

The Jurassic of the Andrychów Klippes (Western Outer Carpathians) - new paleontological studies and palaeogeographical remarks

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The Andrychów (External) Klippes (Roczyny, Targaniczanka N, Targaniczanka S, Pańska Góra N, Pańska Góra S., Inwałd W, Inwałd E) occur in the western part of the Polish Flysch Carpathians between localities Roczyny and Inwałd in a 6 km long zone directed NEE – SWW. The lithological and sedimentological character of Andrychów Klippes, (igneous rocks, shallow-water carbonates, pelagic sediments) as well as age of their sedimentary sequence (Middle Jurassic - Eocene) differ essentially from those of the surrounding flysch. The klippes also differ between themselves in age and lithological development.

In Jurassic palaeogeography they represented a marginal part of the European platform whose morphology was characterised by the presence of high standing blocks, separated by basins. During Alpine north-directed movements, some blocks were detached from the platform and incorporated into flysch sediments, mainly in the front of Silesian nappe. The Oxfordian cherty limestones show significant similarities to coeval sediments deposited on the carbonate ramp fringing southern margin of the European platform. The Tithonian shallow-water limestones with abundant nerineacean-diceratid-coral fauna, numerous algae (dasycladales, codiaceans, solenoporeaceans), forams (littorinids, miliolids, involutinids) and calcareous dinocysts show similarities to the Štramberk limestones, as well as to the carbonate sediments of the European platform which occur as detached blocks and exotics in the Outer Carpathians.

The characteristic foraminiferal assemblage of the „Inwałd“ limestones (the Inwałd klippe, the Roczyny

klippe) consists of littorinids : *Pseudocyclammina lituus* (Yokoyama), *Valvulina alpina* Dragastan, *V. lugeoni* Septfontaine, *Protomarssonella* cf. *dumortieri* (Schwager), *Palaeogaudryina varsoviensis* (Bielecka et Pożaryski); miliolids: *Quinqueloculina mitchurini* Dain, *Q. stellata* Matsieva et Temirbekova, *Istriloculina fabaria* Matsieva et Temirbekova, *Decussoloculina barbui* Neagu, *Scythiloculina confusa* Neagu; involutinids: *Trocholina alpina* Leupold, *T. burlini* Gorbachik, *Andersenolina perconigi* Neagu, *A. elongata* (Leupold). The algal association of the Inwałd limestone is composed of dasycladales: *Actinoporella podolica* (Alth), *Clypeina jurassica* Favre (rare), *Campbelliella striata* (Carozzi), *Salpingoporella annulata* Carozzi, *S. pygmaea* (Gümbel), *Eoteutloporella socialis* (Praturlon); encrusting codiaceans: *Baccinella irregularis* Radoicic, *Pseudolithocodium carpathicum* Mišik, *Lithocodium aggregatum* Elliot; encrusting solenoporeaceans: *Thaumtoporella parvovesiculifera* Rainieri and rare cyanophyceans *Rivularia* sp.

The microfossil assemblages of the peri-Tethyan shelf submerged under the Flysch Carpathians (well Zagórzycze 6) or incorporated into flysch deposits as olistholites (Kruhel) are more environmentally diversified, probably due to different position of investigated sites on the platform. However, generally they represent the same neritic environment. Greater abundance of tintinnids indicates that investigated sites were situated closer to currents that distributed pelagic elements on the platform.

Calendar of geological events of Neogene in Eastern Paratethys

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As is known, Paratethys represents itself a chain of Neogene basins of Eurasia having been split off from the Mediterranean and World ocean in times of Alpine orogenesis, forming its own bioprovince.

Biochronological studies implemented in Cenozoic deposits of World ocean enable to establish a series of "waves of cooling" related mainly with manifestation of Antarctic glaciation and further variations of paleoclimate caused by oscillations of the Earth's orbit. As it has been clarified, the characteristic cyclicity in the Neogene of Eastern

Paratethys, which yet N. I. Andrusov was lucky to discover, is manifested by alternation of sediments formed in basins having salinity close to normal and sediments deposited in basins with salinity strongly deviating from the normal where the representatives of "monomorphic fauna" lived, being the extreme cases of endemism, which inhabited great spaces from Alps to Trans-Caspian region. For example, strata with *Oncophora* (Kotsakhurian regional stage), Karaganian regional stage ("strata with *Spaniodontella*"), upper Sarmatian ("Khersonian") sensu Barbot-de-Marni -

strata with *Mactra*, Tamanian strata of Akchagyl (with *Avimactra* and *Cardium dombra*), etc., are in direct correlation with phases of cooling. At the same time, in glacio-eustatic rhythmicity of sediments of Paratethys the critical events of biota which occurred in Mediterranean, such as Serravalian and Messinian crises of megafauna, have been manifested. It is worth mentioning that in literature the question was debating for a long time about conditions of formation of the abovementioned monomorphic (sensu lato) faunas of Eastern Paratethys: are they the result of salinization or of desalination? The data obtained provide an evidence that the phases of cooling in World ocean led apparently to isolation and desalination of Neogene basins of Eastern Paratethys:

17 million years - of Kotsakhurian regional stage;

15 m.y. - of Karaganian regional stage (sensu N. I. Andrusov - strata with *Spaniodontella*);

9.5 m.y. - of Khersonian regional stage;

2.6 m.y. - of Tamanian strata of Akchagyl, etc., coinciding with global phases of paleoclimate changes directed to its worsening.

Hence, synthesis of all events passed - from underthrust of European and African plates in Neogene (Serravalian crisis), glacio-eustatic decrease of the Atlantic level (Messinian crisis), manifestation of phases of Alpidic orogenesis, to fixation of global waves of cooling - has led to a possibility of creation of peculiar Calendar of geological (mainly tectonic-climatological) events in the Neogene of Paratethys.

The find of Lower Liassic (Hettangian) brachiopods in the Fatric Unit (Central West Carpathians)

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Hettangian brachiopods occur very rarely in the West Carpathians. From the Kopienec Formation Gazdzicki et al. (1979) reported brachiopods of Upper Hettangian age. During the research of the Jurassic sediments in the Fatric Unit in the Veľká Fatra Mountains new brachiopod fauna of Middle Hettangian age has been found (Jakub quarry near Banská Bystrica). In the lithological section, the Svätý Jakub Formation (probably of Rhaetian age) is developed in the basal part. In the overlie, about 20 m thick succession is present, consisting of rhythmic alternation of well-bedded dark-grey biopelmicritic limestones with very thin brownish interbeds slightly enriched in clay and silt quartz. In the upper part of this succession brachiopod fauna occur.

In beds no. 143-147 the *Lobothyris* assemblage occur, with dominant representatives of *Lobothyris*. They show significant variability in shell outline, convexity, presence of anterior median depressions and bilobation, character of beak, beak ridges and foramen size. On the basis of these characters it is possible to distinguish several morphotypes. In the meantime it is not known if morphotypes of *Lobothyris* belong to one species with strong intras-

pecific variability or to several species. Oysters (*Gryphaea* sp.) are scarce in this assemblage.

Up-section, limestone beds (no. 148-150) with no macrofauna are present. In their overlie (beds no. 151-153) monospecific oyster assemblage occur (the *Gryphaea* assemblage). It passes upward into the *Zeilleria-Calcirhynchia-Gryphaea* assemblage (beds no. 154-158).

Higher, limestone beds with oyster assemblage are present (beds no. 159-166), locally with scarce zeilleriids. In the bed no. 167 the *Zeilleria-Calcirhynchia-Gryphaea* assemblage occur again. In this assemblage zeilleriids are prevailing. They show similarity to *Zeilleria mutabilis* (Oppel) and *Z. choffati* (Haas). Rhynchonellids are externally very similar to *Calcirhynchia plicatissima* (Quenstedt) and *C. latifrons* (Stur in Geyer), but they have different internal structure. The Middle Hettangian age is supported by ammonite *Kammerkarites haploptychum* (Wähner) (determined by dr. M. Rakús), which has been found in the bed no. 168.

Gazdzicki, A., Michalik, J., Planderová, E. & Sýkora, M., 1979: An Upper Triassic - Lower Jurassic sequence in the Krížna nappe (West Tatra Mountains, West Carpathians, Czechoslovakia). *Záp. Karpaty, Geol.*, 5, 119-148.