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Analysis of small foraminifera assemblages and clay minerals from bentonite-like layers within Czerwin beds (Subsilesian Unit, Polish Flysch Carpathians) – preliminary results

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Abstract: Two bentonite-like layers were found in the Czerwin beds (Wisniowa tectonic window). Their Early Eocene age was established on the basis of the presence of *Saccamminoides carpathicus* Geroch and the numerous occurrence of *Glomospira* div. sp. In terms of micropaleontological and mineralogical features the deposits stand out between neighbouring layers. Foraminifera tests from the bentonite are small, white and the number of them changes. Clay minerals are represented essentially by a smectite. Taking into consideration all features of bentonites their volcanic origin is possible.

Key words: Subsilesian Unit; Early Eocene; bentonites; clay minerals; smectites; small foraminifera

The area of investigations

The studied formations are situated in Paleogene sediments of Czerwin beds (the Subsilesian Unit in the Wisniowa tectonic window) (fig.1). The Czerwin beds are represented by grey shales with intercalations of thin-bedded fine-grained glauconitic sandstones.

The denomination „bentonite horizons" is used to denote claystone layers of 17 (No. of samples: 15, 16, 17, 18) and 0,5 (No. 9) (fig. 2) centimetres of thickness which stand out between others. The layers are almost white colour. They have sharp bottom and top boundaries and they swell in water.

Micropaleontological analyses

For microfaunal analyses, 22 100-gram samples were collected from soft shales (fig. 2). The material was subjected to maceration process in the solution of Glauber's salt. Then, samples were washed over a 63 μm screen and dried. All tests were then picked from the dry residue, counted and identified.

The assemblage of foraminifera from the bentonite horizon consists essentially of well preserved agglutinated species (98.25 % – 100 %). Planctonic and benthic calcareous foraminifera are sparse (2 % – 0 %) and are badly preserved. Tests of about 90 % of the foraminifera are white, smooth on the surface and built up of finer material then typical grey tests.

The age of the analysed material was established on the basis of the agglutinated foraminifera assemblages which point to Early Eocene zones: Glomospira div. sp. and Saccamminoides carpathicus (zones after Olszewska, 1997).

The predominant genus is *Glomospira* with *Glomospira charoides* (JONES et PARKER) and *Glomospira gordialis* (JONES et PARKER) being the most numerous species. In bentonites, the genus comprises 70 % of all foraminifera while in adhering layers its number decreases to 35 %. The other species of *Glomospira* are single. In the sediment the following benthonic foraminifera are also present: *Abysammina poagi* SCHINTKER et TJALSMA, *Ammosphaeroidina pseudopauciloculata* (MJATLIUK), *Ammodiscus* div. sp., *Arenobulimina dorbigny* (Reuss), *Gerochammina conversa* (GRZYBOWSKI), *Glomospirella grzybowskii* (JURKIEWICZ), *Haplophragmoides* div. sp., *Hormosina* div. sp., *Hyperammina* sp., *Karrerulina coniformis* (GRZYBOWSKI), *Nuttallides trüempy* (NUTTALL), *Paratrochamminoides* div. sp., *Precystammina* sp., *Recurvoides* div. sp., *Rhabdammina cylindrica* GLEASSNER, *Trochammina* div. sp., *Saccammina placenta* (GRZYBOWSKI). Planctonic foraminifera are represented by *Acarinina soldadensis* (BOLI) and *Subbotina velascoensis* (CUSHMAN).

The number of foraminifera within bentonite decreases from the bottom towards the top and changes as follows: 621 f/100 (No. of foraminifera/100 grams of sediment), 259 f/100, 102 f/100 and 20 f/100. Simultaneously the general amount of microfauna of upper and lower deposits averages 210 f/100.

Comparison of test's size has revealed that foraminifera deriving from bentonite are smaller then average and the end parts of their tests are anomalously coiled. The range of their diameter varies between 0.3 and 1.5 mm, but over 50 % of them belong to a very narrow range of size 0.4–0.7 mm. In the neighbouring layers the size of *Glomospira* varies in size from 0.5 to 2.5 mm though the biggest percent of them comprises in the range of 0.7–1.0 mm. Besides their tests are typically coiled. For measurement *Glomospira charoides* (JONES et PARKER) and *Glomospira gordialis* (JONES et PARKER) were chosen as they are present in every sample.

The EDS analyses of the chemical composition of tests of the same species of agglutinated forms from the bentonite and typical foraminifera have not revealed differences in their mineralogical composition.

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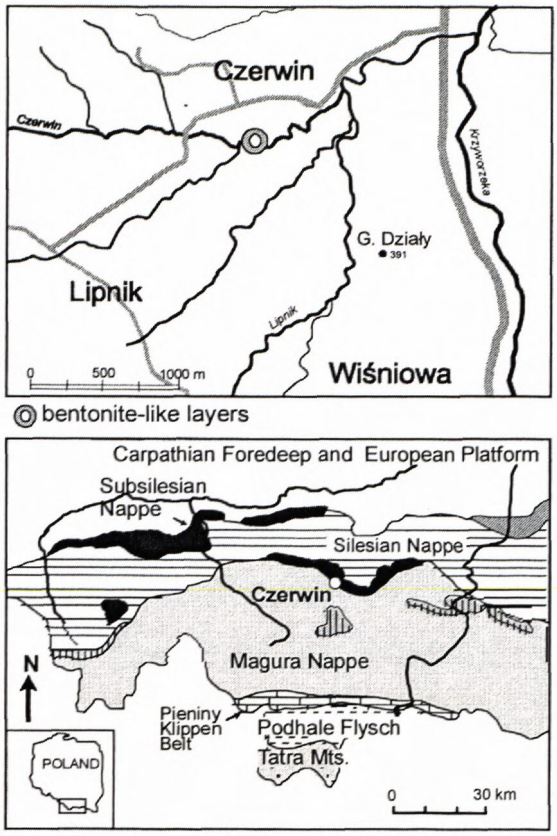

Fig.1. Location of bentonite-like layers.

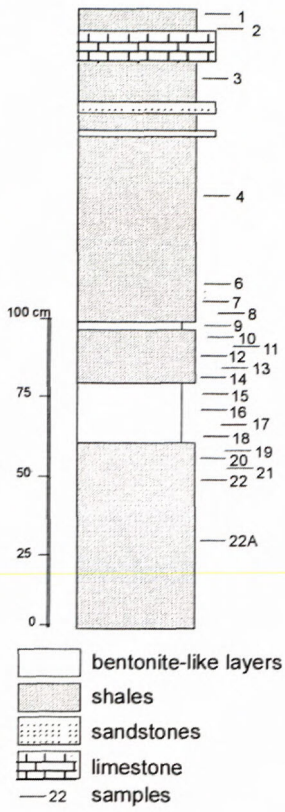

Fig.2. Litological log.

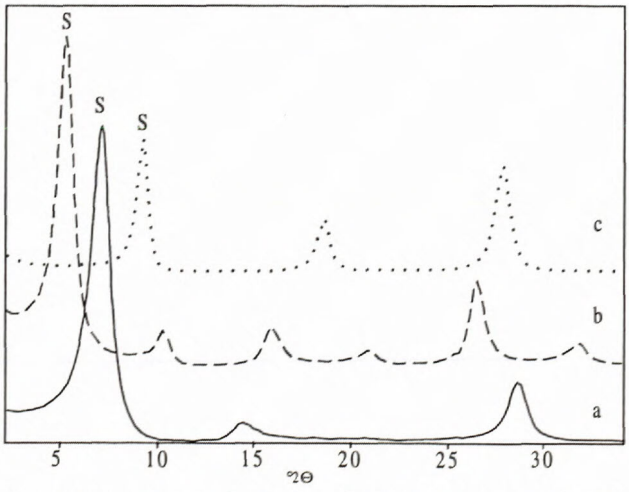

Fig. 3 XRD patterns of smectite (S) from the bentonite (cz. 17, fig. 2) of oriented preparations of < 0.2 m fraction: a – air dried, b – glycolated, c – heated in the temperature of 550 °C.

Analyse of clay minerals

Analyses were carried out on samples derived from two bentonite-type layers from Czerwin as well as those occurring below and under the bentonite in the cross-section of the Czerwin area.

Clay minerals were investigated in air-dried, glycolated and heated in the temperature of 550 °C oriented preparations from fractions: 63–2 μm, 2–0.2 μm and <0,2 μm. Diffraction patterns of samples were recorded in the range 2-65° of the 2Θ angle.

The XRD patterns show that, in contrast to under- and overlying sediments, the clay material of bentonites consists essentially of montmorillonite. Besides the <0,2 μm fraction of samples, 15 and 17 is represented by pure smectite (fig. 3).

Minerals accompanying smectites in fractions <2–0,2 μm and <2–63 μm are: kaolinite, chlorite, mica and quartz. Between top and bottom of the lower layer of bentonites (fig. 1) there is noticeable difference in the amount of kaolinite and quartz. Towards the top of the layer the amount of kaolinite decreases while the amount of quartz increases. The upper layer of bentonites has high and equal proportions of kaolinite and quartz.

Discussion

The numerous occurrence of foraminifera of *Glomospira* genus in the Early Eocene has biostratigraphical value (sc. *Glomospira* Event) (KAMINSKI et al., 1996). The foraminifera of the *Glomospira* genus are detritus feeding organisms living on the surface of the sediment (mobile epifauna). The genus is well adapted to environments of high productivity and low oxygenation and it settles niches that undergone rapid change (Kaminski et al., 1996).

There could had been two reasons for such a plentiful occurrence of *Glomospira*: 1) global: acme zone of forms of the genus, 2) local: change of palaeoecological conditions (change of type of sediment). Anomalies connected with size, test's shape and composition of foraminifera assemblages could be the result of adaptation to adverse living conditions.

Taking into consideration the clay composition (montmorillonite, lack of detritic material) of bentonite layers their volcanic origin (alteration of volcanic ashes in the sedimentation basin of the investigated area) is not out of question and further study leading to explanation of the problem is being made.

Acknowledgement

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