section.

development of numerous and various assemblages of foraminifera during sedimentation of the studied deposits. There were no restrictive factors for development of any ecological group. The Upper Cretaceous variegated deposits at the Ubionka section are characterized by large amount of infauna (60 %) indicating a well oxygenated environment well supplied by nutrients. Small amount of both tubular forms representing suspension-feeders and mobile epifauna (Fig. 2) in benthic communities can suggest low rate of sedimentation and minor influence of the turbidity currents during sedimentation of the Upper Cretaceous variegated shales and marls (Gasiński, 1998).

### Conclusions

Within the Upper Cretaceous variegated deposits at the Ubionka section three lithofacies were distinguished with three different foraminiferal assemblages respectively. Red shales of Turonian age contained assemblage of the *Uvigerinamina jankoi* Zone dominated by agglutinated taxa. Variegated marls, Early Coniacian - Campanian in age, yielded assemblages of *Spiroplectinella costata* and *Hormosina gigantea* Zones with considerably amount of calcareous benthic foraminifera. In grey marls of the Campanian - Maastrichtian age, assemblages representing *Hormosina gigantea* and *Rzehakina inclusa* Zones with numerous calcareous benthic and planktonic foraminifera were found.

During sedimentation of Upper Cretaceous variegated deposits, palaeoecological conditions in the basin supported development of varied foraminiferal groups.

Turonian up to Campanian - Maastrichtian shallowing tendency could have been connected with global or local sea level changes.

**References**

- Caron, M. 1985: Cretaceous planktonic foraminifera. In: Bolli H. M., Saunders J. & Perch-Nielsen K. (Eds.): *Plankton stratigraphy*. Cambridge University Press, Cambridge, 17-86.
- Gasinski, M.A. 1998: Campanian-Maastrichtian pleoecology and paleobiogeography of the Andrychow Klippes, Outer Carpathians, Poland. Jagielonian University (Ed.): *Transactions-Monographies*, Krakow, 333, 104.
- Gasiński, M.A., Jugowiec, M. & Ślaczka, A. 1999: Late Cretaceous foraminiferids and calcareous nannoplankton from the Węglówka marls (Subsilesian Unit, Outer Carpathians, Poland). *Geologica Carpathica*, 50: 63-73.
- Geroch, S., Jednorowska, A., Książkiewicz, M. & Liszkowa, J. 1967: Stratigraphy based upon microfauna in the West Polish Carpathians. *Biuletyn Instytutu Geologicznego*, 211: 185-282.
- Jones, E.W. & Charnock, M.A. 1985: Morphogroups of agglutinated foraminifera. Their life positions and feeding habits and potential applicability in (paleo)ecological studies. *Revue de Paléobiologie*, 4: 311-320.
- Liszkowa, J. 1967: Microfauna of the Upper Cretaceous marls in the Sub-Silesian series of the Wadowice region (Western Carpathians). *Biuletyn Instytutu Geologicznego*, 211: 341-351.
- Książkiewicz, M. 1967: Senonian marls in the window of Sułkowice. In: Liszkowa J., 1967: Microfauna of the Upper Cretaceous marls... *Biuletyn Instytutu Geologicznego*, 211: 351-353.
- Olszewska, B. 1997: Foraminiferal biostratigraphy of the Polish Outer Carpathians: A record of basin geohistory. *Annales Societatis Geologorum Poloniae*, 67: 325-337.
- Sliter, W.V. & Baker, R.A.: 1972: Cretaceous bathymetric distribution of benthic foraminiferids. *Journal of Foraminiferal Research*, 2: 167-183.