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Biostratigraphy of Upper Triassic Sediments of the Eastern Margin of Upper Silesian Coal Basin

ESSENTIALS OF LITHOSTRATIGRAPHY

Lithostratigraphic subdivision of the Upper Triassic in the eastern margin of the Upper Silesian Coal Basin comprises three units: Chrzanów Formation, Bolesław Formation and Grabowa Formation. The Bolesław Formation includes two members: Będów Claystone and Klucze Claystone ones. Moreover, a part of the sequence is determined as later part of Rhaetic sediments and is not classified as a formal unit (Bilan 1976, 1977).

Vast areas of the central-european sedimentary basin show the presence of unconformity between Muschelkalk and Keuper which is regarded as "palaeogeographic discordance" (Wurster 1964). Boundary between Muschelkalk and Keuper is heterochronous (Trammer 1972, 1974, Głazek, Trammer, Zawidzka 1973, Zawidzka 1974) and Lower Keuper consists of argillaceous-arenaceous sediments with plant detritus. Lower Keuper sediments classified as an equivalent of the Lettenkohle facies (Bogacz 1976) and comparable with the Miedary Beds (Kotlicki 1974) occur locally in the basement of the Chrzanów Formation. In other profiles the Chrzanów Formation sediments rest upon the Tarnowice Beds. The overlapping character of the Chrzanów Formation results from the expansion of the basin during deposition of Boundary Dolomite (Bilan 1976).

The Chrzanów Formation which is compared (Bilan 1976) with the Lower Gypsum Keuper and the Boundary Dolomite (in the subdivision after Grodzicka-Szymanko and Orłowska-Zwolińska 1972) and with the Opole Beds and the Potempa Beds (distinguished by Kotlicki and Włodek 1976) corresponds to the Węgrowiec Formation (Senkowiczowa 1980). The age of the Chrzanów Formation is regarded as Cordevolian basing on the ammonites and bivalves found in the Boundary Dolomite and known from the Alpine facies of the same age (Bilan 1977).

The Bolesław Formation covers various Muschelkalk units (Tarnowice Beds, Diplopora Dolomite, Ore-bearing Dolomites) or the Chrzanów Formation (Bilan 1976). Senkowiczowa (1980) compares this formation with the Piotrowina Beds (Kotlicki, Włodek 1976), however, it appears to correspond to the Reed Sandstone (Schilfsandstein). Its uppermost portion (younger part of the Klucze Claystone Member) can be the apparently reduced equivalent of the Upper Gypsum Keuper (Bilan 1976, 1977). The age of Schilfsandstein has been determined as Julian (Kannegieser, Kozur 1972) basing on the similarities in macroflora from the Lunz Beds and the Raibl Beds and on the presence of ostracods known from the Alpine Carnin.

The Grabowa Formation covers various members of the Bolesław Formation or the Muschelkalk. It is compared with the R I cyclothem distinguished by Grodzicka-Szymanko (1971) and with the Drawno Beds, Jarkowc Beds and the older part of Zbąszynek Beds distinguished by Dadlez and Kopik (1963) (Senkowiczowa 1980). Later part of Rhaetic sediments corresponds (Bilan 1976, Senkowiczowa 1980) to the R II cyclothem (in the subdivision after Grodzicka-Szymanko 1971) and to the younger part of the Zbąszynek Beds (in the subdivision after Dadlez and Kopik 1963). Lack of sufficient evidence precludes the more precise determination of the age of Upper Gypsum Keuper and epicontinental Rhaetic sediments. Kozur (1973) classified the Upper Gypsum Keuper as Tuvanian. Rhaetic is preliminarily subdivided into the lower part known as Unionites posterus zone sensu lato and the upper part known as Rhaetavicula contorta zone (Kopik 1967).

FOSSILS FROM THE UPPER TRIASSIC OF THE EASTERN MARGIN OF UPPER SILESIAN COAL BASIN

Upper Triassic sediments from the Silesia-Kraków area contain rare macrofauna. In Rhaetic deposits bones were found belonging to amphibian

Mastodonsaurus sp., reptiles: Megalosaurus cloacinus Quenstedt, Plesiosaurus sp., Termatosaurus albertii Plieninger and fishes: Ceratodus silesiacus Roemer = C. parvus Agassiz, Colobodus (Gyrolepis) sp., Saurichthys acuminatus Quenstedt (Roemer 1870) and Prolepidotus gallineki Michael (Michael 1893).

Macroflora findings are also relatively scarce. In the Rhaetic deposits remains of Pteridophyta: Clathropteris muensteriana Schenk (Cl. platyphylla Goeppert - Roemer, 1870) = Clathropteris meniscoides Brongniart (Orłowska-Zwolińska, Senkowiczowa 1970), Cladophlebia roesserti Presli (Goeppert 1844, 1845), Calamites lehmannianus Goeppert (Roemer 1870) = Neocalamites hoerensis (Schimper) Halle (Orłowska-Zwolińska, Senkowiczowa 1970) and Spermatophyta: Lepidopteris ottonis (Goeppert) Schimper (Goeppert 1844, 1845, Piwocki 1970), Neuropteris sp. cf. N. remota Presli (Roemer 1870), Pterophyllum carnallianum Goeppert and Taeniopteris gigantea Schenk (Goeppert 1844, 1845, Roemer 1870).

The Bolesław Formation contains phylloids: Palaeostheria minuta (Zieten) and P. laxitexta (Jones), bivalves, gastropods and fish remains (Bilan 1975, 1976). In the Grabowa Formation and in the later part of Rhaetic sediments only rare, unidentifiable foraminifers were observed (Bilan 1976). In the lower part of Rhaetic sediments of the Fore-sudetic Monocline and of the Zawiercie area poorly preserved agglutinated foraminifers were noted: Hyperammina sp., Variostoma sp., Diplostermina sp., Mesoendothyra sp., and Rhizammina sp. (Styk 1979). Finally, bivalve Unionites posterus (Deffner et Fraas) (Grodzicka-Szymanko, Orłowska-Zwolińska 1972) has been reported from the lower part of R II cyclothem in the north-eastern margin of the Upper Silesian Coal Basin.

The Upper Triassic from the eastern margin of the Upper Silesian Coal Basin contains abundant microfossils from which ostracods, charophytes, miospores and megaspores appear to be important for stratigraphy and correlation.

Ostracod stratigraphy

Two ostracod zones were distinguished by Bilan (1980) in the Upper Triassic of the eastern margin of Upper Silesian coal Basin: Lutkevichinella germanica (Wienholz et Kozur) range zone, Clinocypris? silesia = Pulviella silesia (Styk) range zone (Styk 1979) and an interzone sandwiched between them.

LITHOSTRATIGRAPHY					BIOSTRATIGRAPHY		
POLISH LOWLAND			UPPER SILESIAN COAL BASIN		OSTRACOD ZONES	CHAROPHYTA ZONES	
WESTERN PART	CENTRAL PART	NORTH-EASTERN-MARGIN	EASTERN MARGIN				
Szyperko - Śliwczynska 1960 Dadlez, Kopik 1963, Kopik 1967	Deczkowski 1977	Grodzicka-Szymanka, Orłowska-Zwolińska 1972	Bilan 1976				
RHAETIC	UPPER	ZBĄSZYNEK BEDS	ZBĄSZYNEK BEDS	CYCLOTHEM R II	HIGHER PART OF RHAETIC SEDIMENTS		
	LOWER	JARKOWO BEDS	JARKOWO BEDS	CYCLOTHEM RI	GRABOWA FORMATION	Pulviella silesia zone	Auerbachichara rhaetica zone
		DRAWNO BEDS					
KEUPER	UPPER	UPPER GYPSUM SERIES	UPPER GYPSUM SERIES	hiatus	BOLESŁAW FORMATION	Lufkevichinella germanica and Pulviella silesia interzone	Stellatochara thuringica zone
		REED SANDSTONE	REED SANDSTONE	REED SANDSTONE			
		LOWER GYPSUM SERIES	LOWER GYPSUM SERIES	LOWER GYPSUM KEUPER AND GRENZDOŁOMIT	CHRZANÓW FORMATION		
	LOWER	Grenzdołomit LETTENKOHLE BEDS	LOWER KEUPER	hiatus	erosion		

Fig. 1. Selected litho- and biostratigraphic subdivisions of Upper Triassic in the Eastern Margin of the Upper Silesian Coal Basin related to the Upper Triassic stratigraphy of the central and western parts of the Polish Lowlands

The *Lutkevichinella germanica* range zone includes sediments belonging to the Będów Claystone Member - lower part of the Bolesław Formation (Fig. 1) correlated with the Reed Sandstone (Schilfsandstein). Kozur and Mostler (1972) have distinguished the two ostracods zones in this unit: alpina-Zone (*Simeonella brotzenorum alpina* Bunza et Kozur 1971) and germanica-Zone (*Karnocythere germanica* Wienholz et Kozur 1970). In the Bolesław Formation the index taksons of the two zones mentioned above reveal similar range of occurrence. *Simeonella brotzenorum alpina* = *Lutkevichinella brotzenorum alpina* (Bunza et Kozur) Styk (1982) exceeds in few cases the upper range of *Karnocythere germanica* = *Lutkevichinella germanica* (Wienholz et Kozur) Styk.

The *Pulviella silesia* zone comprises sediments of the Grabowa Formation whereas the *Lutkevichinella germanica*, *Pulviella silesia* interzone includes those belonging to the Klucze Claystone Member (i.e., upper part of the Bolesław Formation).

Styk (1982) proposed biostratigraphy of the epicontinental Triassic in Poland based on ostracods. In her system the Lower Keuper belongs to the *Speluncella alata* zone whereas in the Upper Keuper the three zones include successively the Lower Gypsum Beds, the Reed Sandstone and the Upper Gypsum Beds. In the Lower and the Upper Gypsum Beds zones only rare specimens of *Darwinula liassica* (Brodie) were found. The *Lutkevichinella brotzenorum alpina* zone of the Reed Sandstone corresponds to the *Lutkevichinella germanica* zone (Bilan 1980).

The *Rhombocythere nodosa* zone includes Lower Rhaetic sediments (Styk 1982). Apart from the index species, *Darwinula globosa* (Duff), *D. dreyeri* Kozur, *D. wandae* Styk, *D. liassica* (Brodie), *D. (Paradarwinula) spinosa* Kozur, *Rhombocythere tenuistriata* (Kozur), *Timiriasevia rhaetica* (Anderson) i *Pulviella silesia* (Styk) were reported, the latter being the index species of the zone which includes the Grabowa Formation (Bilan 1980).

Charophyte stratigraph

Charophyta species from the Upper Triassic of the eastern margin of Upper Silesian Coal Basin were described by Bilan (1969, 1974) who also found diversity in their stratigraphic ranges. The same author (Bilan 1988) presented the stratigraphy of epicontinental Triassic in Poland based upon Charophyta and related to the earlier subdivisions

(Saidakovsky 1962, 1966, 1973), Kisielevsky 1969, Kozur 1974, Saidakovsky, Kisielevsky 1985). The Upper Triassic of the eastern margin of Upper Silesian Coal Basin contains two of the distinguished zones: *Stellatochara thuringica* partial range zone and *Auerbachichara rhaetica* range zone.

The *Stellatochara thuringica* zone defined in the epicontinental Upper Triassic in Poland corresponds to the Keuper. In the Cracow-Silesian Region Charophyta were not observed in the lower part of Keuper (Chrzanów Formation). Lower range of the *Stellatochara thuringica* zone falls into the bottom part of the Błędów Claystone Member whereas its occurrence corresponds to this part of the range of *Stellatochara thuringica* which does not interfere with the range of *Auerbachichara rhaetica*. Apart from *Stellatochara thuringica* Kozur et Reinhardt this zone contains also: *Stellatochara hoellvicensis* Horn of Rantzien, *S. maedleri* Horn of Rantzien, *S. donbassica* (Demin), *S. dnjeproviiformis* Saidakovsky, *S. schneiderae* Saidakovsky, *S. gracilis* (Saidakovsky), *S. lipatovae* (Saidakovsky), *S. germanica* Kozur et Reinhardt, *S. piriformis* Kozur et Reinhardt, *S. kozuri* Bilan, *S. pomerana* Bilan, *S. silesiana* Bilan, *Stenochara maedleri* (Horn of Rantzien), *Stn. pseudoglypta* (Horn of Rantzien), *Stn. donetziana* (Saidakovsky), *Stn. ovata* (Saidakovsky), *Stn. elongata* (Saidakovsky), *Stn. schaikini* Saidakovsky, *Stn. saratoviensis* Kisielevsky, *Stn. pseudoovata* Saidakovsky, *Stn. rantzienii* Saidakovsky, *Stn. karpinskyi* (Demin), *Stn. kisielevskiyi* Bilan, *Stn. incerta* Bilan, *Porochara brotzeni* (Horn of Rantzien), *P. triassica* (Saidakovsky), *P. ukrainica* Saidakovsky, *P. urusovi* Saidakovsky, *P. belorussica* Saidakovsky, *P. concisa* Saidakovsky, *P. abjecta* Saidakovsky, *P. cylindrica* Saidakovsky, *P. sphaerica* Kisielevsky, *Vladimiriella wetlugensis* (Saidakovsky), *V. decora* Saidakovsky, *Clavatorites hoellvicensis* Horn of Rantzien, *C. acuminatus* (Saidakovsky), *C. cuneatus* (Saidakovsky), *C. capitatus* (Saidakovsky), and *Auerbachichara arguta* (Saidakovsky).

The *Auerbachichara rhaetica* range zone includes the Grabowa Formation and the bottom part of later part of Rhaetic sediments. Apart from *Auerbachichara rhaetica* Bilan, the following species were identified: *Auerbachichara starozhilovae* Kisielevsky, *A. kisielevskyi* Saidakovsky, *A. baskuntschakiensis* Kisielevskiyi, *A. polonica* Bilan as well as numerous species known from the zones defined in Dunter, Muschelkalk and Keuper (Bilan 1988).

Spore-and-pollen stratigraphy

Basing on the ranges and percentages of species in the spectrum, stratigraphically important microflora assemblages were distinguished in the epicontinental Triassic sediments in Poland. In the Lower Keuper representatives of the genera *Aratrisporites* (Leschik), *Todisporites* Couper, *Minutosaccus* Mädlar and *Succinctisporites* (Leschik) predominate (Orłowska-Zwolińska 1979).

In the Upper Triassic of the north-eastern margin of the Upper Silesian Coal Basin three spore-and-pollen assemblages were distinguished for Lower Gypsum Keuper with Boundary Dolomite, Reed Sandstone and Rhaetic (Orłowska-Zwolińska 1971, Grodzicka-Szymanko, Orłowska-Zwolińska 1972). These assemblages were compared (Grodzicka-Szymanko, Orłowska-Zwolińska 1972) with those from epicontinental Triassic in Germany (Schulz 1966, 1967, Mädlar 1964), Switzerland (Leschik 1955), England (Clarke 1965, Warrington 1970) and also with the assemblages known from the Alpine facies (Klaus 1960, Venkatachala, Goczan 1964).

The first spore-and-pollen assemblage comprises the oldest Upper Triassic sediments in the studied sequences - Lower Gypsum Keuper with Boundary Dolomite (Grodzicka-Szymanko, Orłowska-Zwolińska 1972), correlated with the Chrzanów Formation (Bilan 1976). Numerous representatives were identified of the genera *Ovalipollis* Krutzsch and *Triadispora* Klaus as well as species: *Conbaculatisporites longdonensis* Clarke, *Taeniaesporites noviaulensis* Leschik, *T. sulcatus* (Pautsch), *Lueckisporites virkkiae* Potonie et Klaus, *Camerosporites secatus* Leschik, *Duplicisporites granulatus* Leschik, *D. verrucosus* Leschik and *Praecirculina granifer* (Leschik).

The second assemblage was identified in the Reed Sandstone sediments (Grodzicka-Szymanko, Orłowska-Zwolińska 1972) comparable with the Bolesław Formation (Bilan 1976). It is dominated by *Ovalipollis* Krutzsch, *Aulisporites astigosus* (Leschik) and *Leschikisporites* (Leschik) and contains also *Aratrisporites paraspinosus* Klaus, *A. coryliseminis* Klaus, *Camerozonosporites* (C.) *laevigatus* Schulz, *C. (C.) rudis* (Leschik) and *Gleicheniidites* cf. *G. senonicus* Ross (Grodzicka-Szymanko, Orłowska-Zwolińska 1972).

The third assemblage occurs in the sediments classified by Grodzicka-Szymanko (1971) as R II cyclothem (later part of Rhaetic sediments, Bilan 1971) and, subordinately, in the top part, as R I

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cyclothem (Grodzicka-Szymanko, Orłowska-Zwolińska 1972) correlated with the Grabowa Formation (Bilan 1976). The assemblage contains still abundant *Ovalipollis Krutzsch* but also *Granuloperculatipollis rudis Venkatachala et Goczan*, *Corollina meyeriana* (Klaus) and *Classopollis classoides* (Pflug). Moreover, *Enzonasporites manifestus* Leschik, *E. vicens* Leschik, *E. marginalis* Leschik, *Brachysaccus* cf. *B. neomundatus* (Leschik) and *Ceproidites microreticulatus* Orłowska-Zwolińska (Grodzicka-Szymanko, Orłowska-Zwolińska 1972).

Megaspore stratigraphy

Megaspore analysis has been applied to the Rhaetic and Lias stratigraphy in the Kraków-Wieluń area (Znosko 1955). Systematic studies of Upper Triassic megaspores from the Polish Lowland (Marcinkiewicz 1962, 1969, 1971, 1978) lead to the establishing of biostratigraphic schema based on megaspore assemblages (Marcinkiewicz 1979).

The megaspore assemblage *Dijkstraia sporites beutleri* Reinhardt and *Maexisporites meditectatus* (Reinhardt) occurs in the Lower Keuper (Marcinkiewicz 1979).

The *Narkisporites harrisi* megaspore assemblage was found in the Reed Sandstone but the occurrence of megaspores is restricted to the lower portion of this unit (Marcinkiewicz 1979). Grey, clayey-muddy sediments containing megaspores can be correlated with the Będów Claystone Member (lower part of the Bolesław Formation). The following species were identified: *Narkisporites harrisi* (Reinhardt et Fricke), *Radosporites planus* (Reinhardt et Fricke), *Echitriletes frickei* Kannegieser et Kozur, *Echitriletes sentus* (Marcinkiewicz), *Hughesisporites gibbosus* (Reinhardt et Fricke), *Verrutriletes ornatus* Reinhardt et Fricke, and *Trileites altotectatus* Kannegieser et Kozur (Marcinkiewicz 1979).

The *Trileites pinguis* megaspore assemblage was reported from Wielichowo Beds in the Fore-sudetic Monocline and in their facial equivalent (Marcinkiewicz 1979). The Wielichowo Beds defined by Dadlez and Kopik (1963) were classified by Marcinkiewicz (1979) as Upper Rhaetic. According to Kopik (1973), the Rhaetic sedimentary cycle in the Cracow-Silesian area is completed by the Gorzów Beds (Zbąszynek Beds pro parte) which are overlain by the late Lower Lias. The stratigraphic gap (i.e. the absence of Wielichowo Beds) is presumably of erosional character.

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*Biostratygrafia osadów górnego triasu
wschodniego obrzeżenia Górnosląskiego Zagłębia Węglowego*

Summary

W podziale litostratygraficznym górnego triasu wschodniego obrzeżenia Górnosląskiego Zagłębia Węglowego wyróżniono trzy jednostki o randze formacji bolesławskiej (ogniwo łożców z Będowa, ogniwo łożców z Kłuczy) oraz kompleks osadów (wyższy zespół osadów retyku) nie określony mianem jednostki formalnej. W osadach górnego triasu obszaru śląsko-krakowskiego występują stosunkowo nieliczne szczątki makrofauny i mikroflory. Licznie występują natomiast mikroskamieniałości: małżoraczkki, ramienice, miospory i megaspory, które uzyskały ważne znaczenie dla stratygrafii i korelacji osadów kajpru i retyku.

Bilan (1980) wyróżnił w osadach górnego triasu wschodniego obrzeżenia Górnośląskiego Zagłębia Węglowego dwa poziomy małżoraczkowe (poziom zasięgu *Karnocythere germanica* = *Lutkevichinella germanica* i poziom zasięgu *Clinocypris? silesia* = *Pulviella silesia*) oraz zawarty pomiędzy nimi międzypoziom. Poziom *Lutkevichinella germanica* obejmujący osady niższego ogniwa formacji bolesławskiej - iłowce z Błędowa, porównać można z poziomem *Simeonella brotzenorum alpina* (Kozur, Mostler 1972) i poziomem *Lutkevichinella brotzenorum alpina* (Styk 1982). Poziom *Pulviella silesia* obejmujący osady formacji grabowskiej odpowiada wyróżnionemu przez Styk (1982) poziomowi *Rhombocythere nodosa*.

Bilan (1988) przedstawił podział epikontynentalnego triasu Polski na podstawie ramienic. W górnym triasie wschodniego obrzeżenia Górnośląskiego Zagłębia Węglowego istnieją dwa spośród wyróżnionych poziomów: poziom ścięśniony *Stellatochara thuringica* i poziom zasięgu *Auerbachichara rhaetica*. Poziom *Stellatochara thuringica* obejmuje osady kajpru. We wschodnim obrzeżeniu Górnośląskiego Zagłębia Węglowego nie znaleziono ramienic w osadach formacji chrzanowskiej. Dolna granica zasięgu gatunku wskaźnikowego tego poziomu przebiega w spagowej części ogniwa iłowców z Błędowa, a zasięg poziomu odpowiada tej części zasięgu *Stellatochara thuringica*, która nie pokrywa się z zasięgiem *Auerbachichara chaetica*. Poziom *Auerbachichara rhaetica* obejmuje formację grabowską i spagową część wyższego zespołu osadów retyku.

W osadach górnego triasu północno-wschodniego obrzeżenia Górnośląskiego Zagłębia Węglowego wyróżniono trzy zespoły sporowo-pyłkowe (Grodzicka-Szymanko, Orłowska-Zwolińska, 1972). Pierwszy zespół sporowo-pyłkowy reprezentuje najstarsze w badanych profilach osady górnego triasu - dolny kajper gipsowy wraz z dolomitem granicznym, porównywane z formacją chrzanowską (Bilan 1976). Drugi zespół stwierdzony został w osadach piaskowca trzcinowego, porównywanych z formacją bolesławską. Zespół trzeci występuje w osadach zaliczonych przez Grodzicką-Szymanko (1971) do cyklotemu R II (= wyższy zespół osadów retyku - Bilan 1976), a podrzędnie w stropowej części cyklotemu R I (Grodzicka-Szymanko, Orłowska-Zwolińska 1972), porównywanego z formacją grabowską (Bilan 1976).

Marcinkiewicz (1979) opracowała schemat biostratygraficzny górnego triasu Polski pozakarpackiej oparty na zespołach megasporowych. Zespół *Dijkstraia sporites beutleri* występuje w kajprze dolnym, zespół *Narkisporites harrisi* w osadach piaskowca trzcinowego, a zespół megasporowy *Trileites pinguis* stwierdzony został w warstwach wielichowskich.

OBJASNIENIE FIGURY

Fig. 1. Zestawienie wybranych schematów lito- i biostratygraficznych górnego triasu wschodniego obrzeżenia Górnośląskiego Zagłębia Węglowego w nawiązaniu do podziałów górnego triasu ze środkowej i zachodniej części Niżu Polskiego