

## Ostracod Zones in the Upper Triassic of the Eastern Margin of the Upper Silesian Coal Basin

by

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*Presented by R. NEY on June 26, 1978*

**Summary.** Two Ostracod zones and the interzone between them were defined in the Upper Triassic of the Upper Silesian Coal Basin. The *Karnocythere germanica* range zone includes the Błędów Claystone Member, and the *Clinocypris? silesia* range zone is related to the Grabowa Formation. The interzone between *Karnocythere germanica* and *Clinocypris? silesia* includes the Klucze Claystone Member. A tentative parallelization of Ostracod zones and chronostratigraphic division is presented in the paper.

**Introduction.** The difficulties in establishing the stratigraphy of the Cracow-Silesian Upper Triassic deposits are due to the position of these sediments in the basin (the peripheral zone), breaks in the sedimentation as well as to the specific environmental conditions. The notable development in examinations of the stratigraphy of the central part of the Middle-European basin gives a base for parallelizing the main tendencies in the development of the central and marginal zones of the basin. The criteria of defining the Keuper/Rhaetic boundary in that area were found to be related to divisions of the Upper Triassic of the Polish Lowland [31, 35, 14, 21, 27]. The Triassic divisions for the Cracow-Silesian region were elaborated [19, 23, 7] and tentative parallelizations of division of the Silesian Triassic with the Alpine division were given [23, 9, 22].

Four complexes of sediments characterized by individual lithological features were distinguished in profiles of the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin. These are (from the bottom): the Chrzanów Formation, the Bolesław Formation (comprising two members: the Błędów Claystone Member and the Klucze Claystone Member), the Grabowa Formation, and the higher part of Rhaetic sediments. It has been agreed that there are no foundations to treat the latter complex as a formal stratigraphic unit [7].

**Biostratigraphy.** The Upper Triassic sediments of the Cracow-Silesian region contains numerous fossils. Fragments of macrofauna and macroflora were described in the 19th century and in the first half of the 20th century [16, 17, 30, 1-4]. The occurrence of numerous microfossils of fundamental importance for correlation and stratigraphy was found later. The studies on microspores [19], Charophyte [5-7, 11] and Ostracoda [32-34] helped to distinguish the forms typical for individual lithostratigraphical units.

In particular, some Ostracoda species showing limited stratigraphical range, characterized by abundant occurrence, can be the base for creation of Ostracoda zones. Basing on the analysis of occurrence of individual species in the profiles of the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin, two zones: the *Karnocythere germanica* range zone and the *Clinocypris? silesia* range zone as well as the *Karnocythere germanica* and *Clinocypris? silesia* interzone between them were distinguished.

#### The *Karnocythere germanica* range zone

Index fossil: *Karnocythere germanica* Wienholz et Kozur, 1970, Pl. 1, fig. 1-3, p. 589-590.

Definition: Range of the zone is determined by the range of occurrence of the *Karnocythere germanica* species. Also *Simeonella brotzenorum alpina* Bunza et Kozur [13] and species of the *Darwinula* genus occur in abundance within the described zone.

The *Karnocythere germanica* zone comprises sediments of the lower member of the Bolesław Formation-Błęków Claystone Member (Fig. 1). These sediments show considerable differentiation of environmental conditions from limnic to mezohaline brackish which explains why that index fossil occurs numerously and even in masses (oligo-miohaline brackish conditions), and in some places it is absent. The elimination of *Karnocythere germanica* in some parts of the profile of the Błęków Claystone Member was caused by a change of environmental conditions. Thus, within the *Karnocythere germanica* zone barren intrazones occur and their definition does not seem to be useful because of a different quantity and limited range of profile intrazones which do not include representatives of the species.

Thickness: The *Karnocythere germanica* zone shows fluctuations in thickness from several to more than 20 m and, at the same time, differentiation comes from the reduction of the Błęków Claystone Member caused by pre-Rhaetic erosion.

Geographical distribution: Sediments of Basisschichten des Schilfsandsteins GDR [38], Reed Sandstone of Polish Lowland [34, 7].

Remarks: Two Ostracoda zones (Fig. 2) were distinguished within Schilfsandstein by Kozur and Mostler [25]: *alpina*-Zone (*Simeonella brotzenorum alpina* range zone) and *germanica*-Zone (*Karnocythere germanica* range zone). In sediments of Bolesław Formation index fossils of the quoted zones

represent similar age interval of occurrence (in some rare cases, the range of *Simeonella brotzenorum alpina* slightly exceeds the upper range of *Karnocythere germanica*), however no co-existence was found. This is related to the occurrence of these forms in environments of precisely determined conditions of salinity. *Karnocythere germanica* occurs in oligo-miohaline brackish conditions; on the other hand, *Simeonella brotzenorum alpina* represents mezohalinitic environment [38, 10]. For that reason, instead of a possible *Karnocythere germanica* and *Simeonella brotzenorum alpina* concurrent range zone, the *Karnocythere germanica* range zone, having more numerous index fossil, has been defined.

#### The *Clinocypris? silesia* range zone

Index fossil: *Clinocypris? silesia* Styk, 1972. Tab. 2, fig. 3a, b, p. 273.

Definition: The range of the described zone defined by the range of occurrence of the *Clinocypris? silesia* species. Within the zone, numerous Ostracoda of the *Darwinula* genus occur beside the index fossil.

The *Clinocypris? silesia* zone includes sediments of the Grabowa Formation (Fig. 1). The index taxon does not show continuous range of occurrence in the profile of this formation. Because of a notable differentiation of environmental conditions observed during the development of the Grabowa Formation, profile intervals are found in which this species is absent. For a similar reason as in the case of *Karnocythere germanica* zone, the determination of barren intrazones does not seem to be useful.

Thickness: In the eastern margin of the Upper Silesian Coal Basin, thickness of the described zone varies over wide range from several to 70 m, in some parts to more than 100 m. The significant variation in thickness was caused by the sedimentation of the Grabowa Formation on a undulated base affected by pre-Rhaetic erosion and by the erosion which came after the period of deposition of the Grabowa Formation.

Geographical distribution: *Clinocypris? silesia* is known from Lower Rhaetic sensu polonico [34, 7].

#### The *Karnocythere germanica* and *Clinocypris? silesia* barren interzone

Definition: The range of the described interzone includes the sediments localized between the *Karnocythere germanica* range zone and the *Clinocypris? silesia* range zone. Ostracoda of the *Darwinula* genus are numerous in these sediments and also in the above defined zones. In rare profiles, in the bottom part of the interzone occurs *Simeonella brotzenorum alpina*.

The *Karnocythere germanica* and *Clinocypris? silesia* interzone includes sediments of the upper member of Boleslaw Formation—The Klucze Claystone Member (Fig. 1).

Thickness: Differences in thickness (from several to 30 m) of the described interzone are caused by erosion due to tectonic movements between Keuper and Rhaetic.

Karnocythere germanica and Clinocypris? silesia zones as independent units

Range zones: Karnocythere germanica and Clinocypris? silesia are independent units. This is due to the following reasons: absence of Ostracod fauna (Chrzanów Formation), poor identification of its rare representatives (higher part of Rhaetic sediments), absence of forms which could be adopted as index fossil (Klucze Claystone Member), the peculiar character of environmental conditions of the peripheral part of the sedimentation basin.

The Błędown Claystone Member overlies various complexes of Muschelkalk or Chrzanów Formation sediments (without Ostracoda). In sediments included in the upper member of the Bolesław Formation (Klucze Claystone Member) numerous Ostracoda of the *Darwinula* genus were found. The most numerous species, *Darwinula liassica* (Brodie) has a wide range of occurrence. This form is known in the Middle-European basin from Lower Keuper to Rhaetic; in the Saratov region (the Russian platform) the species was found in Lower and Middle Triassic sediments [26]. *Darwinula wandae* Styk is numerous in the Błędown Claystone Member and in the Grabowa Formation sediments; exceptionally it occurs in the Klucze Claystone Member. Other representatives of the *Darwinula* genus occur occasionally in the mentioned sediments. In the light of the mentioned facts there are no sufficient grounds for definition of the zone, basing on the range of occurrence of the *Darwinula* species. The possibility of creation of a *Darwinula liassica* partial range zone corresponding to the described interzone range seems to be inexpedient because of wide vertical range of this species, which might lead to diverging interpretations in cases of regional biostratigraphic correlations.

Grabowa Formation sediments are overlain by Jurassic deposits, Quaternary sediments or by the higher part of Rhaetic sediments, in which rare badly preserved Ostracoda were found.

**Chronostratigraphic position of the distinguished zones.** Analyses of development of the Upper Triassic sediments in the eastern margin of the Upper Silesian Coal Basin as well as analyses of organic fragments found in the sediment make the correlation of individual units of division possible, including divisions given for the Polish Lowland area. The Chrzanów Formation corresponds with the Lower Gypsum Keuper and the Boundary Dolomite. The Błędown Claystone Member is connected with the lower part of the Reed Sandstone. The Klucze Claystone Member corresponds with the upper part of Reed Sandstone, while their upper part can be the markedly reduced equivalent of the Upper Gypsum Keuper [7, 9]. The Grabowa Formation can be determined as Lower Rhaetic sensu polonico (excluding its highest part). The higher part of Rhaetic sediments is the reduced equivalent of Upper Rhaetic (including the highest part of Lower Rhaetic) division of Rhaetic according to Kopik [21].

Sediments recognized as the Lettenkohle facies equivalent [12], which can be compared with the Miedary Beds [23], occur in some parts of the base

of the Chrzanów Formation. In other profiles, the Tarnowice Beds occur in the floor of the Chrzanów Formation. In Lower Keuper, on a very large area of the Middle-European basin, the sedimentation of clayey-sandy beds with flora detritus had taken place. The deposits are considered as deltaic ones, and the disconformity between the Muschelkalk and Keuper is considered as a "palaeogeographic discordance" [40]. The boundary between the Muschelkalk and Keuper is heterochronic, however in the eastern part of the basin an earlier replacement of Muschelkalk carbonate rocks by Lettenkohle facies sediment had taken place [36, 37, 15, 41, 42].

In relation to the parallelization of Middle-European Triassic division with the Alpine division, the chronostratigraphical position of the described Ostracod zones can be defined (Fig. 1).

CHRONOSTRATIGRAPHY		LITHOSTRATIGRAPHY			OSTRACOD ZONES	
		GERMANY	POLISH LOWLAND	EASTERN MARGIN OF THE UPPER SILESIA COAL BASIN		
UPPER TRIASSIC	RHAETIAN	RHATKEUPER	UPPER RHAETAVICULA CONTORTA	EROSION HIGHER PART OF RHAETIC SEDIMENTS		
	NORIAN	STEINMERGELKEUPER	LOWER UNIONITES POSTERUS (S.I.)	EROSION GRABOWA FORMATION	CLINOCYPRIS ? SILESIA ZONE	
	CARNIAN	TUVALIAN	OBERER GIPSKEUPER	UPPER GYPSUM KEUPER	EROSION KŁUCZE CLAYSTONE MEMBER	KARNOCYHERE GERMANICA AND CLINOCYPRIS ? SILESIA BARREN INTERZONE
		JULIAN	SCHILFSANDSTEIN	REED SANDSTONE	BOLESŁAW FORMATION BLEDOŃ CLAYSTONE MEMBER	KARNOCYHERE GERMANICA ZONE
	CORDEVOLIAN	UNTERER GIPSKEUPER GRENZDOLOMIT	LOWER GYPSUM KEUPER BOUNDARY DOLOMITE	CHRZANÓW FORMATION		

Fig. 1. Stratigraphic position of the distinguished Ostracoda zones

The age of the Chrzanów Formation corresponding with the Lower Gypsum Keuper including the Boundary Dolomite is determined as Cordevolian. It was proved by the presence of the following ammonites in the Boundary Dolomite: *Neoclypites? peregrinus* and *Allocceratites schmidi*. *Neoclypites? peregrinus* is similar to *Neoclypites desertorum*, known from Lower Carnian of Nevada. *Allocceratites schmidi* is similar to the form *Hungarites (Israelites) ramonensis* from Upper Fassanian of Israel [28]. Other arguments confirming that the Lower Gypsum Keuper and Boundary Dolomite belongs to Cordevolian, are as follows [24]: the occurrence of *Myophoria (Costatoria) goldfussi* (known from the Alps), the similarity of *Thuringionautilus jugatonodosus* to *Thuringionautilus klipsteini* (known from St. Cassian Beds) and the similarity of *Modiolus subdiminatus* to the Carnian *Modiolus sub-*

*carinatus*, at the same time the boundary with Julian can be determined by the range of *Myophoria kefersteini*.

The age of Reed Sandstone (Schilfsandstein) is determined as Julian [20]. It is proved by the similarity of Schilfsandstein macroflora of the Lunz and Raibl Beds as well as by occurrence of *Simeonella brotzenorum alpina* and *Lutkevichinella simplex oblonga* (known from the Alpine Carnian). Upper boundary of Schilfsandstein, defined as the upper boundary of Julian, can be determined by the range of *Omphaloptycha lunzensis* and *Narkisporites harrisi*.

There are no suitable criteria for a direct determination of the age of the Upper Gypsum Keuper and Lower Rhaetic sensu polonico. Oberer Gipskeuper is included into Tuvalian [24]. The division presented by Kozur and Mostler [25] does not distinguish the Ostracoda zones in the age interval from Tuvalian to Alaunian, i.e. in the sediments of Oberer Gipskeuper and in the part of Steinmergelkeuper corresponding with the Lakian and Alaunian (see Fig. 2).

CHRONOSTRATIGRAPHY		OSTRACOD ZONES		
		GERMANY	UPPER SILESIA / PROPOSED UNIT /	
UPPER TRIASSIC	RHAETIAN		KOZUR MOSTLER - 1972	
			COMBROOKENSIS - ZONE	
			MARTINI - ZONE	
			PENARTENSIS - ZONE	
	NORIAN	SEVATIAN	WICHERI - ZONE	---
			RUEGGERI - ZONE	
			GRACILIS - ZONE	
	ALAUNIAN		CLINOCYPRIS ? SILESIA ZONE	
	LAKIAN			
	CARNIAN	TUVALIAN		KARNOCYHERE GERMANICA CLINOCYPRIS ? SILESIA BARREN INTERZONE
JULIAN		GERMANICA ZONE ALPINA - ZONE	KARNOCYHERE GERMANICA ZONE	
CORDEVOLIAN				

Fig. 2. Ostracoda zones of the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin as related to the division by Kozur and Mostler [25]

The Clinocypris? silesia range zone connected with the Grabowa Formation can be compared with Lower Rhaetic sensu polonico (excluding its highest part). Recently, the unit is parallelized with Norian (like Steinmergelkeuper). In the Upper Steinmergelkeuper (Sevastian) the following three Ostracod zones were distinguished [25]: gracilis A.-Zone, rueggeri-Zone and wicheri-Zone basing on the range of the *Rhombocythere* species. In some profiles of the Lower Rhaetic of the Polish Lowlands species of the *Rhombocythere* genus were found [34], therefore the use of this division for partition

of the mentioned deposits is possible. In sediments of the Grabowa Formation, *Rhombocythere* were found. The fact can be explained by the range of the discussed unit (the Grabowa Formation corresponds with the Lower Rhaetic excluding its highest part, so it may occur without the Sevastian equivalent), or it may correspond with the position of these sediments in Middle-European basin (the peripheral zone).

The higher part of Rhaetic deposits, compared with large cyclothem R<sub>11</sub> [18, 19], may be compared with the upper part of Postera-Schichten (elegans-Zone) and with the Contorta-Schichten [39]. The upper epicontinental Rhaetic sensu polonico corresponding with Rhätkeuper (Contorta-Schichten) is parallelized with Rhaetian. In this aspect, the statement about the exclusively facial sense and exclusively lithostratigraphic meaning of Rhaetic sensu polonico [29] assumes a new significance. The occurrence of the *Rhaetavicula contorta* species both in the Alpine and in the Middle-European basin plays an important role when comparing the epicontinental Rhaetic with the Rhaetic sensu stricto (Rhaetian). The Rhätkeuper sediments contain also: *Taeniodon praecursor*, *Protocardia rhaetica*, *Modiolus minutus*, *Cardium cloacinum*, *Isocyprina evaldi* and *Gervillia inflata* [24]. Three Ostracod zones were defined in the Rhätkeuper sediments [25]: penartensis A.-Zone, martini-Zone and combrookensis-Zone.

**Added in proof.** While this paper was in print, an atlas of Triassic fossils appeared (*Atlas skamieniałości przewodnich i charakterystycznych*, in: *Budowa geologiczna Polski*, vol. III part 2a: Trias) where O. Styk describes the index taxons of zones as: *Karnocythere germanica* under the name ?*Lukte-vichinella germanica* (Wienholz et Kozur) and *Chinocypris? silesia*—*Pulviella silesia* (Styk).

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**В. Билян, Остракодовые зоны верхнего триаса восточного края Верхнесилезского угольного бассейна**

**Резюме.** В отложениях верхнего триаса восточного края Верхнесилезского угольного бассейна найдены многочисленные остатки остракодов. Установлены две зоны: зона *Karnocythere germanica* и зона *Clinocypris? silesia*, а также найден между этими зонами пустой горизонт. К зоне *Karnocythere germanica* принадлежит подсвета глин из Блендова, а к зоне *Clinocypris? silesia* отложения Грабовской свиты. Присутствие *Karnocythere germanica* и *Clinocypris silesia* в многих профилях триаса Польской низменности является основой для предположения, что зоны описанные по расстоянию этих таксонов проявляют широкое географическое распространение в отложениях эпиконтинентального бассейна. Представлена предварительная корреляция выделенных остракодовых зон с хроностратиграфической схемой. Зона *Karnocythere germanica* связана с нижней частью юлийского подъяруса. В связи с отсутствием точных критериев для определения границ ярусов карнийского и норийского, а также норийского и рётского в эпиконтинентальном бассейне, зону *Clinocypris? silesia* относится к нижнему рэту, эквивалентному в большой степени норийскому ярусу.