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CORRELATION OF THE UPPER JURASSIC–CRETACEOUS EPICONTINENTAL SEDIMENTS IN SOUTHERN POLAND AND SOUTHWESTERN UKRAINE BASED ON THIN SECTIONS

PORÓWNANIE GÓRNOJURAJSKO-KREDOWYCH UTWORÓW EPIKONTYNENTALNYCH POŁUDNIOWEJ POLSKI I POŁUDNIOWO-ZACHODNIEJ UKRAINY NA PODSTAWIE ANALIZY PŁYTEK CIENKICH

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Abstract. Detailed micropaleontological investigation of more than 400 samples (150 identified species) from the Mesozoic sediments of southern Poland and southwestern Ukraine was the basis for their correlation. The youngest Mesozoic assemblage identified in the studied material represent the early Late Cretaceous (Turonian). This assemblage occurs in the so-called the III Formation of Turonian epicontinental strata in Poland, and in the Dubivtsi Formation in West Ukraine. Microfossil assemblages of the Early Cretaceous age (Berriasian–Barremian) allow for a correlation of the Ropczyce and Dębica formations (central part of S Poland) and the upper part of the Babczyn and Cieszanów formations (SE Poland) with the Stavchany Formation and a part of the Bukovyna Formation in SW Ukraine. Tithonian microfossil assemblages from Poland resemble those of the shallow-water Nyzhniv Formation from the Ukrainian part of the East European Platform. Open-marine microfossils (e.g. calpionellids) commonly occur only in the Ukrainian material. Poor microfossil assemblages of the Kimmeridgian age occur in majority of studied subdivisions. They were identified in the Sobków Formation and the upper part of the Niwki Formation in the central part of S Poland, Ruda Lubycka, the upper part of the Bełżyce, Basznia, and Głowaczów formations (SE Poland) and in the Moryantsi and Pidluby formations (Bilche-Volitsia zone of the Carpathian Foredeep) and in the Rava Rus'ska Formation (Eastern European Platform). Among the Oxfordian microfossil assemblages, only those containing *Alveosepta jaccardi* (Schrodt) and *Protomarssonella jurassica* (Mityanina) allow for a correlation of subdivisions from both areas. These assemblages occur in the "Coral-algal" Formation in the Tarnów–Dębica region and in the Bełżyce, Jasieniec and Jarczów formations in SE Poland. The coeval sediments belong to the Boniv, Rudky and Sokal formations in West Ukraine. Scarce data from the Middle Jurassic sediments do not allow for a correlation of the material studied.

Key words: correlation, foraminifera, calcareous dinocysts, red algae, Late Jurassic–Cretaceous, southern Poland, southwestern Ukraine.

Abstrakt. Szczegółowa analiza mikropaleontologiczna ponad 400 próbek (150 oznaczonych gatunków) z utworów mezozoicznych południowej Polski i zachodniej Ukrainy umożliwiła korelację tych utworów. Najmłodsze stwierdzone, w badanym materiale, zespoły reprezentują niższą późną kredę (turon). Zespół ten występuje w tzw. III formacji utworów epikontynentalnych w Polsce oraz w formacji dubowieckiej SW Ukrainy. Zespoły mikroskamieniałości wieku wczesnej kredy (berias–barrem) pozwalają na korelację formacji z Ropczyc i Dębicy (centralna część Polski południowej) oraz górnej części formacji z Babczyna i formacji cieszanowskiej (SE Polska) z formacją stawczańską i częścią formacji bukowińskiej SW Ukrainy. Stwierdzone w materiale z Polski zespoły mikroskamieniałości tytonu przypominają zespoły z płytkowodnych utworów formacji niżniowskiej ukraińskiej części platformy wschodnioeuropejskiej. Natomiast większość zespołów mikroskamieniałości tytonu z badanych utworów SW Ukrainy charakteryzuje obecność form otwartego morza (kal-

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pionellidów). Zespoły mikroskamieniałości kimerydu, choć ubogie,występują w większości badanych utworów. Stwierdzono je w formacji z Sobkowa i w górnej części formacji z Niwek (centralna część Polski południowej) w formacji z Rudy Lubyckiej oraz w górnych częściach formacji bełżyckiej, z Baszni, głowaczowskiej (SE Polska), a także na Ukrainie w formacjach moranieckiej i podlubieckiej (strefa Bilcze-Wolica zapadliska przedkarpackiego) i w formacji z Rawy Ruskiej (platforma wschodnioeuropejska). Z zespołów oksfordu jedynie te, które zawierały otwornice *Alveosepta jaccardi* (Schrodt) i *Protomarssonella jurassica* (Mityanina), pozwalają na korelację badanych wydzieleń litostratygraficznych. Zespoły takie występują w formacji „koralowcowo-glonowej" rejonu Tarnów–Dębica (centralna część Polski południowej) oraz w formacjach bełżyckiej, jasienieckiej i jarczowskiej (SE Polska). Na obszarze SW Ukrainy do równowiekowych utworów należą formacje: boniwska, rudkowska i sokalska. Niedostateczna ilość danych mikropaleontologicznych z utworów jury środkowej nie pozwoliła na wykonanie korelacji.

Slowa kluczowe: korelacja, otwornice, wapienne dinocysty, krasnorosty, późna jura, kreda, południowa Polska, południowo-zachodnia Ukraina.

INTRODUCTION

Mesozoic sediments cover over 80 percent of the Polish territory representing the easternmost part of the Central European Basin (Dadlez, Marek, 1997). They overlie discordantly older, sediments of the different age and generally (except for the Carpathians) represent shallow-water epicontinental sedimentation. Four stages (i.e. Permian–Triassic, Early Jurassic, Middle–Late Jurassic and Cretaceous) of tectono-sedimentary development have been recognized (Dadlez, Marek, *op.cit.*).

Extensive stratigraphical investigations of the Mesozoic sediments of Poland were summarized by Sokołowski (1973) as well as Marek and Pajchlowa (1997). These investigations were based on studies of macro- and microfossils, in majority of cases, extracted from the embedding rocks. However, preparation techniques used often did not allow extracting fossils from the hard rocks leaving part of data unavailable. The undertaken studies, using a thin section technique, aimed at supplementing (or updating) the existing stratigraphical information. The studies concerned sediments of the 3rd and 4th stages (Middle Jurassic–Cretaceous) outcropping on the surface and recognized in wells in the Carpathian Foredeep and the adjacent Polish part of the West European Platform. The other important purpose of the study was an attempt to correlate the coeval sediments of West Ukraine known from both the Carpathian Foredeep and the East European Platform.

MATERIAL AND METHODS

The material came from six Polish wells (Łukowa 4, Nawsie 1, Pilzno 40, Ropczyce 7, Zagórzyce 6, Zagórzyce 7; analysed in 155 thin sections) and 15 Ukrainian wells (Bortiatyn 1, Didushychi 1, 2; Yuryiv 1, Korolyn 6, Kokhanivka 26, 30; Lanivka 1, Moryantsi 1, Pyatnychany 1, Podil'tsi 1, Pohlynaiucha 1, Pivnichne Hirs'ke 1, Verchany 1, Voloscha 1; in 247 thin sections) (Fig. 1). All these samples were provided by and are stored in the Department of Environmental Analyses, Cartography and Economic Geology, Faculty of Geology, Geophysics and Environmental Protection, AGH, University of Science and Technology, Kraków.

The thin sections were examined under a polar Nikon Labophot microscope connected with a Nikon NIS-Elements photomicrographic device. Correlation of the microfossils was additionally based on the results of recent biostratigraphical study of the Lublin–Lubaczów region (Olszewska, 2010).

Lithological sections of the wells and the results of microfacies analysis are presented in separated papers (Krajewski *et al.*, 2011a, b).

GEOLOGICAL SETTING

The Upper Jurassic and Lower Cretaceous sediments from the basement of the southern part of the Carpathian Foredeep were recognized in numerous wells drilled in the Kraków–Ropczyce and Lubaczów–Stryi area (Morycowa, Moryc, 1976; Golonka, 1978; Kutek, 1994; Dulub, Zhabina, 1999; Olszewska, 1999, 2001, 2004, 2010; Dulub *et al.*, 2003; Moryc, 1997, 2006; Maksym *et al.*, 2001; Zdanowski *et al.*, 2001; Król, 2004; Gliniak *et al.*, 2005; Gutowski *et al.*, 2005, 2007; Karpenchuk *et al.*, 2006; Zhabina, Anikeyeva, 2007; Świdrowska *et al.*, 2008; Matyja, 2009; Urbaniec *et al.*, 2010; Krajewski *et al.*, 2011a, b).

The study area is located between two major Paleozoic tectonic zones, which were also active in the Mesozoic (Żaba, 1999; Buła, Habryn, 2010, 2011). The western element is the Kraków–Lubliniec Fault Zone, the eastern one is the Holy Cross Fault Zone (Żaba, 1999; Gutowski, Wybraniec, 2006; Buła, Habryn, 2010, 2011). The major part of the Kraków–Ropczyce study area lies on the Małopolska Massif,

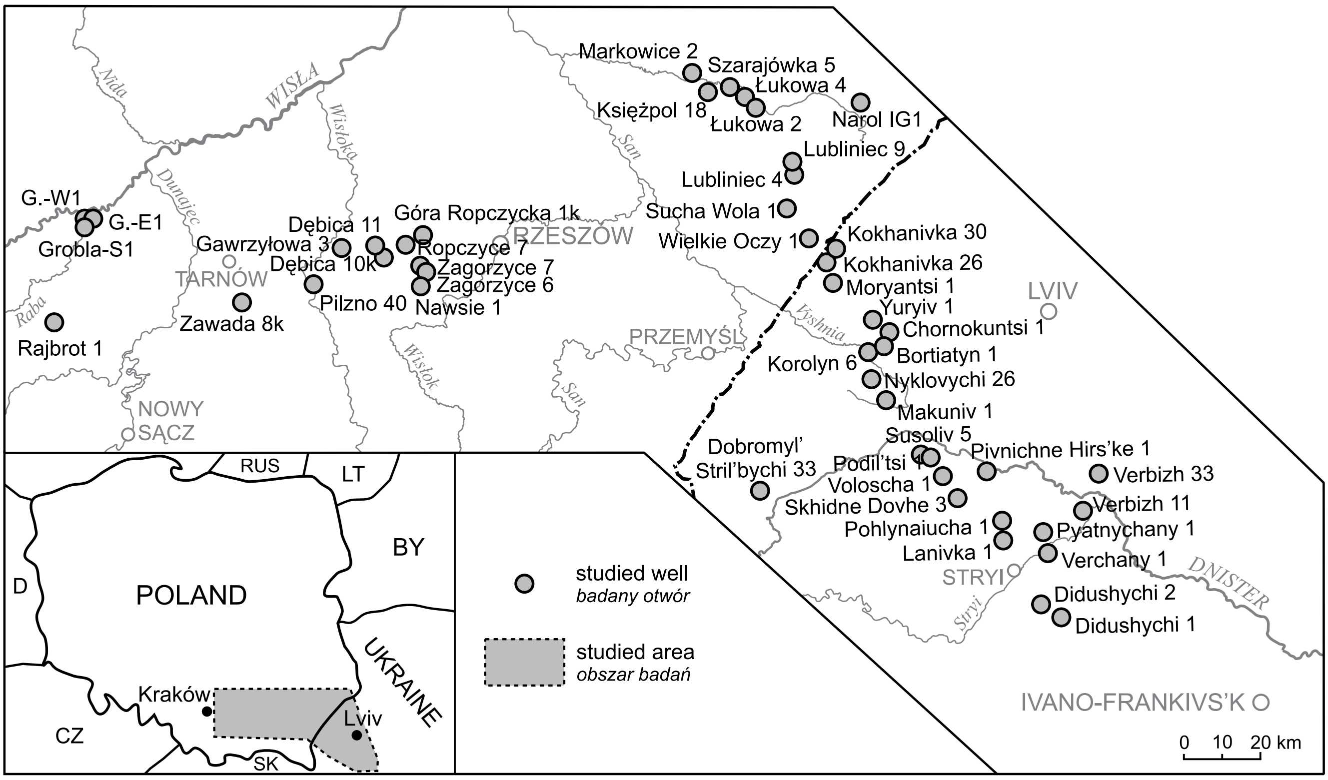


Fig. 1. Location of boreholes in the Kraków–Ropczyce and Lubaczów–Stryi area

Lokalizacja badanych otworów na obszarze Kraków–Ropczyce i Lubaczów–Stryj

while the narrow part of the Lubaczów–Stryi area streches along the strongly tectonically active south-western edge of the East European Platform (Karpenchuk *et al*., 2006; Buła, Habryn, 2010, 2011; Krajewski *et al*., 2011).

An ongoing research suggests that the block-like character of the Palaeozoic basement and the tectonic activity of the above-mentioned fault zones significantly affected the Late Jurassic and Early Cretaceous sedimentation in the study area (Krajewski, Matyszkiewicz, 2004; Karpenchuk *et al*., 2006; Matyszkiewicz *et al*., 2006; Gutowski *et al*., 2006; Krajewski *et al*., 2011a, b).

The sediments accumulated in the southeastern part of the Mid-Polish Trough (Pożaryski, Brochwicz-Lewiński, 1979; Kutek, 1994; Dadlez *et al*., 1995; Stephenson *et al*., 2003; Gutowski, Wybraniec, 2006). The SE continuation of the trough under the Carpathians and its development were the subject of many publications (Pożaryski, Brochwicz-Lewiński, 1979; Kutek, 1994; Świdrowska *et al*., 2008; Matyja, 2009). However, until now the problem has not been definitely solved.

The studied complex makes part of a sedimentary succession, Callovian–Valanginian in age. In the basement of the Carpathian Foredeep, it is separated from the older and younger sediments by discontinuity surfaces forming an independent structural element. Within the complex, several smaller sedimentary sequences have been designated (Kutek, 1994; Gutowski *et al*., 2005; Świdrowska *et al*., 2008; Krajewski *et al*., 2011a, b).

In the Kraków–Ropczyce area, the Upper Jurassic–Lower Cretaceous sediments overlie the Middle Jurassic, Triassic or Palaeozoic deposits. Erosion and tectonics caused significant differences in the thickness of the sediments from about 300 m in the Kraków region to 1300 m in the Ropczyce area. Results of stratigraphical research suggest that the sediments represent the time span Oxfordian–Valanginian and possibly Hauterivian (Moryc, Morycowa, 1976; Król, 2004; Olszewska, 1999, 2004, 2010; Gutowski *et al*., 2007; Matyja, 2009; Urbaniec *et al*., 2010; Krajewski *et al*., 2011a). Within this succession, several informal lithostratigraphic formations have been designated. Their stratigraphy and lithology vary according to specific authors (e.g. Gutowski *et al*., 2007; Matyja, Barski, 2007; Urbaniec *et al*., 2010).

Three sedimentary series have been recognized in the Polish part of the Foredeep : 1 – Callovian–Oxfordian, 2 – Kimmeridgian (?Early Tithonian), 3 – Tithonian–Valanginian (Krajewski *et al*., 2011a; *cf*. Kutek, 1994; Gutowski *et al*., 2005).

The first series includes a transgressive sequence that begins with clastic Callovian sediments passing into carbonate Oxfordian ones of variable thickness (100–300 m). Differences in thickness are due to variability of the basement, intense development of carbonate buildups and differences in compaction between massive and bedded facies (Matyszkiewicz, 1999; Kochman, 2010).

The Oxfordian sequence begins with a marly-calcareous complex with common calcified siliceous sponge mummies (*cf*. Trammer, 1982). Small initial sponge bioherms are locally observed (*cf*. Matyszkiewicz, 1997). The marly-calcareous complex is covered by massive and bedded limestones represented by pelitic and detrital limestones and microbial-sponge biostromes. The massive facies appear in the Late Oxfordian. They represent microbial-sponge complexes, similar to those in the Kraków–Częstochowa Upland. They usually have a complicated internal structure composed of several smaller buildups and detrital sediments (Krajewski, 2000). In the uppermost part of the sequence, the earliest Kimmeridgian marly facies appear.

The Kimmeridgian is represented predominantly by pelitic marly limestones and marls. The thickness of the Kimmeridgian deposits usually attains 300–400 m. The monotonous series is poor in fossils represented mainly by calcified siliceous sponges, brachiopods and foraminifers (Gutowski *et al*., 2007; Krajewski *et al*., 2011a). Up the profile, there is an increase in the proportion of calcareous facies, however, compared with the Oxfordian, microbial-sponge buildups are rare. The Kimmeridgian/Tithonian boundary is rather obscure (Matyja, 2009) and probably lies in the uppermost part of the marly facies.

The Tithonian sediments were found only in the central and eastern part of the study area. Their thickness attains 500–600 m. The Lower Tithonian marly sediments pass into pelitic and detrital limestones with siliceous sponges and thrombolites similar to the Upper Oxfordian ones. In the upper part of the section, facies with numerous, weakly diversified corals (predominantly microsolenids) are observed. It is possible that the appearance of the coral facies connected with the shallowing took place throughout the whole study area. However, the development of the coral facies does not seem to be related to the sites of occurrence of older microbial-sponge buildups (Gutowski *et al*., 2007; Matyja, 2009; Krajewski *et al*., 2011a). The coral facies occurs as biostromes or small patch reefs in sediments dominated by wackestones or bioclastic grainstones. In the upper part of the Tithonian sequence, a distinct shallowing trend is documented by the ooid facies (Krajewski *et al*., 2011a).

The Lower Cretaceous sediments were found only in the eastern part of the Kraków–Ropczyce area where they attain a thickness of about 150 m. Their facies development is strongly diversified (Zdanowski *et al*., 2001; Urbaniec *et al*., 2010; Krajewski *et al*., 2011a). The Berriasian sediments are a continuation of regressive sequence and represent, in majority of cases, the extreme shallow-water intra-platform facies (Zdanowski *et al*., 2001; Urbaniec *et al*., 2010; Krajewski *et al*., 2011a). The facies are often developed as peloid-oncoid, bioclastic, microbial sediments with numerous Charophyta gyrogonites, snails, pelecypods, coprolites and mudstones with fenestral structures. They represent short sedimentary sequences characteristic of restricted lagoons (sometimes brackish) or tidal flat environments.

The Valanginan transgression caused essential changes in the facies development. Ooid-bioclastic facies, locally with vadoids, vadose cements and breccias may indicate temporal emersion of the platform. The Lower Cretaceous sedimentary sequence ends up with sediments containing numerous bryozoans, echinoderms, ooids with admixture of siliciclastic material (Zdanowski *et al*., 2001; Urbaniec *et al*., 2010; Krajewski *et al*., 2011a).

The Upper Jurassic (Oxfordian–Tithonian) and Lower Cretaceous (Berriasian–Valanginian) sediments in the Ukrainian part of the Foredeep basement are represented by carbonate and siliciclastic facies, rarely by evaporates (Dulub, Zhabina, 1999; Anikeyeva, 2000; Dulub *et al.*, 2003; Gutowski *et al*., 2005; Zhabina, Anikeyeva, 2007; Anikeyeva, Zhabina, 2002; Olszewska, 2010; Krajewski *et al*., 2011b). In the Lubaczów area, the Upper Jurassic–Lower Cretaceous sediments are not fully identified or documented (Moryc, 2004; Olszewska, 2010). More information was supplied by research (e.g. Karpenchuk *et al*., 2006; Zhabina, Anikeyeva, 2007; Świdrowska *et al*., 2008; Krajewski *et al*., 2011) carried out in the narrow zone of the Ukrainian part of the Foredeep situated between the East European Platform and the Lower San Horst Structure (Buła, Habryn, 2011). Their results suggest considerable diversity of sedimentary facies in the Lubaczów–Stryi area (e.g. Dulub, Zhabina, 1999; Gutowski *et al*., 2005; Zhabina, Anikeyeva, 2007; Krajewski *et al*., 2011b). The Upper Jurassic–Lower Cretaceous complex may be divided into three sedimentary intervals: 1 – Oxfordian–Lower Kimmeridgian, 2 – Kimmeridgian–Tithonian, 3 – Berriasian–Valanginian. The facies represent various sedimentary environments in the strongly tectonized narrow zone (Karpenchuk *et al*., 2006). The sediments show a distinct succession of the facies development from the SW (Carpathian Foredeep) to the NE (East European Platform).

In the south-western part of the Ukrainian study area, the Middle and Upper Oxfordian sediments directly overlie Middle Jurassic clastics, while in the north-eastern part – Palaeozoic deposits. The Upper Jurassic sedimentary sequence is not complete due to intense tectonic activity and erosion. Recent research revealed that the carbonate-marly facies with numerous spicules characteristic for the deeper shelf occur in the south-western part of the study area (Krajewski *et al*., 2011b), however, towards the north-east, a facies with corals, bioclasts and ooids representing shallow-water environments appear. The microbial-sponge facies typical for the north Tethyan shelf, common in the Polish part of the Carpathian Foredeep, in the Ukrainian part occur more rarely and only in a narrow zone. What is more, its occurrence is rather poorly documented. During a recent study of numerous drill holes (Krajewski *et al*., 2011b), the above-mentioned facies were also not recognized.

The Kimmeridgian sequence begins with carbonate-siliciclastic sediments known as the "variegated horizon" (Dulub *et al*., 2003; Gutowski *et al*., 2005; Olszewska, 2010). The horizon is covered by facially diversified carbonates and marly limestones, up to 500 m in thickness. In the lower part of the succession, the facies resemble those of the Oxfordian (e.g. facies with *Saccocoma*, radiolarians or sponge spicules). Towards the East European Platform, within a short distance, those deep shelf facies pass into partly dolomitized bioclastic sediments with evaporates, that represent inner platform environments (Zhabina, Anikeyeva, 2007; Krajewski *et al*., 2011a, b). The facies change upwards in the section. Caciturbidites that accumulated on the platform edge are present in the south-western part of the study area. Except for pelitic deposits, the dominant facies form redeposited shallow-water detrital limestones (Krajewski *et al*., 2011). Towards the NE, the slope facies pass into those of the platform edge represented by ooidal-bioclastic sediments, rarely by small coral-sponge buildups of the patch reefs type (Dulub, Zhabina, 1999; Karpenchuk *et al*., 2006; Zhabina, Anikeyeva, 2007). The platform edge facies pass towards the NE into those of the inner platform represented, among others, by peloidal-bioclastic sediments with coprolites, snails, pelecypods and evaporates of the tidal flat.

The Kimmeridgian succession is followed by Tithonian sediments. Their thickness grows up to 550 m in the south-western part of the study area (Krajewski *et al*., 2011b). Numerous calciturbiditic sequences of the platform slope, containing material redeposited from the platform barrier, were observed. Within the redeposited parts, there are biolithites and ooid grainstones originated from erosion of the barrier of the platform edge. Towards the NE, the slope sediments pass into coral-sponge and ooidal facies as well as sediments of isolated inner platform lagoons and tidal flat. A part of those sediments probably also represents the lowest Berriasian.

The Berriasian and Valanginian sediments in the Ukrainian part of the study area are known mainly from the northeast (Zhabina, Anikeyeva, 2007; Krajewski *et al*., 2011b). These are detrital facies with numerous ooids, bryozoans and echinoderms, similar to the facies observed in the Valanginian of the Polish part of the Foredeep basement (Zdanowski *et al*., 2001; Gutowski *et al*., 2007; Urbaniec *et al*., 2010; Krajewski *et al*., 2011). These facies imply accumulation on a shallow and open carbonate platform.

By comparing the Upper Jurassic–Lower Cretaceous complexes of the Carpathian Foredeep of Poland (Kraków–Ropczyce area) with that from Ukraine (Lubaczów–Stryi area), a significant differences may be observed. In the Polish part, sedimentation of the Upper Jurassic complex took place on a broad open shelf (ramp) situated in the Małopolska Block. The dominant sediments of microbial and sponge facies occur in the Oxfordian, Kimmeridgian and Lower Tithonian, while the coral-sponge facies occur in the rest of the Tithonian. Carbonate buildups of the Polish part are characteristic for the Upper Oxfordian. They are numerous but dispersed throughout the shelf area.

In the Ukrainian part, deposition of the Upper Jurassic sediments took place in a narrow zone. A transition from the shallow-water intra-platform, separated by a narrow barrier, to the deeper sedimentation area is observed in this region (Krajewski *et al*., 2011b). The sequences lack analogies of the microbial and sponge facies typical for the Polish part of the Carpathian Foredeep (although they were mentioned in the literature), but the dominant sedimentary types are calciturbidites, ooidal and peritidal with fenestral structures. These facies, by contrast, are not observed in the Polish part of the study area (Kraków–Ropczyce region). Uniformity of sedimentary facies in both these parts of the Carpathian Foredeep had not occurred by the latest Tithonian, but is observed mainly in the Berriasian and Valanginian.

RESULTS OF BIOSTRATIGRAPHICAL INVESTIGATIONS

POLAND

The investigated material contained microfossils of the Paleogene (Łukowa 4), Late Cretaceous (Nawsie 1, Zagórzyce 6, Zagórzyce 7), Early Cretaceous (Nawsie 1, Pilzno 40, Ropczyce 7, Zagórzyce 6, Zagórzyce 7), Tithonian (Nawsie 1, Pilzno 40, Zagórzyce 6, Zagórzyce 7), Kimmeridgian (Nawsie 1, Pilzno 40, Zagórzyce 6, Zagórzyce 7), Oxfordian (Nawsie 1, Pilzno 40, Zagórzyce 6) and the Middle Jurassic (Zagórzyce 6).

Late Cretaceous

The Upper Cretaceous sediments were studied in the following wells: Nawsie 1 (depth 3040.0–3050.0 m), Zagórzyce 6 (depth 2791.0–2795.0 m), Zagórzyce 7 (depth 2633.2–2689.6 m).

Microfossil assemblages were composed of foraminifera, calcareous dinoflagellate cysts (calcareous dinocysts) and fragments of red algae. Stratigraphic range of foraminifera (Pl. I) suggested the Turonian age of the sediments.

Typical foraminiferal assemblage contained: *Bolivinopsis rosula* (Ehrenberg), *Dorothia crassa* (Marsson), *Dorothia oxycona* (Reuss), *Marssonella turris* (d'Orbigny) (Pl. I, Fig. 1), *Archaeoglobigerina cretacea* (d'Orbigny), *Whiteinella baltica* Douglas & Rankin (Pl. I, Fig. 4), *Dicarinella imbricata* (Mornod), *Globigerinelloides ultramicra* Subbotina (Pl. I, Fig. 2), *Gümbelitria cenomana* (Keller), *Hedbergella delrioensis* (Carsey) (Pl. I, Fig. 8), *Heterohelix moremani* (Cushman) (Pl. I, Fig. 3) and *Marginotruncana marginata* (Reuss) (Pl. I, Fig. 7).

Foraminifera were accompanied by calcareous dinocysts: *Orthopithonella ovalis* (Kaufmann) (Pl. I, Fig. 6), *Orthopithonella sphaerica* (Kaufmann), *Stomiosphaerina biedai* Nowak (Pl. I, Fig. 5) and fragments of red algae (Pl. I, Fig. 9).

Early Cretaceous

Sediments related to the Early Cretaceous (Berriasian–Hauterivian) were studied in the wells: Nawsie 1 (depth. 3108.0–3111.0 m), Pilzno 40 (depth 2315.0–2317.0 m), Ropczyce 7 (depth 2183.0–2805.0 m), Zagórzyce 6 (depth 2791.0–2795.0 m), Zagórzyce 7 (depth 2703.0–2844.0 m).

Valanginian–Hauterivian

Foraminiferal assemblages commonly contained: *Verneuilinoides neocomiensis* (Majtliuk), *Praedorothia pra-*

ehauteriviana (Moullade) (Pl. II, Fig. 9), *Meandrospira favrei* (Charollais, Brönnimann & Zaninetti (Pl. II, Fig. 4a, b), *Mayncina bulgarica* Laugh, Peybernes & Rey (Pl. II, Fig. 5a, b), *Epistomina caracolla* (Roemer) and *Feurtilia frequens* Maync (Pl. II, Fig. 2).

Among rare calcareous dinocysts, stratigraphically significant *Carpistomiosphaera valanginiana* (Borza) (Pl. III, Fig. 2) and *Stomiosphaera wanneri* Borza (Pl. III, Fig. 4a, b) were identified.

Berriasian

Foraminiferal assemblages assigned to this age were more specifically diversified. They were composed of *Protomarssonella kummi* (Zedler) (Pl. II, Fig. 8), *Protomarssonella hechti* (Dieni & Massari) (Pl. II, Fig. 7), *Paleotextularia crimica* Gorbatchik, *Siphovalvulina variabilis* Septfontaine, *Dobrogelina ovidi* Neagu, *Haplophragmoides joukovskyi* Charollais, Brönnimann & Zaninetti (Pl. II, Fig. 3), *Nautiloculina bronnimanni* Arnaud-Vanneau & Peybernes (Pl. II, Fig. 6), *Charentia evoluta* (Gorbatchik), *Protopeneroplis ultragranulata* (Gorbatchik) (PL. II, Fig. 10), *Neotrocholina infragranulata* (Noth) (Pl. III, Fig. 5) and *Scythiloculina confusa* (Pl. II, Fig. 1).

The increase in species diversity and abundance was observed also in calcareous dinocysts, containing, among others: *Cadosina fusca* Wanner (Pl. III, Fig. 1), *Colomisphaera fortis* Řehanek (Pl. III, Fig. 3), *Colomisphaera tenuis* (Nagy), *Crustocadosina semiradiata* (Wanner) and *Stomiosphaera moluccana* Wanner.

The reported Berriasian microfossil assemblage corresponds to the so-called "Assemblage F" descibed from the Lower Cretaceous epicontinental sediments underlying the Outer Carpathians and the Carpathian Foredeep (Olszewska, 2004).

Late Jurassic

The Tithonian sediments were studied in wells: Nawsie 1 (depth 3237.0–3868.0 m), Pilzno 40 (depth 2345.0–2879.0 m), Zagórzyce 6 (depth 2810.0–3223.0 m), Zagórzyce 7 (depth 2844.0–2862.0 m). A typical microfossil assemblage contained calpionellids, foraminifera, calcareous cysts of dinoflagellata (calcareous dinocysts), charophyta and coprolites (Pl. V, Fig. 11). The foraminiferal assemblage was composed (among others) of *Textularia depravatiformis* Bielecka & Kuznetsova (Pl. V, Fig. 9), *Buccicrenata primitiva* BouDagher-Fadel (Pl. IV, Fig. 3), *Charentia evoluta* (Gorbatchik) (Pl. IV, Fig. 4), *Lituola ?baculiformis* Schlagintweit & Gawlick (Pl. IV, Fig. 7), *Verneuilinoides kirillae* Dain, *Melathrokerion spirialis* Gorbatchik (Pl. IV, Fig. 9), *Nautiloculina oolithica* Mohler (Pl. IV, Fig. 10), *Paleogaudryina magharaensis* Said & Bakarat, *Pseudocyclammina lituus* (Yokoyama) (Pl. V, Fig. 1), *Protopeneroplis striata* Weynschenk (Pl. IV, Fig. 12), *Siphovalvulina variabilis* Septfontaine (Pl. V, Fig. 6) and *Feurtilia frequens* Maync (Pl. IV, Fig. 8). Common representatives of the family Involutininae included *Andersenolina alpina* (Leupold) (Pl. IV, Fig. 1), *Andersenolina histeri* Neagu (Pl. IV, Fig. 2), *Neotrocholina molesta* (Gorbatchik) (Pl. IV, Fig. 11) and *Ichnusella burlini* (Gorbatchik). Among frequent miliolids, *Decussoloculina barbui* Neagu (Pl. IV, Figs. 5, 6), *Decussoloculina mirceai* Neagu (Pl. V, Figs. 4, 5), *Scythiloculina confusa* Neagu, and *Rumanoloculina mitchurini* (Dain) (Pl. V, Figs. 2, 3) were recognised. Orthostratigraphic calpionellids were represented by Middle Tithonian *Praetintinopsella andrusovi* Borza (Pl. V, Fig. 7). The calcareous dinocyst assemblage included *Comittosphaera pulla* (Borza) (Pl. V, Fig. 8), whose first occurrence marks the beginning of the Tithonian (Reháková, 2000). Charophyta are represented by sections of stems of the family Clavatoracea (Pl. V, Fig. 10) known predominantly from the Jurassic/Cretaceous transition (Harris, 1939; Feist *et al.*, 1995). Coprolites (Pl. V, Fig. 11) are also common components of this assemblage. The reported microfossils correspond to "Assemblage E" characteristic for Tithonian sediments in the basement of the Outer Carpathians and the Carpathian Foredeep (Olszewska, 2004).

The thickness of the studied sediments assigned to the Kimmeridgian compared to those described above is relatively small. They were studied in the following wells: Nawsie 1 (depth 4232.0–4235.0 m), Pilzno 40 (depth 2961.0–3152.0 m), Zagórzyce 6 (depth 3432.0–3802.0 m), Zagórzyce 7 (depth 2861.2 m). Microfossil assemblages from the above-mentioned depths are rather poor. They are composed of rare representatives of foraminifera, calcareous dinocysts, ostracods, bryozoans, fragments of green algae *Globochaete alpina* Lombard (Pl. VI, Fig. 10) and planktic crinoids of the genus *Saccocoma* Agassiz (Pl. VI, Fig. 11).

The Kimmeridgian age of the assemblage is based on foraminifera such as *Textularia depravatiformis* Bielecka & Kuznetsova, *Verneuilinoides kirillae* Dain (Pl. VI, Fig. 6), *Mesoendothyra izjumiana* Dain (Pl. VI, Fig. 4) and *Rumanoloculina verbizhiensis* (Dulub) (Pl. VI, Fig. 5) and calcareous dinocysts *Carpistomiosphaera borzai* (Nagy) (Pl. VI, Fig. 7), *Colomisphaera pieniniensis* (Borza) (Pl. VI, Fig. 9) and *Colomisphaera lapidosa* (Vogler) (Pl. VI, Fig. 8).

Among foraminifera, the presence of long-ranging species *Crescentiella morronensis* (Crescenti) (Pl. VI, Fig. 1), *Glomospira variabilis* Kübler & Zwingli (Pl. VI, Fig. 2) and *Mohlerina basiliensis* (Mohler) (Pl. VI, Fig. 3) is noteworthy.

The reported assemblage corresponds to the Kimmeridgian "Assemblage D" described from the basement of the Outer Carpathians (Olszewska, 2004).

The Oxfordian (predominantly Middle) occurs in the lower part of the wells: Nawsie 1 (depth 4272.0–4532.0 m), Pilzno 40 (depth 3313.0–3322.0 m) and Zagórzyce 6 (depth 3872.0–3884.0 m).

The moderately diversified microfossil assemblages are composed mostly of foraminifera and calcareous dinocysts. Planktic chlorophyta (*Globochaete alpina* Lombard), radiolarians, bryozoans and echinoderms as well as fragments of planktic crinoids of the genus *Saccocoma* Agassiz, occur in lower quantities.

The age of these assemblages is determined by the occurrence of foraminifera: *Eomarssonella paraconica* Levina (Pl. VII, Fig. 3), *Miliammina olgae* Bielecka (Pl. VII, Fig. 6), *Cornuspira eichbergensis* Kübler & Zwingli (Pl. VII, Fig. 2), *Ophthalmidium pseudocarinatum* Dain (PL. VII, Fig. 8), *Spirillina andreae* Bielecka (Pl. VIII, Fig. 1), *Spirillina tenuisssima* (Gümbel) (Pl. VIII, Fig. 2), *Paalzowella turbinella* (Gümbel) (Pl. VII, Fig. 10), *Rumanolina seiboldi* (Lutze) (Pl. VII, Fig. 11). *Ammobaculites irregularis* (Gümbel) (Pl. VII, Fig.1), *Ophthalmidium strumosum* (Gümbel) (Pl. VII, Fig. 9), *Ophthalmidium oxfordianum* (Deecke) (Pl. VII, Fig. 7), *Siphovalvulina variabilis* Septfontaine (Pl. VII, Fig. 12) and *Haghimashella arcuata* (Haeusler) (Pl. VII, Fig. 5).

The persistent, locally numerous, occurrence of *Globuligerina oxfordiana* Grigelis (Pl. VII, Fig. 4) suggests an older than the Late Oxfordian age of majority of faunas.

Foraminifera are accompanied by calcareous dinocysts: *Colomisphaera lapidosa* (Vogler) (Pl. VIII, Fig. 3), *Comittosphaera czestochowiensis* Řehanek (Pl. VIII, Fig. 4), *Orthopithonella gustafsonii* Bolli (Pl. VIII, Fig. 5) and *Crustocadosina semiradiata* (Wanner).

The presence of the latter species, with the first occurrence in the Late Oxfordian (Borza, 1969), suggests that part of the investigated sections may reach that age. This interpretation is supported by the presence of rare *Saccocoma* fragments.

This assemblage corresponds to the upper part of "Assemblage B" (Early–Middle Oxfordian) described from the basement of the Outer Carpathians and the Foredeep (Olszewska, 2004, 2005).

Middle Jurassic

The lowest parts of the wells Nawsie 1 (depth 4574.0–4577.0 m) and Zagórzyce 6 (depth 3983.0–4082.0 m) may represent Middle Jurassic clastic sediments. The samples contain single pyritized moulds of foraminifera including *Gaudryina*, *Textularia*, *Dentalina*, *Nodosaria* and *Epistomina*.

Summary

Results of the stratigraphic analysis of Mesozoic microfossil assemblages presented above suggest that the investigated strata (situated in the central part of the Carpathian Foredeep) represent the lowest Upper Cretaceous, Lower Cretaceous (excluding its upper part), Upper Jurassic (excluding Lower Oxfordian) and uppermost Middle Jurassic.

UKRAINE

The Ukrainian material yielded microfossils representing the Miocene (Lanivka 1, Pyatnychany 1), Paleogene (Kokhanivka 30, Verchany 1), Late Cretaceous (Didushychi 1, 2; Pohlynayucha, Pivnichne Hirs'ke 1), Early Cretaceous (Didushychi 1, Pyatnychany 1, Podil'tsi 1, Pivnichne Hirs'ke 1, Verchany 1), Tithonian (Didushychi 2, Korolyn 6, Kokhanivka 26, Lanivka 1, Moryantsi 1, Nyklovychi 27, Podil'tsi 1, Pivnichne Hirs'ke 1, Verchany 1), Kimmeridgian (Bortiatin 1, Didushychi 1, 2; Korolyn 6, Lanivka 1, Moryantsi 1, Podil'tsi 1, Verchany 1, Voloscha 1), Oxfordian (Bortiatin 1, Korolyn 6, Moryantsi 1, Podil'tsi 1, Yuryiv 1) and Middle Jurassic (Bortiatin 1, Korolyn 6, Verchany 1).

Characteristic microfossils from these sediments are presented below.

Late Cretaceous

The Upper Cretaceous sediments (Cenomanian–Turonian) were recognised in the wells: Didushychi 1 (depth 1350.0–1734.0 m), Didushychi 2 (depth 1764.0–1902.0 m), Pivnichne Hirs'ke 1 (depth 1588.2–1593.2 m) and Pohlynaiucha 1 (depth 1348.0–1731.0 m). The microfossil assemblages are composed of foraminifera, calcareous cysts of dinoflagellata, and calcareous algae.

The foraminiferal assemblage contained: *Marssonella trochus* (d'Orbigny), *Marssonella turris* (d'Orbigny) (Pl. IX, Fig. 1), *Globigerinelloides bentonensis* (Morrow) (Pl. IX, Fig. 6), *Guembelitria cenomana* (Keller), *Hedbergella delrioensis* (Carsey) (Pl. IX, Fig. 8), *Heterohelix moremani* (Cushman) (Pl. IX, Fig. 4), *Marginotruncana marginata* (Reuss) (Pl. IX, Fig. 7) and *Whiteinella baltica* Douglas & Rankin (Pl. IX, Fig. 9).

Foraminifera are accompanied by calcareous dinocysts: *Orthopithonella ovalis* (Kaufmann), *Orthopithonella sphaerica* (Kaufmann) (Pl. IX, Fig. 5) and *Stomiosphaerina biedai* Nowak (Pl. IX, Fig. 2). Additionally, fragments of red algae, probably representatives of the genus *Archaeolithothamnium* (Pl. IX, Fig. 3) have been identified.

This assemblage corresponds to that of the lower part of the Dubovitsi Formation of the Carpathian Foredeep, containing, among others, foraminifera *Marssonella turris* (d'Orbigny) and numerous representatives of calcdinocysts *Orthopithonella ovalis* (Kaufmann) (Gavrilyshin *et al*., 1991).

Early Cretaceous

Barremian–Aptian (Didushychi 1), Valanginian (Pyatnychany 1, Pivnichne Hirs'ke 1, Verchany 1) and Berriasian (Didushychi 1, Podil'tsi 1, Verchany 1) microfossils were identified in the Early Cretaceous material.

Barremian–Aptian microfossils were found in the Didushychi 1 well (depth 1913.0–1923.0 m). The assemblages were composed of foraminifera: *Nautiloculina cretacea* Peybernes (Pl. X, Fig. 7), *Trocholina paucigranulata* Moullade (Pl. X, Fig. 9), *Derventina filipescui* Neagu (Pl. X, Fig. 12) and *Pseudolituonella* cf. *gavonensis* Foury (Pl. X, Fig. 11) and calcareous algae of the family Dasycladacea.

Microfossils assigned to the Valanginian–Hauterivian interval were found in the following wells: Didushychi 1 (depth 2009.0–2019.0 m), Pivnichne Hirske 1 (depth 1707.0–1742.0 m), Pyatnychany 1 (depth 1945.0–1500.0 m) and Verchany 1 (depth 1237.0–1247,0 m). The foraminiferal assemblages are characterised by the presence of: *Meandrospira favrei* (Charollais, Brönnimann & Zaninetti) (Pl. X, Fig. 3), *Gerochella cylindrica* Neagu (Pl. XI, Fig. 2), *Praedorothia ouachensis* (Sigal), *Praedorothia praeoxycona* (Moullade) (Pl. XI, Fig. 1), ?*Pseudotextularia crimica* Gorbatchik, *Pfenderina flandrini* Moullade (Pl. XI, Fig. 3) and *Epistomina caracolla* (Roemer).

Grainstones contained bioclasts with Tithono-Berriasian calpionellids *Calpionella alpina* Lorenz (Pl. XI, Fig. 4), *Calpionella elliptica* Nagy (Pl. XI, Fig. 5) and *Tintinopsella doliformis* Colom (Pl. XI, Fig. 6).

Berriasian microfossils were indentified in the wells: Didushychi 1 (depth 2019.0–2198.0 m), Pivnichne Hirs'ke 1 (depth 1751.0–1755.0 m), Podil'tsi 1 (depth 1948.8–1959.8 m) and Verchany 1 (depth 1547.1–1563.4 m). The foraminiferal assemblages are composed of: *Protopeneroplis ultragranulata* (Gorbatchik) (Pl. X, Fig. 6), *Charentia evoluta* (Gorbatchik) (Pl. XII, Fig. 3), *Haplophragmoides joukowskyi* Charollais, Brönnimannn & Zaninetti (Pl. X, Fig. 1), *Mayncina bulgarica* Laug, Peybernes & Rey (Pl. X, Fig. 2), *Nautiloculina bronnimanni* Arnaud-Vanneau & Peybernes (Pl. X, Fig. 5), *Neotrocholina molesta* (Gorbatchik) (Pl. XII, Fig. 9), *Neotrocholina infragranulata* (Noth) (Pl. X, Fig. 4), *Redmondoides lugeoni* (Septfontaine), *Dobrogelina ovidi* Neagu (Pl. XIII, Fig. 1) and *Scythiloculina confusa* Neagu (Pl. X, Fig. 8).

Calcareous dinocysts (eg. *Crustocadosina semiradiata* (Wanner), calcareous algae or calcimicrobes ("*Porostromata*") are rare.

All Lower Cretaceous sediments of the Carpathian Foredeep in SW Ukraine belong to the Berriasian–Hauterivian Stavchany Formation (Dulub, 1972; Gavrylishin *et al*., 1991; Zhabina, Anikeyeva, 2007).

Late Jurassic

Tithonian sediments were found in the wells: Didushychi 1 (depth 2425.0–2760.0 m), Didushychi 2 (depth 1975.0–2249.0 m), Korolyn 6 (depth 2143.0–2547.0 m), Kokhanivka 26 (depth 1112.5–1200.0 m), Lanivka 1 (depth 1855.0–1860.0 m), Moryantsi 1 (depth 2015.0–2400.0 m), Nyklovychi 27 (depth 2145.0–2194.0 m), Pivnichne Hirs'ke 1 (depth 1770.0–1787.0 m), Podil'tsi 1 (depth 2099.0–2260.0 m) and Verchany 1 (depth 1563.4–1628.1 m).

The considerably diversified microfossil assemblage included foraminifera with numerous trocholinas and miliolids, calpionellids, calcareous cysts of dinoflagellata, planktic calcareous algae, charophyta, planktic crinoids and coprolites (Pl. XI, Fig. 7). The foraminiferal assemblage contained: *Paleogaudryina magharaensis* Said & Bakarat (Pl. XII, Fig. 11), *Protomarssonella hechti* (Dieni & Massari), *Verneuilinoides kirillae* Dain (Pl. XIII, Fig. 4), *Kastamonina abanica* Sirel, *Anhispirocyclina lusitanica* (Egger) (Pl. XII, Fig. 1), *Andersenolina alpina* (Leupold) (Pl. XII, Fig. 2), *Ichnusella burlini* (Gorbatchik) (Pl. XII, Fig. 5), *Everticyclammina praekelleri* Banner & Highton (Pl. XII, Fig. 4), *Istriloculina fabaria* Matsieva & Temirbekova (Pl. XII, Fig. 6), *Istriloculina rectoangularia* Matsieva & Temirbekova (Pl. XII, Fig. 7), *Rumanoloculina mitchurini* (Dain), *Melathrokerion spirialis* Gorbatchik (Pl. XII, Fig. 8), *Pseudocyclammina lituus* (Yokoyama) (Pl. XII, Fig. 10) and *Protomarssonella kummi* (Zedler) (Pl. XIII, Fig. 2). The presence of *Anchispirocyclina lusitanica* (Egger) permits affiliation of the shallow water Tithonian assemblages of SW Ukraine to the *Anchispirocyclina lusitanica* zone common in both Tethyan margins (Pélissié *et al*., 1984; Kuznetsova *et al*., 1996).

The calpionellid assemblage was composed of age-important species: *Semichitinoidella sujkowskii* Nowak (Pl. XIII, Fig. 5), *Crassicollaria intermedia* (Durand Delga) (Pl. XIII, Fig. 7) , *Crassicollaria brevis* Remane and *Calpionella alpina* Lorenz (Pl. XIII, Fig. 6).

There were numerous Tithonian calcareous dinocysts: *Colomispharea cieszynica* Nowak (Pl. XIII, Fig. 8), *Colomisphaera fortis* Řehánek, *Colomisphaera misolensis* (Vogler) (Pl. XIII, Fig. 9), *Colomisphaera radiata* (Vogler) (Pl. XIII, Fig. 10), *Colomisphaera tenuis* (Nagy) (Pl. XIII, Fig. 11), *Comittosphaera pulla* (Borza) (Pl. XIII, Fig. 12), *Comittosphaera sublapidosa* (Vogler) (Pl. XIII, Fig. 14), *Parastomiosphaera malmica* (Borza) (Pl. XIII, Fig. 13) and *Stomiosphaera moluccana* Wanner (Pl. XIII, Fig. 15).

The sediments regarded as Kimmeridgian were found in the wells: Bortiatin 1 (depth 1920.0–2290.0 m), Korolyn 6 (depth 2548.0–2962.0 m), Lanivka 1 (depth 1950.0–2306.0 m), Moryantsi 1 (depth 2552.0–2912.0 m), Podil'tsi 1 (depth 2300.0–2813.0 m), Verchany 1 (depth 1628.0–1856.0 m) and Voloscha 1 (depth 2215.0–2265.0 m).

The microfossil assemblage was composed of foraminifera, calcareous cysts of dinoflagellata, calcareous algae (planktic chlorophyceans) and numerous fragments of planktic crinoids of the genus *Saccocoma* (Pl. XV, Figs. 6, 7).

The foraminiferal assemblage was characterised by the presence of: *Labyrinthina mirabilis* Weynschenk (Pl. XIV, Figs. 2, 3), *Mesoendothyra izjumiana* Dain (Pl. XIV, Fig. 4), *Textularia depravatiformis* Bielecka & Kuznetsova (Pl. XV, Fig. 1), *Pseudomarssonella dumortieri* (Schwager), *Protopeneroplis striata* Weynschenk (Pl. XIV, Figs. 6, 7), *Trocholina conica* (Schlumberger) (Pl. XIV, Fig. 5), *Quinqueloculina podlubiensis* Terestchuk (Pl. XIV, Fig. 8), *Rumanoloculina verbizhiensis* (Dulub) (Pl. XIV, Fig. 9), *Nautiloculina oolithica* Mohler (Pl. XIV, Fig. 10), *Neokilianina rahonensis* (Foury & Vincent) (Pl. XV, Fig. 2), *Sievoides kocyigiti* Farinacci & Ekmeci (Pl. XIV, Fig. 12) and *Spirillina elongata* Bielecka & Pożaryski) (Pl. XIV, Fig. 11). The species *Alveosepta jaccardi* (Schrodt) (Pl. XIV, Fig. 1) has its last occurrence in the assemblage.

Carpistomiosphaera borzai (Nagy) (Pl. XV, Fig. 3), *Colomisphaera pieniniensis* (Borza) (Pl. XV, Fig. 5), *Colomisphaera nagyi* (Borza) (Pl. XV, Fig. 4) and *Colomisphaera carpathica* (Borza) represent characteristic calcareous dinocysts.

Numerous fragments of planktic crinoids of the genus *Saccocoma* Agassiz are constant elements of these assemblages. (Pl. XV, Figs. 6, 7).

Oxfordian microfossils were found in the wells: Bortiatin 1 (depth 2455.0–2500 m), Yuryiv 1 (depth 1753.0–1930.0 m), Korolyn 6 (depth 2970.0–3088.0 m), Moryantsi 1 (depth 3055.0–3067.0 m) and Podil'tsi 1 (depth 2903.0–2915.0 m).

The main components of the assemblages were, like in the younger subdivisions, foraminifera and calcareous cysts of dinoflagellata. However, calcareous algae and rests of *Saccocoma* occurred in lower quantities.

The foraminiferal assemblage contains stratigraphically significant species: *Cornuspira eichbergensis* Kübler & Zwingli (Pl. XVI, Fig. 1), *Crescentiella morronensis* (Crescenti) (Pl. XVI, Fig. 2), *Eomarssonella paraconica* Levina (Pl. XVI, Fig. 3), *Protomarssonella jurassica* (Mityanina) (Pl. XVI, Fig. 11), *Paleogaudryina heersumensis* Lutze, *Paleogaudryina varsoviensis* (Bielecka & Pożaryski) (Pl. XVI, Fig. 10), *Globuligerina oxfordiana* Grigelis (Pl. XVI, Fig. 4), *Mohlerina basiliensis* (Mohler) (Pl. XVI, 5), *Nautiloculina* cf. *circularis* (Said & Bakarat) (Pl. XVI, Fig. 6), *Ophthalmidium oxfordianum* (Deecke) (Pl. XVI, Fig. 7), *Ophthalmidium pseudocarinatum* Dain (Pl. XVI, Fig. 12), *Ophthalmidium strumosum* (Gümbel) (Pl. XVI, Fig. 8), *Quinqueloculina tersa* Danitch, *Quinqueloculina semisphaeroidalis* Danitch (Pl. XVII, Fig. 1), *Paalzowella turbinella* (Gümbel) (Pl. XVI, Fig. 9), *Rumanolina seiboldi* (Lutze) (Pl. XVII, Fig. 2), *Protopeneroplis striata* Weynschenk and *Uvigerinammina uvigeriniformis* (Seibold & Seibold) (Pl. XVII, Fig. 3). Stratigraphic distribution of the age-significant species (Tab. 5) suggests the Middle, or locally Late Oxfordian. Specific composition of the foraminiferal assemblages partly ressemble those found in the Oxfordian of the Eastern Mediterranean (Kuznetsova *et al*., 1996).

Foraminifera were accompanied by a characteristic assemblage of calcareous dinocysts composed of: *Colomisphaera lapidosa* (Vogler) (Pl. XVII, Fig. 4), *Comittosphaera czestochowiensis* Řehánek (Pl. XVII, Fig. 5) and *Orthopithonella gustafsonii* (Bolli) (Pl. XVII, Fig. 6).

Middle Jurassic

Microfossil assemblages that may be related to the Midle Jurassic faunas were found only in the wells Bortiatin 1 (depth 2520.0–2545.0 m) and Kokhanivka 30 (depth 1205.0–1216.0 m).

These poor assemblages were composed predominantly of foraminifera partly filled with Fe compounds. The following foraminiferal species were identified in the samples:

Protomarssonella osowiensis (Bielecka & Styk), *Bosniella croatica* (Gušić), *Protopeneroplis striata* Weynschenk, *Rumanolina* cf. *pazdroae* (Bielecka & Styk), *Trocholina conica* (Schlumberger) and *Spirillina radiata* (Terquem).

Summary

The above-presented rewiev of the Mesozoic microfossils identified in the investigated material from West Ukraine suggests that they represent an incomplete succession from the top of the Middle Jurassic through the Upper Jurassic (excluding the Lower Oxfordian), the Lower Cretaceous (excluding its uppermost part) and the lowest Upper Cretaceous.

The following stratigraphical subdivisions determined within the sedimentary succession of the Bilche-Volitsia zone of the Carpathian Foredeep have been identified based on our microfossil studies:

- **Stavchany Formation** (Late Berriasian–Barremian) identified in the Didushychi 1 well (depth 1913.0–2019.0 m).
- **Karolina Formation** (Tithonian–Beriasian/?Early Valanginian). The formation was described by Ukrainian authors from the Korolyn 6 (depth 2010.0–2530.0 m) and Nyklovychi 27 (depth 1950.0–2250.0 m) wells. In the Korolyn 6 well, the formation occurs at a depth of 2143.0–2447.0 m and represents the Tithonian exclusively.
- **Moryantsi Formation** (Kimmeridgian) according to Ukrainian data occurs in the following wells: Bortiatin 1 (depth 2468.0–2485.0 m), Moryantsi 1 (depth 2510.0–2983.0 m), Korolyn 6 (depth 2539.0–3020.0 m), Podil'tsi 1 (depth 2000.0–2497.0 m) and Voloscha 1 (1838.0–1863.0 m).

The microfossil assemblages identified in the samples suggested the occurrence of the Formation in the following wells: Bortiatin 1 (depth1920.0–2290.0 m), Korolyn 6 (depth 2548.0–2970.0 m), Moryantsi 1 (depth 2552.0–2912.0 m), Podil'tsi 1 (depth 2300.0–2813.0 m) and Voloscha 1 (depth 2215.0–2265.0 m). Difference in the occurrence of the Moryantsi Formation in the Podil'tsi 1 and Voloscha 1 wells according to the above reported data probably depends on micropaleontological investigation of additional parts of sections.

- **Boniv Formation**, according to Ukrainian data occurs in the wells: Bortiatin 1 (depth 2410.0–2496.0 m), Korolyn 6 (depth 3025.0–3110.0 m) and Podil'tsi 1 (depth 2897.0–2990.0 m). Earlier investigations suggest that the micropaleontological content of the formation is poor (Dulub *et al*., 2003).

According to recent investigations, sediments of the formation were found in the wells: Bortiatin 1 (depth 2455.0–2500 m), Korolyn 6 (depth 2970.0–3088.0 m) and Podil'tsi 1 (depth 2903.0–2915.0 m). The identified foraminiferal species, among others, *Mesoendothyra izjumiana* Dain (Late Oxfordian–Kimmeridgian) and *Alveosepta jaccardi* Schrodt (Late Oxfordian–Kimmeridgian) suggest at least the Late Oxfordian age for the Boniv Formation and its correlativeness with the Rudki and Sokal formations of the East European Platform (Dulub *et al*., 2003, Zhabina, Anikeyeva, 2007).

It is interesting that the sponge facies with its microfossils, typical of the Early Oxfordian of Poland, was not observed in the investigated boreholes.

CORRELATION OF MICROFOSSIL ASSEMBLAGES FROM SOUTHERN POLAND AND SOUTHWESTERN UKRAINE

The direct correlation of microfossil assemblages from the investigated wells of Poland and Ukraine is somewhat difficult because of a considerable distance between the study areas (central part of S Poland, W Ukraine) with different sedimentation conditions.

A much better correlation is possible between West Ukraine and SE Poland (Lubaczów–Lublin region). These areas are similar in terms of sedimentation and paleontological records (Olszewska, 2010).

LATE CRETACEOUS

Microfossil assemblages identified during the study represent generally the Turonian (Tab. 2). Their palaeogeographic distribution is very broad in both investigated areas (Heller, Moryc, 1984; Krassowska, 1997; Gavrylishin *et al*., 1991). Turonian sediments of Poland, characterised by the presence of this assemblage, belong to the so-called III Formation composed of limestones, marls and gaizes (Błaszkiewicz, Cieśliński, 1979). Sediments of the same age in West Ukraine constitute part of the Dubivtsi Formation (Gavrylishin *et al*., 1991).

EARLY CRETACEOUS

Microfossil assemblages identified in the material from both investigated areas are of Berriasian–Barremian age. The Valanginian–Hauterivian assemblages from these areas are characterised by the presence of *Epistomina caracolla* (Roemer) and *Meandrospira favrei* (Charollais, Brönnimann & Zaninetti). These species are known from the Cieszanów Formation in Poland and from the Stavchany Formation in Ukraine. The closest specific similarity display assemblages representing age Berriassian–Valanginian (Tab. 3). In the central part of southern Poland, these assemblages are typical of the Ropczyce and Dębica formations, and in SE Poland – of the upper part of the Babczyn and Cieszanów formations (Tab. 1). The same assemblages occur in the Stavchany and partly Bukovyna formations in West Ukraine.

LATE JURASSIC

Tithonian microfossil assemblages from both investigated areas differ considerably. Ukrainian assemblages contain numerous calpionellids, as well as, so called “large foraminifera” typical for the Tethyan areas of carbonate sedimentation (Tab. 4). In the Polish assemblages (from both central-southern Poland and the Lubaczów–Lublin area), calpionellids are rare and usually occur as redeposited taxa. Large foraminifera such as *Kastamonina abanica* Sirel, *Anchispirocyclina lusitanica* (Egger) or *Rectocyclammina chouberti* Hottinger, frequent in Ukraine, are rare or even absent in coeval assemblages in Poland. On the other hand, assemblages of “small foraminifera” and calcareous cysts of dinoflagellata display a high degree of similarity. These assemblages are found in the Sobków Formation (central part of S Poland), in the lower part of the Babczyn Formation (Lubaczów–Lublin area) in Poland and in the shallow-water sediments of the Nyzhniv Formation in West Ukraine (Tab. 1).

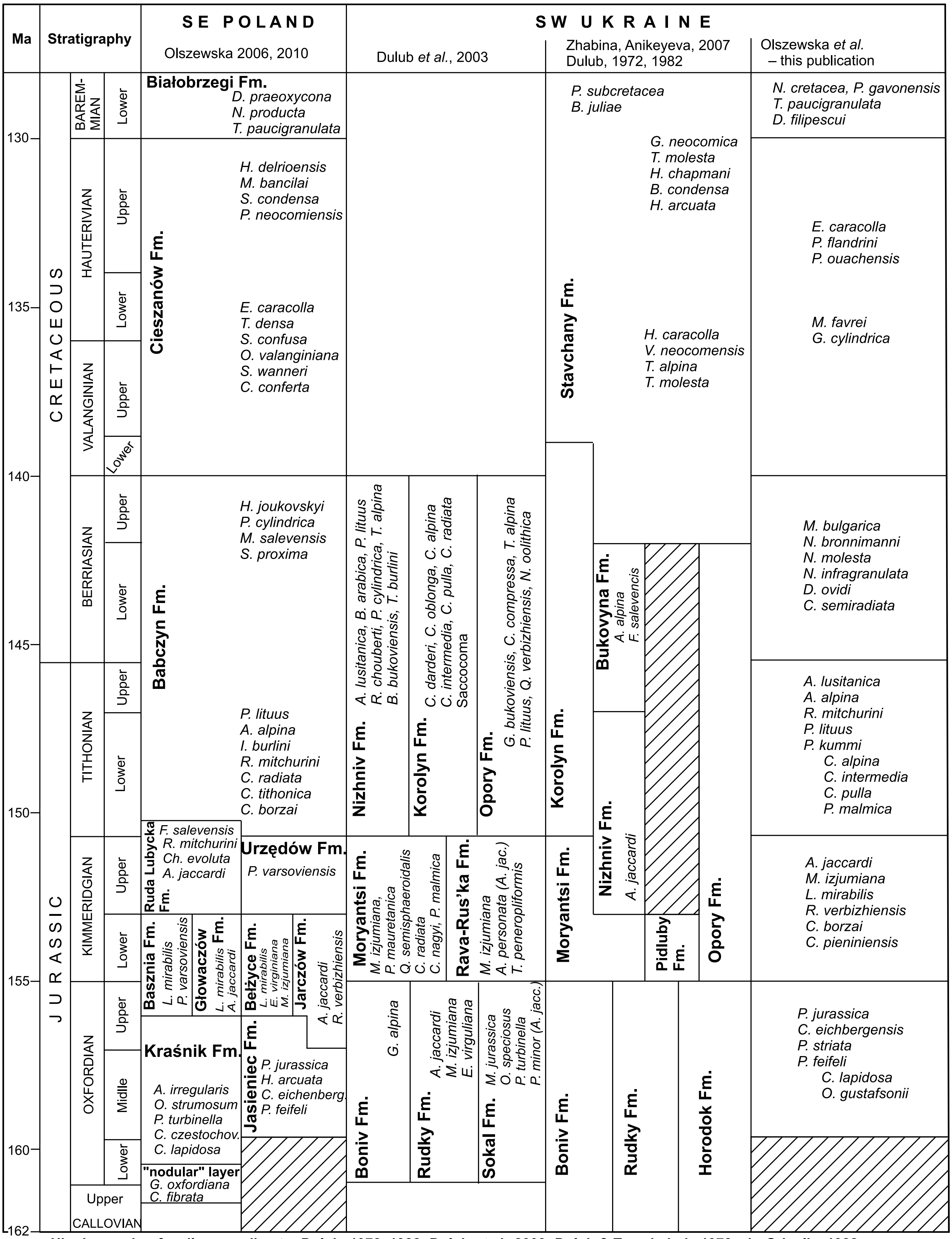
Kimmeridgian microfossil assemblages from both investigated areas are very poor in diversity and abundance (Tab. 5). Nevertheless, there are some species in common that facilitate correlation (Tab. 1). In the central part of S Poland, these assemblages occur in the lower part of the Sobków Formation and in the upper part of the Niwki Formation. In the Lubaczów–Lublin region they are found in the Ruda Lubycka Formation and in the upper parts of the Bełżyce, Basznia, and Głowaczów formations (Olszewska, 2005, 2010). On the Ukrainian territory, assemblages of similar specific composition occur in the Moryantsi and Pidluby formations (Bilche–Volitsia zone of the Carpathian Foredeep), and in the Rava Rus’ska Formation (East European Platform). A characteristic feature of the majority of Kimmeridgian subdivisions in both these areas, as turned out during the investigations, is variably strong dolomitization.

The Oxfordian microfossil assemblages are more diversified and contain more species common for both investigated areas (Tab. 6). The significant difference, however, is the lack of Early Oxfordian assemblages in material from West Ukraine, related to the so-called “sponge facies” widely developed in Poland (Chęciny series, Kraśnik Formation). The foraminiferal species *Alveosepta jaccardi* (Schrodt) reported from the Ukrainian Boniv, Rudky and Sokal formations is known since the Late Oxfordian (Kuznetsova *et al*., 1996; Bassoulet, 1997; BouDagher-Fadel, 2008), which determines the age designation of those subdivisions. Assemblages with *Alveosepta jaccardi* (Schrodt) were reported from the “Coral-algal” Formation of the Tarnów–Dębica region (Morycowa, Moryc, 1976), in Upper Oxfordian and Kimmeridgian sediments of the Holy Cross Mts. (Barwicz-Piskorz, 1995) and in the Jasieniec, Jarczów and Bełżyce formations in the Lubaczów–Lublin area of Poland (Olszewska, 2010) (Tab. 1).

Table 1

Correlation of the Upper Jurassic–Lower Cretaceous units of SE Poland and SW Ukraine

Korelacja jednostek jury górnej i kredy dolnej SE Polski i SW Ukrainy



Ukraine – microfossils according to: Dulub, 1972, 1982; Dulub *et al.*, 2003; Dulub & Tereshchuk, 1972a, b; Grigelis, 1982; Anikeyeva, 2000; Linetskaya & Lozynyak, 1983

Table 2

Stratigraphic distribution of age significant species of the Upper Cretaceous formations

Zasięgi wiekowe ważnych stratygraficznie gatunków z formacji należących do kredy górnej

Species	POLAND	UKRAINE	Cenomanian	Turonian	Coniacian
Bolivinopsis rosula	X				
Dorothia crassa	X				
Dorothia oxycona	X				
Archaeoglobigerina cretacea	X				
Whiteinella baltica	X	X			
Dicarinella imbricata	X				
Globigerinelloides ultramicra	X				
Guembelitria cenomana	X	X			
Hedbergella delrioensis	X	X			
Heterohelix moremani	X	X			
Marginotruncana marginata	X				
Marssonella trochus		X			
Marssonella turris		X			
Globigernelloides bentonensis		X			
Marginotruncana coronata		X			
Orthopithonella ovalis	X	X			
Orthopithonella sphaerica	X	X			
Stomioshaerina biedai	X	X			
Archaeolithothamnium	X	X			

Table 3

Stratigraphic distribution of age significant species of the Lower Cretaceous formations

Zasięgi wiekowe ważnych stratygraficznie gatunków z formacji należących do kredy dolnej

Species	POLAND	UKRAINE	Berriasian	Valanginian	Hauterivian	Barremian	Aptian
Nautiloculina cretacea		X					
Derventina filipescui		X					
Pseudolituonella cf. gavonensis		X					
Praedorothia praehauteriviana	X						
Verneuilinoides neocomiensis	X						
Meandrospira favrei	X	X					
Mayncina bulgarica	X						
Epistomina caracolla	X	X					
Feurtilia frequens	X						
Protomarsonella hechti	X						
Paleotextularia crimica	X	X					
Siphovalvulina variabilis	X						
Dobrogelina ovidi	X	X					
Haplophragmoides joukovskyi	X	X					
Nautiloculina bronnimanni	X	X					
Protopeneroplis ultragranulata	X	X					
Neotrocholina infragranulata	X	X					
Gerochella cylindrica		X					
Praedorothia ouachensis		X					
Praedorothia praeoxycona		X					
Pfenderina flandrini		X					
Charentia evoluta	X	X					
Redmondoides lugeoni		X					
Carpistomiosphaera valanginiana	X						
Stomiosphaera wanneri	X						
Cadosina fusca	X						
Colomisphaera fortis	X						
Colomisphaera tenuis	X						
Crustacadosina semiradiata	X	X					
Stomiosphaera moluccana	X						

Table 4

Stratigraphic distribution of age significant species of the Tithonian formations

Zasięgi wiekowe ważnych stratygraficznie gatunków z formacji należących do tytonu

Species	POLAND	UKRAINE	Kimmeridgian	Tithonian	Berriasian
Buccicrenata primitiva	X				
Charentia evoluta	X				
Lituola baculiformis	X				
Verneuilinoides kirillae	X				
Melathrokerion spiralis	X	X			
Nautiloculina oolithica	X				
Paleogaudryina magharaensis	X				
Pseudocyclamina lituus	X	X			
Protopeneroplis striata	X				
Glomospira variabilis	X				
Andersenolina alpina	X				
Andersenolina histeri	X				
Neotrocholina molesta	X				
Ichnusella burlini	X	X			
Decussoloculina barbui	X				
Decussoloculina mirceai	X				
Scythiloculina confusa	X				
Rumanoloculina mitchurini	X	X			
Kastamonina abanica		X			
Anchispirocyclina lusitanica		X			
Everticyclammina praekelleri		X			
Istriloculina fabaria		X			
Protomarssonella kummi	X	X			
Praetintinnopsella andrusovi	X				
Semichitinoidella sujkowskyi		X			
Crassicollaria intermedia		X			
Crassicollaria brevis		X			
Calpionella alpina		X			
Comittosphaera pulla	X	X			
Colomisphaera cieszynica		X			
Colomispharea fortis		X			
Colomisphaera radiata		X			
Comittosphaera sublapidosa		X			
Colomisphaera tenuis		X			
Parastomiosphaera malmica		X			
Stomiosphaera moluccana		X			

Table 5

Stratigraphic distribution of age sifnificant species of the Kimmeridgian formations

Zasięgi wiekowe ważnych stratygraficznie gatunków z formacji należących do kimerydu

Species	POLAND W	POLAND E	UKRAINE	Oxfordian	Kimmeridgian	Tithonian
Textularia depravatiformis	X		X			
Mesoendothyra izjumiana	X	X	X			
Labyrinthina mirabilis		X	X			
Protomarsonella dumortieri						
Protopeneropsis striata						
Trocholina conica						
Quinqueloculina podlubiensis						
Rumanoloculina verbizhiensis		X				
Neokilianina rahonensis						
Sievoides kocygiti						
Spirillina elongata						
Alveosepta jaccardi						
Palaeogaudryina varsoviensis		X				
Everticyclamina virguliana		X				
Nautiloculina oolithica		X				
Carpistomiosphaera borzai	X	X	X			
Colomisphaera pieniniensis	X		X			
Colomisphaera carpathica			X			
Colomisphaera nagyi			X			
Globochaete alpina	X		X			
Saccocoma	X		X			

Table 6

Stratigraphic distribution of age significant species of the Oxfordian formations

Zasięgi wiekowe ważnych stratygraficznie gatunków z formacji należących do oksfordu

Species	POLAND W	POLAND E	UKRAINE	Callovian	Oxfordian L	Oxfordian M	Oxfordian U	Kimmeridgian
Eomarsonella paraconica	X		X					
Miliammina olgae	X							
Cornuspira eichbergensis	X	X	X					
Ophthalmidium pseudocarinatum	X	X	X					
Spirillina andreae	X							
Paalzowella turbinella	X		X					
Rumanolina seiboldi	X							
Globuligerina oxfordiana	X	X	X					
Protomarssonella jurassica		X	X					
Alveosepta jaccardi		X						
Mohlerina basilensis		X	X					
Bicazzamina jurassica		X						
Haghimashella arcuata	X	X						
Rumanolina feifeli		X	X					
Trocholina belarussica		X						
Crescentiella morronensis	X	X	X					
Palaeogaudryina heersumensis			X					
Palaeogaudryina varsoviensis			X					
Nautiloculina circularis			X					
Ophthalmidium oxfordianum	X		X					
Ophthalmidium strumosum	X		X					
Quinqueloculina tersa			X					
Quinqueloculina semisphaeroidalis			X					
Protopeneroplis striata			X					
Uvigerinamina uvigeriniformis			X					
Spirillina tenuissima	X		X					
Comittosphaera czestochowiensis	X		X					
Colomisphaera lapidosa			X					
Crustacadosina semiradiata	X	X						
Cadosina parvula		X						
Orthopithonella gustafsonii		X	X					
Saccocoma	X	X						

CONCLUSIONS

Micropaleontological investigations carried out on thin sections made from indurated Mesozoic rocks of southern Poland and southwestern Ukraine revealed the presence of assemblages similar in specific composition. The Late Cretaceous (Turonian) assemblages of both regions contain characteristic foraminifera (*Whiteinella baltica, Gümbelitria cenomana*, *Hedbergella delrioensis*, *Heterohelix moremani*) and calcareous dinocysts (*Orthopithonella ovalis*, *Orthopithonella sphaerica*, *Stomiosphaerina biedai*) used for correlation of sediments from Poland with those of the Dubovets Fm. from West Ukraine.

The Early Cretaceous (Berriasian–Barremian) assemblages include many common foraminifera species (*Meandrospira favrei*, *Epistomina caracolla*, *Haplophragmoides joukovskyi*, *Nautiloculina bronnimanni*, *Protopeneroplis ultragranulata*, *Charentia evoluta*) but differ in scarcity of calcareous dinocysts in the Ukrainian material. Comparison of individual assemblages facilitates correlation of the Ropczyce and Dębica fms. (S Poland), Babczyn and Cieszanów fms. (SE Poland) and the Stavchany and Bukovina fms. of SW Ukraine.

Tithonian microfossil assemblages from both these regions have less in common because the Polish assemblages contain rather shallow-water taxa, while the coeval Ukrainian assemblages are rich in planktic calpionellids and calcareous dinocysts indicating an open sea environment. Nevertheless, correlation between the upper part of the Sobków Fm. (S Poland), the lower part of the Babczyn Fm. (SE Poland) and the platform sediments of the Nizhniv Fm. (West Ukraine) is possible.

The Kimmeridgian assemblages, although poor in material from both regions, contain index foraminifera species (*Mesoendothyra izjumiana*) and calcareous dinocysts (*Carpistomiosphaera borzai*, *Colomisphaera pieniniensis*) as well as characteristic fragments of planktic crinoid *Saccocoma*. These microfossils allow for correlation of the lower part of the Sobków Fm. (S Poland), upper parts of the Basznia, Głowaczów, Bełżyce and Jarczów fms. (SE Poland) and the Moryantsi and Pidluby fms. (Bilche-Volytsia zone) and the Rawa Rus'ka Fm. (East European Platform) of West Ukraine.

Correlation of the Oxfordian assemblages is based on the occurrence of foraminifera (*Alveosepta jaccardi*, *Protomarssonella jurassica*, *Ophtalmidium pseudocarinatum*) and calcareous dinocysts (*Comittosphaera czestochowiensis*, *Orthopithonella gustafsonii*). The species *Alveosepta jaccardi* (Schrodt), important for determination of the age of the assemblages, has not been found in the Ukrainian material although it is reported by Ukrainian authors. These microfossils allow for correlation of the "Coral-algal Fm." (S Poland), Bełżyce, Jasieniec and Jarczów fms. (SE Poland) with the Boniv, Rudky and Sokal fms. (West Ukraine).

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STRESZCZENIE

Analiza mikropaleontologiczna płytek cienkich z utworów mezozoicznych południowej Polski i południowo-zachodniej Ukrainy ujawniła obecność zespołów o podobnym składzie gatunkowym. Zespoły późnej kredy (turonu) obydwu obszarów zawierały charakterystyczne otwornice (*Whiteinella baltica*, *Gümbelitria cenomana*, *Hedbergella delrioensis*, *Heterohelix moremani*) i wapienne dinocysty (*Orthopithonella ovalis*, *Orthopithonella sphaerica*, *Stomiosphaerina biedai*) pozwalające na korelację utworów Polski z utworami formacji dubowieckiej zachodniej Ukrainy.

Zespoły wczesnej kredy (berias–barrem) zawierają szereg wspólnych gatunków otwornic (*Meandrospira favrei*, *Epistomina caracolla*, *Haplophragmoides joukovskyi*, *Nautiloculina bronnimanni*, *Protopeneroplis ultragranulata*, *Charentia evoluta*), lecz różnią się ubóstwem wapiennych dinocyst w próbkach ukraińskich. Porównanie poszczególnych zespołów umożliwia korelację formacji z Ropczyc i Dębicy (S Polska) oraz formacji cieszanowskiej i z Babczyna (SE Polska) z formacją bukowińskią i stawczańską SW Ukrainy.

Zespoły mikroskamieniałości tytonu obydwu badanych obszarów wykazują mniejsze podobienstwo z uwagi na przewagę elementów płytkowodnych w zespołach polskich w porównaniu do przewagi form otwartego morza

(kalpionellidy, wapienne dinocysty) w zespołach ukraińskich. Niemniej jednak możliwa była korelacja górnej części formacji z Sobkowa (S Polska) oraz dolnej części formacji z Babczyna (SE Polska) z formacją niżniowską SW Ukrainy.

Zespoły kimerydu obydwu obszarów, chociaż stosunkowo ubogie, zawierały indeksowe otwornice (*Mesoendothyra izjumiana*), wapienne dinocysty (*Carpistomiosphaera borzai*, *Colomisphaera pieniniensis*) oraz charakterystyczne fragmenty liliowców pelagicznych z rodzaju *Saccocoma*. Całość zespołu pozwala na korelację dolnej części formacji z Sobkowa (S Polska) oraz górnych części formacji z Baszni, głowaczowskiej, bełżyckiej i jarczowskiej (SE Polska) z formacją moraniecką i podlubiecką (strefa Bilcze–Wolica zapadliska przedkarpackiego) i formacją Rawy Ruskiej (platforma wschodnioeuropejska) zachodniej Ukrainy.

Korelacja zespołów mikroskamieniałości oksfordu jest oparta na otwornicach (*Alveosepta jaccardi, Protomarssonella jurassica, Ophthalmidium pseudocarinatum*) i wapiennych dinocystach (*Comittosphaera czestochowiensis*, *Orthopithonella gustafsonii*). Gatunku *Alveosepta jaccardi* (Schrodt), ważnego dla określenia wieku zespołów, nie stwierdzono w badanym materiale z Ukrainy, ale jest on cytowany w literaturze ukraińskiej. Wymienione wyżej mikroskamieniałości pozwalają na korelację formacji koralowcowo-glonowej (S Polska) oraz bełżyckiej, jasienieckiej i jarczowskiej (SE Polska) z ukraińskimi formacjami boniwską, rudkowską i sokalską.

PLATE I

Foraminifera from the Polish part of the Carpathian Foredeep – Late Cretaceous

Otwornice polskiej części zapadliska przedkarpackiego – późna kreda

Fig. 1. *Marssonella turris* (d'Orbigny), longitudinal section, Nawsie 1, depth 3032.0–3034.0 m
Marssonella turris (d'Orbigny), przekrój podłużny, Nawsie 1, głębokość 3032,0–3034,0 m

Fig. 2. *Globigerinelloides ultramicra* Subbotina, axial section, Nawsie 1, depth 3032.0–3034.0 m
Globigerinelloides ultramicra Subbotina, przekrój osiowy, Nawsie 1, głębokość 3032,0–3034,0 m

Fig. 3. *Heterohelix moremani* (Cushman), longitudinal section, Zagórzyce 7, depth 2633.2–2638.0 m
Heterohelix moremani (Cushman), przekrój podłużny, Zagórzyce 7, głębokość 2633,2–2638,0 m

Fig. 4. *Whiteinella baltica* Douglas & Rankin, axial section, Zagórzyce 7, depth 2633.2–2638.0 m
Whiteinella baltica Douglas & Rankin, przekrój osiowy, Zagórzyce 7, głębokość 2633,2–2638,0 m

Fig. 5. *Stomiosphaerina biedai* Nowak, transverse section, Nawsie 1, depth 3032.0–3034.0 m
Stomiosphaerina biedai Nowak, przekrój poprzeczny, Nawsie 1, głębokość 3032,0–3034,0 m

Fig. 6. *Orthopithonella ovalis* (Kaufmann), longitudinal section, Nawsie 1, depth 3032.0–3034.0 m
Orthopithonella ovalis (Kaufmann), przekrój podłużny, Nawsie 1, głębokość 3032,0–3034,0 m

Fig. 7. *Marginotruncana marginata* (Reuss), axial section, Zagórzyce 7, depth 2633.2–2638.0 m
Marginotruncana marginata (Reuss), przekrój osiowy, Zagórzyce 7, głębokość 2633,2–2638,0 m

Fig. 8. *Hedbergella delrioensis* (Carsey), equatorial secion, Zagórzyce 7, depth 2633.2–2638.0 m
Hedbergella delrioensis (Carsey), przekrój równikowy, Zagórzyce 7, głębokość 2633,2–2638,0 m

Fig. 9. Fragment of crustose coralline red algae, Zagórzyce 7, depth 2633.2–2638.0 m
Fragment krasnorostu z rodziny Corallinaceae, Zagórzyce 7, głębokość 2633,2–2638,0 m

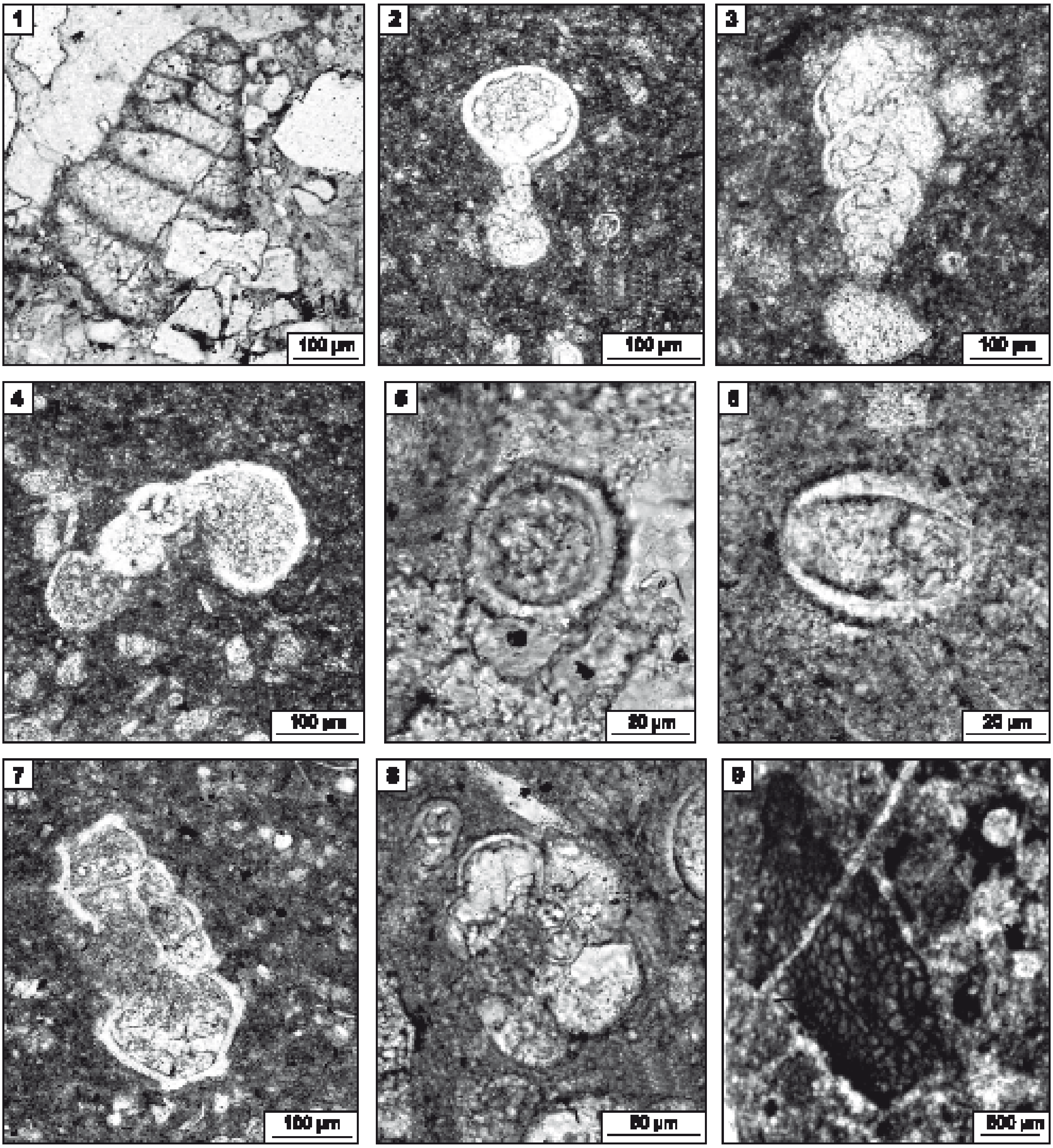

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PLATE II

Foraminifera from the Polish part of the Carpathian Foredeep – Early Cretaceous

Otwornice polskiej części zapadliska przedkarpackiego – wczesna kreda

Fig. 1. *Scythiloculina confusa* Neagu, transverse section, Zagórzyce 7, depth 2844.0–2862.0 m
Scythiloculina confusa Neagu, przekrój poprzeczny, Zagórzyce 7, głębokość 2844,0–2862,0 m

Fig. 2. *Feurtilia frequens* Maync, axial section, Ropczyce 7, depth 2241.0–2250.0 m
Feurtilia frequens Maync, przekrój osiowy, Ropczyce 7, głębokość 2241,0–2250,0 m

Fig. 3. *Haplophragmoides joukovskyi* Charollais, Brönnimann & Zaninetti, equatorial section, Ropczyce 7, depth 2241.0–2250.0 m
Haplophragmoides joukovskyi Charollais, Brönnimann & Zaninetti, przekrój równikowy, Ropczyce 7, głębokość 2241,0–2250,0 m

Figs. 4a, b. *Meandrospira favrei* (Charollais, Brönnimann & Zaninetti), equatorial sections, Ropczyce 7, depth 2241.0–2250.0 m
Meandrospira favrei (Charollais, Brönnimann & Zaninetti), przekroje równikowe, Ropczyce 7, głębokość 2241,0–2250,0 m

Figs. 5a, b. *Mayncina bulgarica* Laug, Peybernès & Rey, equatorial sections, Ropczyce 7, depth 2241.0–2250.0 m
Mayncina bulgarica Laug, Peybernès & Rey, przekroje równikowe, Ropczyce 7, głębokość 2241,0–2250,0 m

Fig. 6. *Nautiloculina bronnimanni* Arnaud-Vanneau & Peybernès, axial section, Ropczyce 7, depth 2241.0–2250.0 m
Nautiloculina bronnimanni Arnaud-Vanneau & Peybernès, przekrój osiowy, Ropczyce 7, głębokość 2241,0–2250,0 m

Fig. 7. *Protomarssonella hechti* (Dieni & Massari), longitudinal section, Nawsie 1, depth 3108.0–3111.0 m
Protomarssonella hechti (Dieni & Massari), przekrój podłużny, Nawsie 1, głębokość 3108,0–3111,0 m

Fig. 8. *Protomarssonella kummi* (Zedler), longitudinal section, Nawsie 1, depth 3108.0–3111.0 m
Protomarssonella kummi (Zedler), przekrój podłużny, Nawsie 1, głębokość 3108,0–3111,0 m

Fig. 9. *Praedorothia praehauteriviana* (Dieni & Massari), longitudinal section, Ropczyce 7, depth 2241,0–2250,0 m
Praedorothia praehauteriviana (Dieni & Massari), przekrój podłużny, Ropczyce 7, głębokość 2241,0–2250,0 m

Fig. 10. *Protopeneroplis ultragranulata* (Gorbatchik), oblique section, Pilzno 40, depth 2409.0–2412.0 m
Protopeneroplis ultragranulata (Gorbatchik), przekrój skośny, Pilzno 40, głębokość 2409,0–2412,0 m

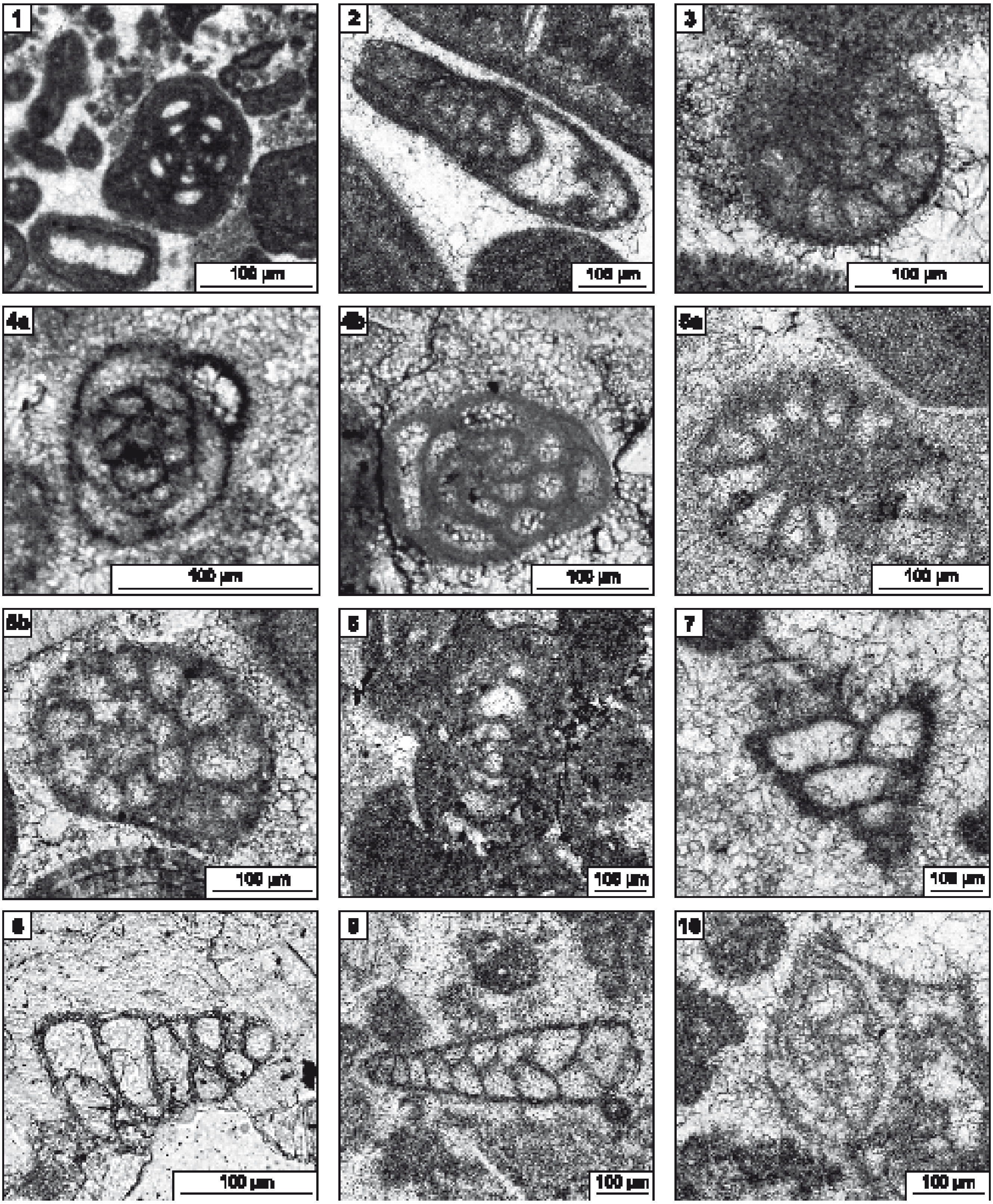

PLATE III

Microfossils from the Polish part of the Carpathian Foredeep – Early Cretaceous, continued

Mikroskamieniałości polskiej części zapadliska przedkarpackiego – wczesna kreda, cd.

Fig. 1. *Cadosina fusca* Wanner, Zagórzyce 6, depth 2791.0–2795.0 m
Cadosina fusca Wanner, Zagórzyce 6, głębokość 2791,0–2795,0 m

Fig. 2. *Carpistomiosphaera valanginiana* (Borza), Zagórzyce 6, depth 2791.0–2795.0 m
Carpistomiosphaera valanginiana (Borza), Zagórzyce 6, głębokość 2791,0–2795,0 m

Fig. 3. *Colomisphaera fortis* Řehanek, Zagórzyce 6, depth 2810.0-2819.0 m
Colomisphaera fortis Řehanek, Zagórzyce 6, głębokość 2810.0–2819.0 m

Figs. 4a, b. *Stomiosphaera wanneri* Borza, Zagórzyce 6, depth 2791.0–2795.0 m
Stomiosphaera wanneri Borza, Zagórzyce 6, głębokość 2791–0–2795,0 m

Fig. 5. *Neotrocholina infragranulata* (Noth), axial section, Zagórzyce 7, depth 2826.0–2844.0 m
Neotrocholina infragranulata (Noth), przekrój osiowy, Zagórzyce 7, głębokość 2826,0–2844,0 m

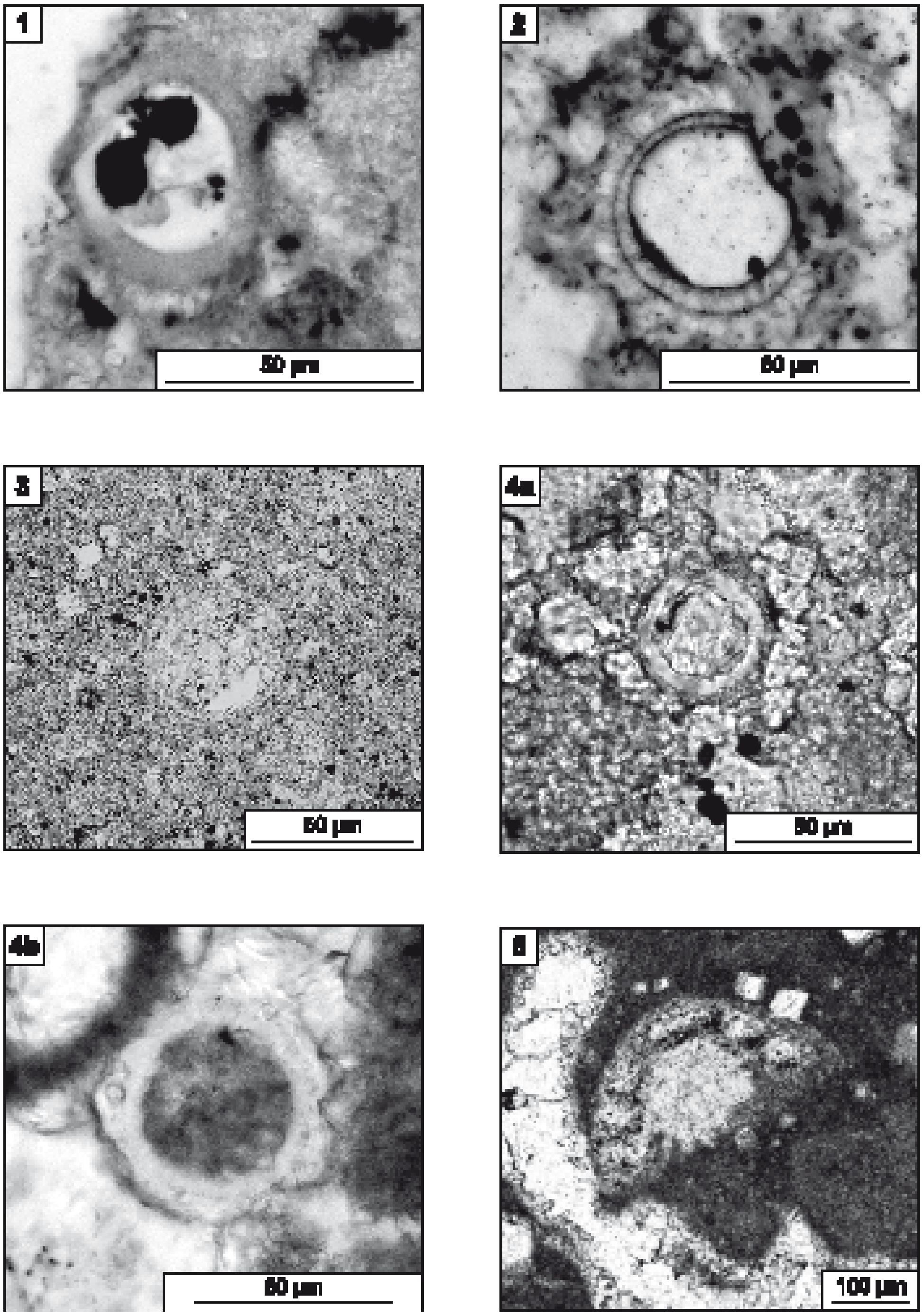

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PLATE IV

Foraminifera from the Polish part of the Carpathian Foredeep – Tithonian

Otwornice polskiej części zapadliska przedkarpackiego – tyton

Fig. 1. *Andersenolina alpina* (Leupold), axial section, Pilzno 40, depth 2345.0–2348.0 m
Andersenolina alpina (Leupold), przekrój osiowy, Pilzno 40, głębokość 2345,0–2348,0 m

Fig. 2. *Andersenolina histeri* Neagu, axial section, Zagórzyce 6, depth 3040.0–3042.0 m
Andersenolina histeri Neagu, przekrój osiowy, Zagórzyce 6, głębokość 3040,0–3042,0 m

Fig. 3. *Buccicrenata primitiva* BouDagher-Fadel, longitudinal section, Pilzno 40, depth 2409.0–2412.0 m
Buccicrenata primitiva BouDagher-Fadel, przekrój podłużny, Pilzno 40, głębokość 2409,0–2412,0 m

Fig. 4. *Charentia evoluta* (Gorbatchik), oblique section, Pilzno 40, depth 2409.0–2412.0 m
Charentia evoluta (Gorbatchik), przekrój skośny, Pilzno 40, głębokość 2409,0–2412,0 m

Fig. 5. *Decussoloculina barbui* Neagu, axial section, Zagórzyce 6, depth 2844.0–2862.0 m
Decussoloculina barbui Neagu, przekrój osiowy, Zagórzyce 6, głębokość 2844,0–2862,0 m

Fig. 6. *Decussoloculina barbui* Neagu, transverse section, Zagórzyce 6, depth 2844.0–2862.0 m
Decussoloculina barbui Neagu, przekrój poprzeczny, Zagórzyce 6, głębokość 2844,0–2862,0 m

Fig. 7. *Lituola* ? *baculiformis* Schlagintweit & Gawlick, longitudinal section, Pilzno 40, depth 2599.0–2602.0 m
Lituola ? *baculiformis* Schlagintweit & Gawlick, przekrój podłużny, Pilzno 40, głębokość 2599,0–2602,0 m

Fig. 8. *Feurtilia frequens* Maync, oblique section, Zagórzyce 7, depth 2844.0–2862.0 m
Feurtilia frequens Maync, Peybernès & Rey, przekrój skośny, Zagórzyce 7, głębokość 2844,0–2862,0 m

Fig. 9. *Melathrokerion spirialis* Gorbatchik, axial section, Zagórzyce 6, depth 3220.0–3223.0 m
Melathrokerion spirialis Gorbatchik, przekrój osiowy , Zagórzyce 6, głębokość 3220,0–3223,0 m

Fig. 10. *Nautiloculina oolithica* Mohler, axial section, Zagórzyce 6, depth 3040.0–3042.0 m
Nautiloculina oolithica Mohler, przekroj osiowy, Zagórzyce 6, głębokość 3040,0–3042,0 m

Fig. 11. *Neotrocholina molesta* (Gorbtachik), axial section, Zagórzyce 7, depth 2829.0–2838.0 m
Neotrocholina molesta (Gorbtachik), przekrój osiowy, Zagórzyce 7, głębokość 2829,0–2838,0 m

Fig. 12. *Protopeneroplis striata* Weynschenk, oblique section, Pilzno 40, depth 2409.0–2412.0 m
Protopeneroplis striata Weynschenk, przekrój skośny, Pilzno 40, głębokość 2409,0–2412,0 m

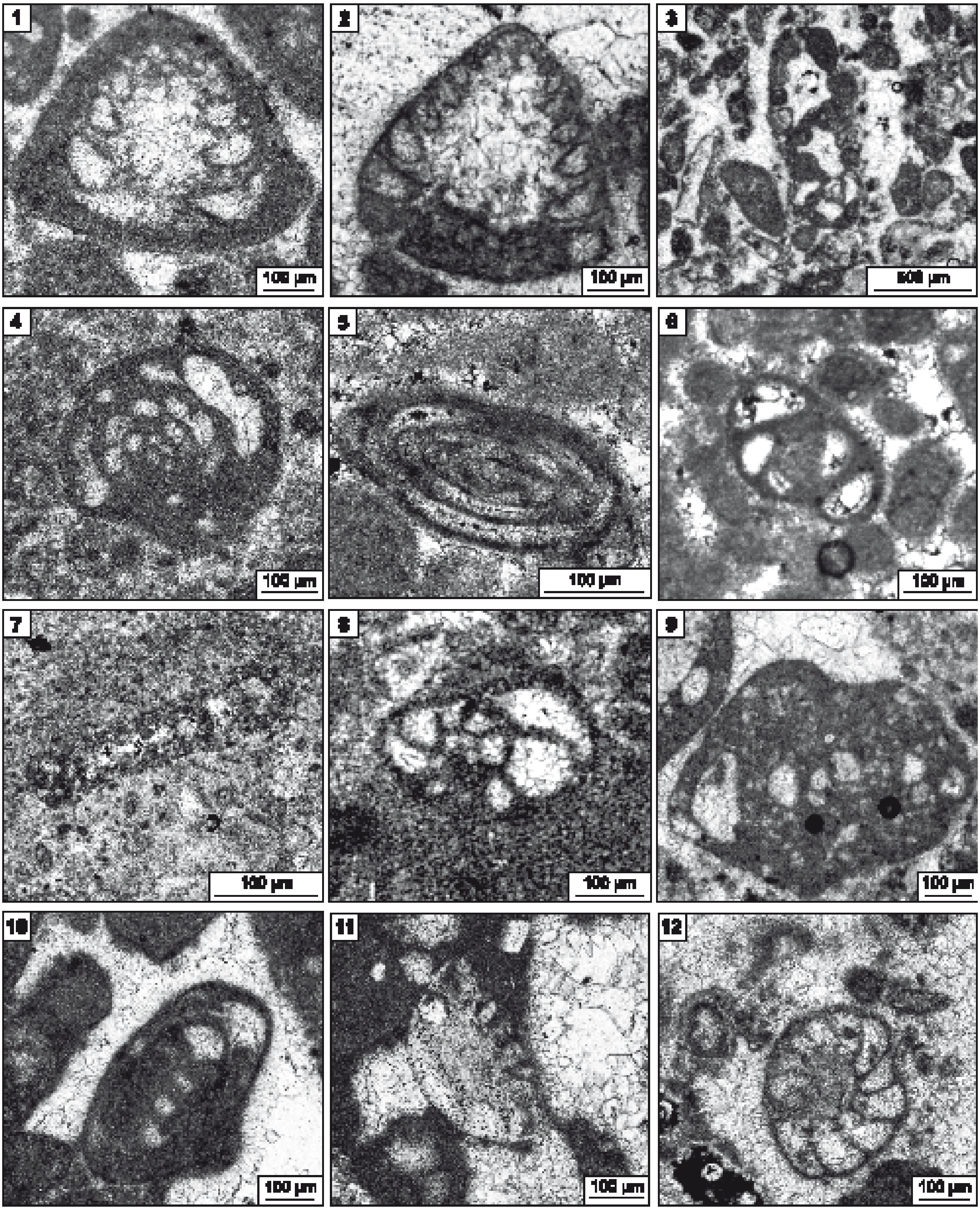
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PLATE V

Microfossils from the Polish part of the Carpathian Foredeep – Tithonian, continued

Mikroskamieniałości polskiej części zapadliska przedkarpackiego – tyton, cd.

Fig.1. *Pseudocyclammina lituus* (Yokoyama), a – axial section, b – equatorial section, Zagórzyce 6, depth 2810.0–2819.0 m
Pseudocyclammina lituus (Yokoyama), a – przekrój osiowy, b – przekrój równikowy, Zagórzyce 6, głębokość 2810,0–2819,0 m

Fig. 2. *Rumanoloculina mitchurini* (Dain), axial section, Zagórzyce 6, depth 3040.0–3042.0 m.
Rumanoloculina mitchurini (Dain), przekrój osiowy, Zagórzyce 6, głębokość 3040,0–3042,0 m

Fig. 3. *Rumanoloculina mitchurini* (Dain), transverse section, Zagórzyce 6, depth 3040.0–3042.0 m
Rumanoloculina mitchurini (Dain), przekrój poprzeczny, Zagórzyce 6, głębokość 3040.0–3042.0 m

Fig. 4. *Decussoloculina mirceai* Neagu, transverse section, Zagórzyce 7, depth 2844.0–2862.0 m
Decussoloculina mirceai Neagu, przekrój poprzeczny, Zagórzyce 7, głębokość 2844,0–2862,0 m

Fig. 5. *Decussoloculina mirceai* Neagu, axial section, Zagórzyce 7, depth 2844.0–2862.0 m
Decussoloculina mirceai Neagu, przekrój osiowy, Zagórzyce 7, głębokość 2844,0–2862,0 m

Fig. 6. *Siphovalvulina variabilis* Septfontaine, longitudinal section, Zagórzyce 6, depth 3040.0–3042.0 m
Siphovalvulina variabilis Septfontaine, przekrój podłużny, Zagórzyce 6, głębokość 3040,0–3042,0 m

Fig. 7. *Praetintinnopsella andrusovi* Borza, longitudinal section, Pilzno 40, depth 2665.0–2669.0 m
Praetintinnopsella andrusovi Borza, przekrój podłużny, Pilzno 40, głębokość 2665,0–2669,0 m

Fig. 8. *Comittosphaera pulla* (Borza), Pilzno 40, depth 2862.0–2879.0 m
Comittosphaera pulla (Borza), Pilzno 40, głębokość 2862,0–2879,0 m

Fig. 9. *Textularia depravatiformis* Bielecka & Kuznetsova, longitudinal section, Pilzno 40, depth 2409.0–2412.0 m
Textularia depravatiformis Bielecka & Kuznetsova, przekrój podłużny, Pilzno 40, głębokość 2409,0–2412,0 m

Fig. 10. Characeae, transverse sections of stem and oogonium of a representative of the family Clavatoracea, Zagórzyce 6, depth 2829.0–2838.0 m
Characeae, przekrój poprzeczny łodygi i oogonium przedstawiciela rodziny Clavatoracea, Zagórzyce 6, głębokość 2829,0–2838,0 m

Fig. 11. Coprolites, diverse sections, Zagórzyce 6, depth 2824.0–2829.0 m
Koprolity, różne przekroje, Zagórzyce 6, głębokość 2824,0–2829,0 m

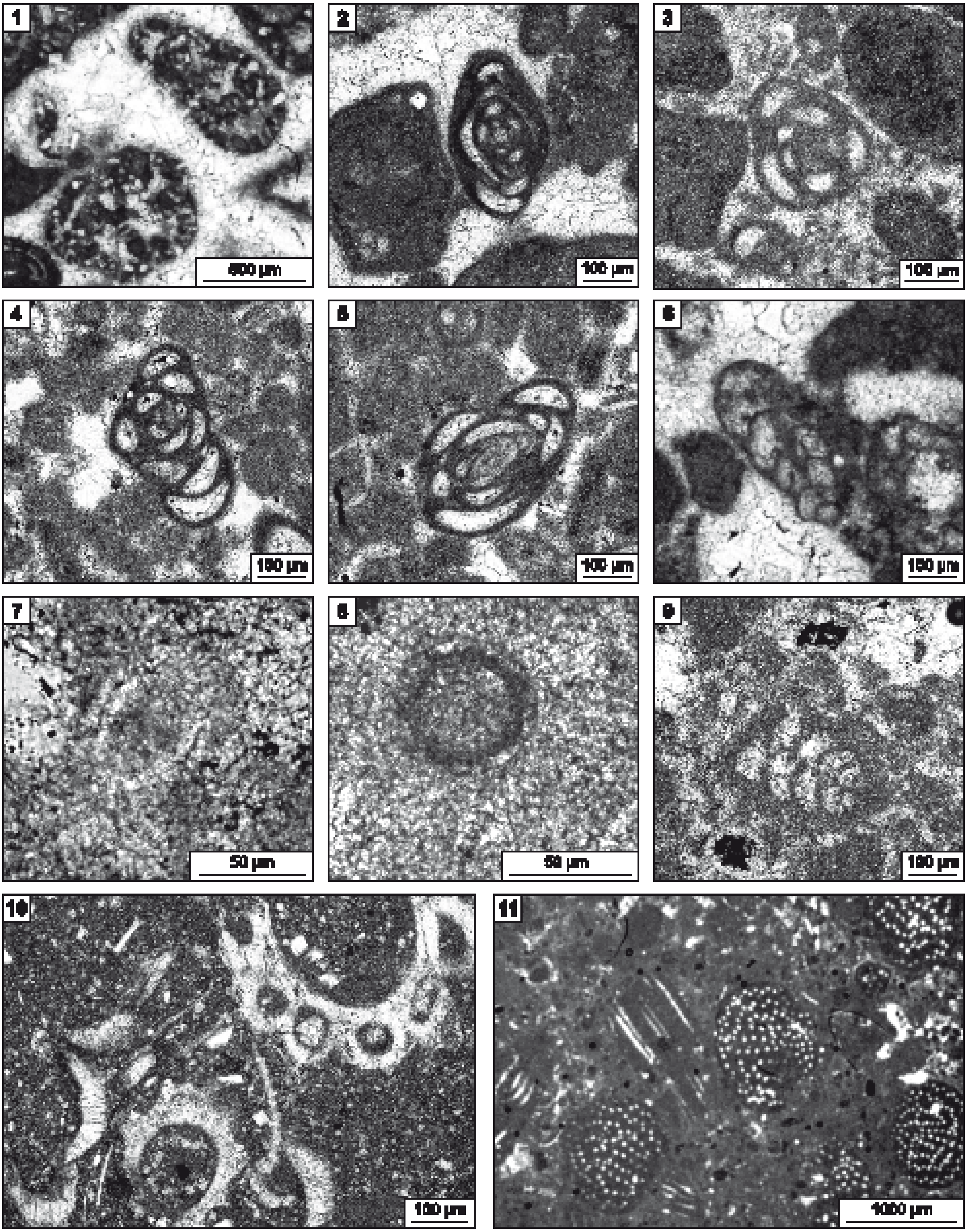

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PLATE VI

Microfossils from the Polish part of the Carpathian Foredeep – Kimmeridgian

Mikroskamieniałości polskiej części zapadliska przedkarpackiego – kimeryd

Fig. 1. *Crescentiella morronensis* (Crescenti), longitudinal section, Zagórzyce 6, depth 3432.0–3438.0 m
Crescentiella morronensis (Crescenti), przekrój podłużny, Zagórzyce 6, głębokość 3432,0–3438,0 m

Fig. 2. *Glomospira variabilis* Kübler & Zwingli, oblique section, Zagórzyce 6, depth 3681.0–3685.0 m
Glomospira variabilis Kübler & Zwingli, przekrój skośny, Zagórzyce 6, głębokość 3681,0–3685,0 m

Fig. 3. *Mohlerina basiliensis* (Mohler), oblique section Zagórzyce 6, depth 3432.0–3438.0 m
Mohlerina basiliensis (Mohler), przekrój skośny, Zagórzyce 6, głębokość 3432,0–3438,0 m

Fig. 4. *Mesoendothyra izjumiana* Dain, oblique section, Zagórzyce 6, depth 3432.0–3438.0 m
Mesoendothyra izjumiana Dain, przekrój skośny, Zagórzyce 6, głębokość 3432,0–3438,0 m

Fig. 5. *Rumanoloculina verbizhiensis* (Dulub), transverse section, Zagórzyce 6, depth 3432.0–3438.0 m
Rumanoloculina verbizhiensis (Dulub), przekrój poprzeczny, Zagórzyce 6, głebokość 3432.0–3438.0 m

Fig. 6. *Verneuilinoides kirillae* Dain, longitudinal section, Zagórzyce 6, depth 3432.0–3438.0 m
Verneuilinoides kirillae Dain, przekrój podłużny, Zagórzyce 6, głębokość 3432,0–3438,0 m

Fig. 7. *Carpistomiosphaera borzai* (Nagy), Zagórzyce 6, depth 3681.0–3685.0 m
Carpistomiosphaera borzai (Nagy), Zagórzyce 6, głębokość 3681,0–3685,0 m

Fig. 8. *Colomisphaera lapidosa* (Vogler), Pilzno 40, depth 3228.0–3237.0 m
Colomisphaera lapidosa (Vogler), Pilzno 40, głębokość 3228,0–3237,0 m

Fig. 9. *Colomisphaera pieniniensis* (Borza), Zagórzyce 6, depth 3798.0–3802.0 m
Colomisphaera pieniniensis (Borza), Zagórzyce 6, głębokość 3798,0–3802,0 m

Fig. 10. Planktonic green alga *Globochaete alpina* Lombard, Zagórzyce 6, depth 3798.0–3802.0 m
Planktoniczna zielenica *Globochaete alpina* Lombard, Zagórzyce 6, głębokość 3798,0–3802,0 m

Fig. 11. Fragments of planktonic crinoids *Saccocoma* sp., Zagórzyce 6, depth 3798.0–3802.0 m
Fragmenty planktonicznych liliowców *Saccocoma* sp., Zagórzyce 6, głębokość 3798,0–3802,0 m

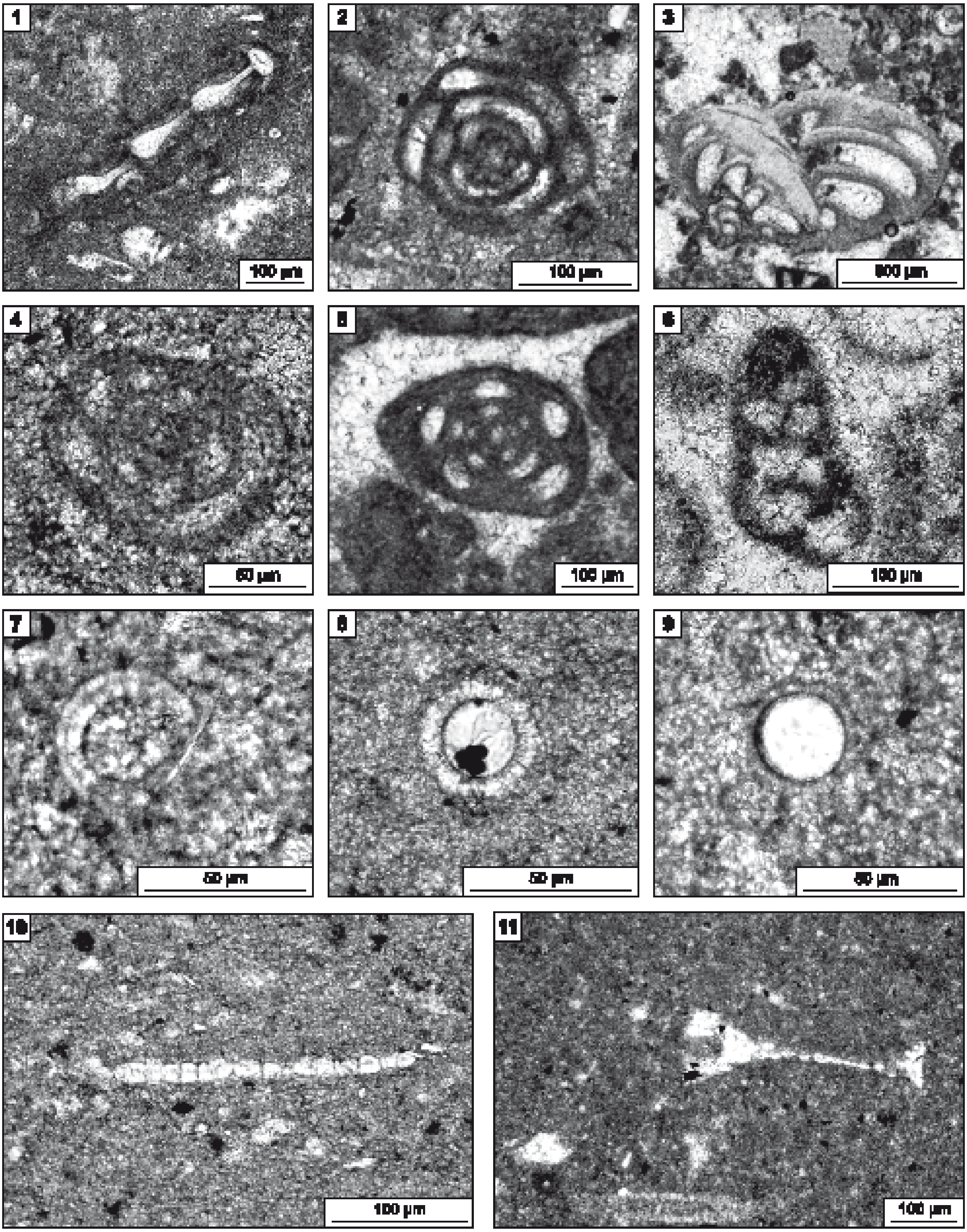

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PLATE VII

Foraminifera from the Polish part of the Carpathian Foredeep – Oxfordian

Otwornice polskiej części zapadliska przedkarpackiego – oksford

Fig. 1. *Ammobaculites irregularis* (Gümbel), longitudinal section, Nawsie 1, depth 4372.0–4375.0 m
Ammobaculites irregularis (Gümbel), przekrój podłużny, Nawsie 1, głębokość 4372,0–4375,0 m

Fig. 2. *Cornuspira eichbergensis* Kübler & Zwingli, equatorial section, Pilzno 40, depth 3313.0–3322.0 m
Cornuspira eichbergensis Kübler & Zwingli, przekrój równikowy, Pilzno 40, głębokość 3313,0–3322,0 m

Fig. 3. *Eomarssonella paraconica* Levina, longitudinal section, Nawsie 1, depth 4492.0–4496.0 m
Eomarssonella paraconica Levina, przekrój podłużny, Nawsie 1, głębokość 4492,0–4496,0 m

Fig. 4. *Globuligerina oxfordiana* Grigelis, axial section, Pilzno 40, depth 3313.0–3332.0 m
Globuligerina oxfordiana Grigelis, przekrój osiowy, Pilzno 40, głębokość 3313,0–3332,0 m

Fig. 5. *Haghimashella arcuata* (Haeusler), juvenile specimen, longitudinal section, Pilzno 40, depth 3313.0–3332.0 m
Haghimashella arcuata (Haeusler), okaz młodociany, przekrój podłużny Pilzno 40, głebokość 3313.0–3332.0 m

Fig. 6. *Miliammina olgae* Bielecka, transverse section, Pilzno 40, depth 3313.0–3332.0 m
Miliammina olgae Bielecka, przekrój poprzeczny, Pilzno 40, głębokość 3313,0–3332,0 m

Fig. 7. *Ophthalmidium oxfordianum* (Deecke), axial section, Pilzno 40, depth 3313.0–3332.0 m
Ophthalmidium oxfordianum (Deecke), przekrój osiowy, Pilzno 40, głębokość 3313,0–3332,0 m

Fig. 8. *Ophthalmidium pseudocarinatum* (Dain), transverse section, Pilzno 40, depth 3313.0–3332.0 m
Ophthalmidium pseudocarinatum (Dain), przekrój poprzeczny, Pilzno 40, głębokość 3313,0–3332,0 m

Fig. 9. *Ophthalmidium strumosum* (Gümbel), transverse section, Pilzno 40, depth 3313.0–3332.0 m
Ophthalmidium strumosum (Gümbel), przekrój poprzeczny, Pilzno 40, głębokość 3313,0–3332,0 m

Fig. 10. *Paalzowella turbinella* (Gümbel), axial section, Zagórzyce 6, depth 3881.0–3884.0 m
Paalzowella turbinella (Gümbel), przekrój osiowy, Zagórzyce 6, głębokość 3881,0–3884,0 m

Fig. 11. *Rumanolina seiboldi* (Lutze), axial section, Zagórzyce 6, depth 3881.0–3884.0 m
Rumanolina seiboldi (Lutze), przekrój osiowy, Zagórzyce 6, głębokość 3881,0–3884,0 m

Fig. 12. *Siphovalvulina variabilis* Septfontaine, logitudinal section, Zagórzyce 6, depth 3881.0–3884.0 m
Siphovalvulina variabilis Septfontaine, przekrój podłużny, Zagórzyce 6, głębokość 3881,0–3884,0 m

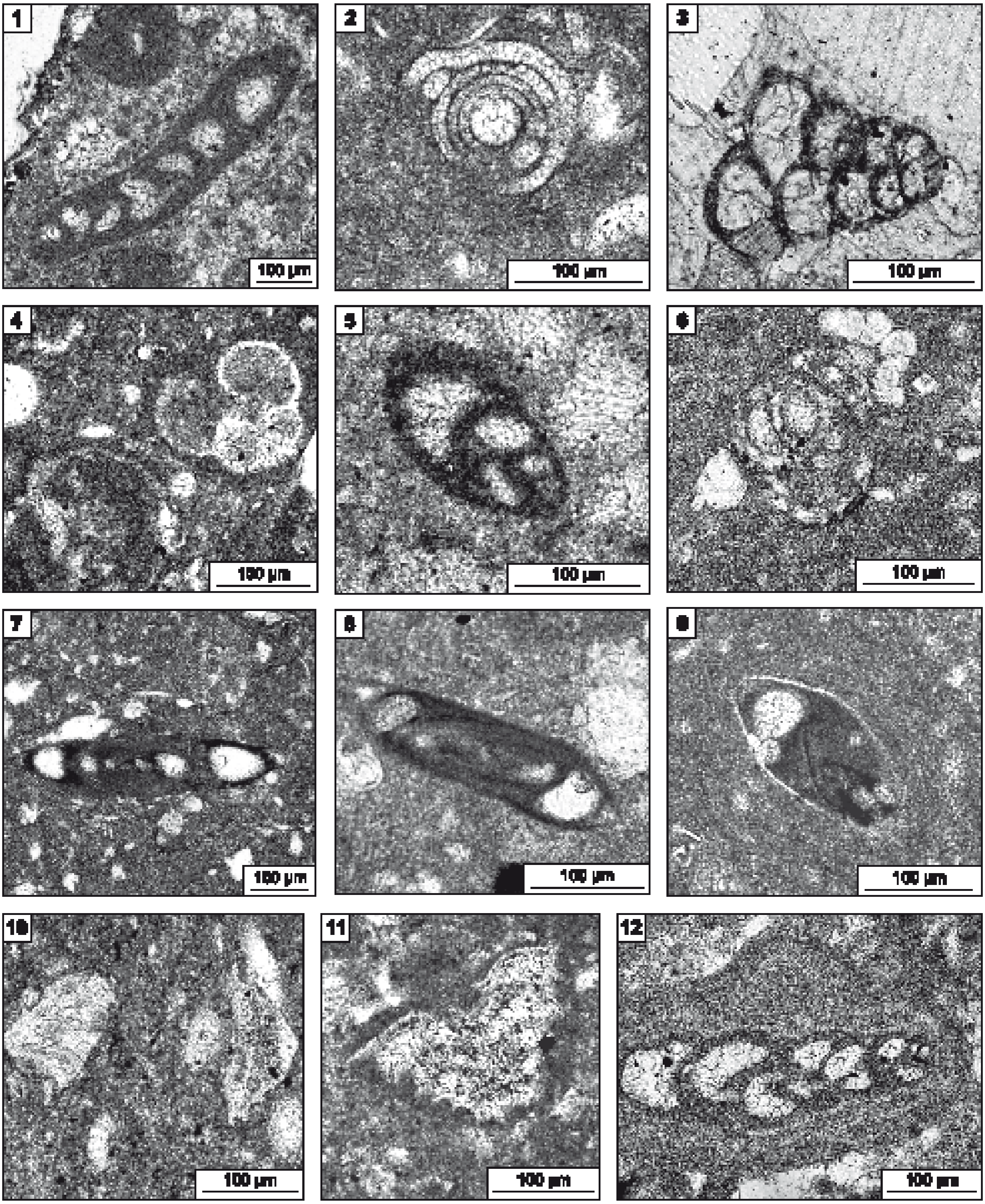

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PLATE VIII

Microfossils from the Polish part of the Carpathian Foredeep – Oxfordian, continued

Mikroskamieniałości polskiej części zapadliska przedkarpackiego – oksford, cd.

Fig. 1. *Spirillina andreae* Bielecka, axial section, Nawsie 1, depth 4372.0–4375.0 m
Spirillina andreae Bielecka, przekrój osiowy, Nawsie 1, głębokość 4372,0–4375,0 m

Fig. 2. *Spirillina tenuissima* Gümbel, equatorial section, Pilzno 40, depth 3313.0–3322.0 m
Spirillina tenuissima Gümbel, przekrój równikowy, Pilzno 40, głębokość 3313,0–3322,0 m

Fig. 3. *Colomisphaera lapidosa* (Vogler), Zagórzyce 6, depth 3872.0–3875.0 m
Colomisphaera lapidosa (Vogler), Zagórzyce 6, głębokość 3872,0–3875,0 m

Fig. 4. *Comittosphaera czestochowiensis* Řehanek, Pilzno 40, depth 3313.0–3322.0 m
Comittosphaera czestochowiensis Řehanek, Pilzno 40, głębokość 3313,0–3322,0 m

Fig. 5. *Orthopithonella gustafsoni* Bolli, Nawsie 1, depth 4372.0–4375.0 m
Orthopithonella gustafsoni Bolli, Nawsie 1, głębokość 4372,0–4375,0 m

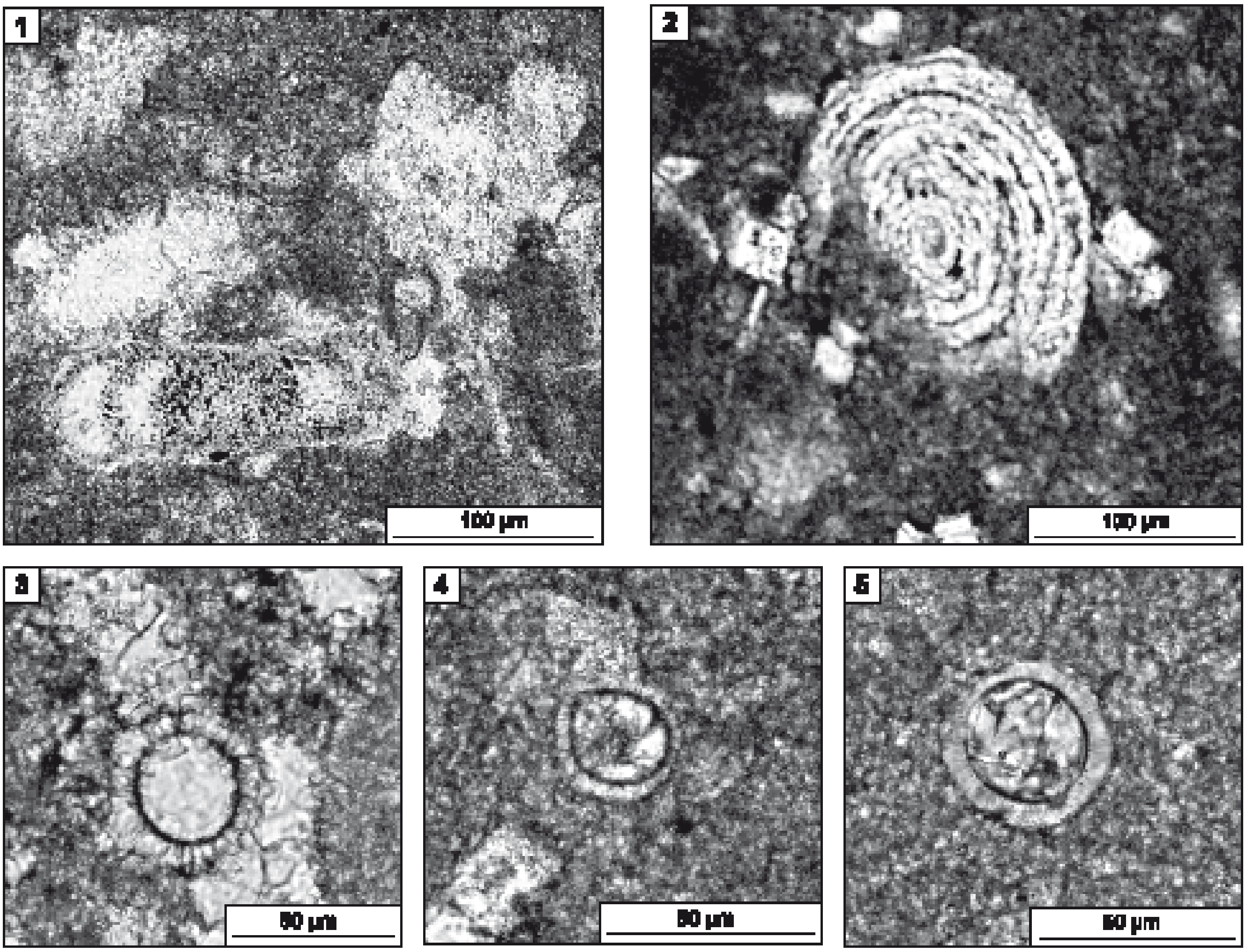
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PLATE IX

Microfossils from the Ukrainian part of the Carpathian Foredeep – Late Cretaceous

Mikroskamieniałości ukraińskiej części zapadliska przedkarpackiego – późna kreda

Fig. 1. *Marssonella turris* (d'Orbigny), longitudinal section, Didushychi 1, depth 1499.0–1570.0 m
Marssonella turris (d'Orbigny), przekrój podłużny, Didushychi 1, głębokość 1499,0–1570,0 m

Fig. 2. *Stomiosphaerina biedai* Nowak, oblique section, Didushychi 1, depth 1499.0–1570.0 m
Stomiosphaerina biedai Nowak, przekrój skośny, Didushychi 1, głębokość 1499,0–1570,0 m

Fig. 3. Red crustose coralline alga, Corallinaceae, Pohlynaiucha 1, depth 1348.0–1356.0 m
Krasnorost z rodziny Corallinaceae, Pohlynaiucha 1, głębokość 1348,0–1356,0 m

Fig. 4. *Heterohelix moremani* (Cushman), longitudinal section, Didushychi 2, depth 1897.0–1902.0 m
Heterohelix moremani (Cushman), przekrój podłużny, Didushychi 2, głębokość 1897,0–1902,0 m

Fig. 5. *Orthopithonella sphaerica* (Kaufmann), Didushychi 1, depth 1499.0–1570.0 m
Orthopithonella sphaerica (Kaufmann), Didushychi 1, głębokość 1499,0–1570,0 m

Fig. 6. *Globigerinelloides bentonensis* (Morrow), axial section, Didushychi 2, depth 1893.0–1897.0 m
Globigerinelloides bentonensis (Morrow), przekrój osiowy, Didushychi 2, głębokość 1893,0–1897,0 m

Fig. 7. *Marginotruncana marginata* (Reuss), axiual section, Didushychi 2, depth 1893.0–1897.0 m
Marginotruncana marginata (Reuss), przekrój osiowy, Didushychi 2, głębokość 1893,0–1897,0 m

Fig. 8. *Hedbergella delrioensis* (Carsey), equatorial section, Didushychi 2, depth 1893.0–1897.0 m
Hedbergella delrioensis (Carsey), przekrój osiowy, Didushychi 2, głębokość 1893,0–1897,0 m

Fig. 9. *Whiteinella baltica* Douglas & Rankin, axial section, Didushychi 2, depth 1893.0–1897.0 m
Whiteinella baltica Douglas & Rankin, przekrój osiowy, Didushychi 2, głębokość 1893,0–1897,0 m

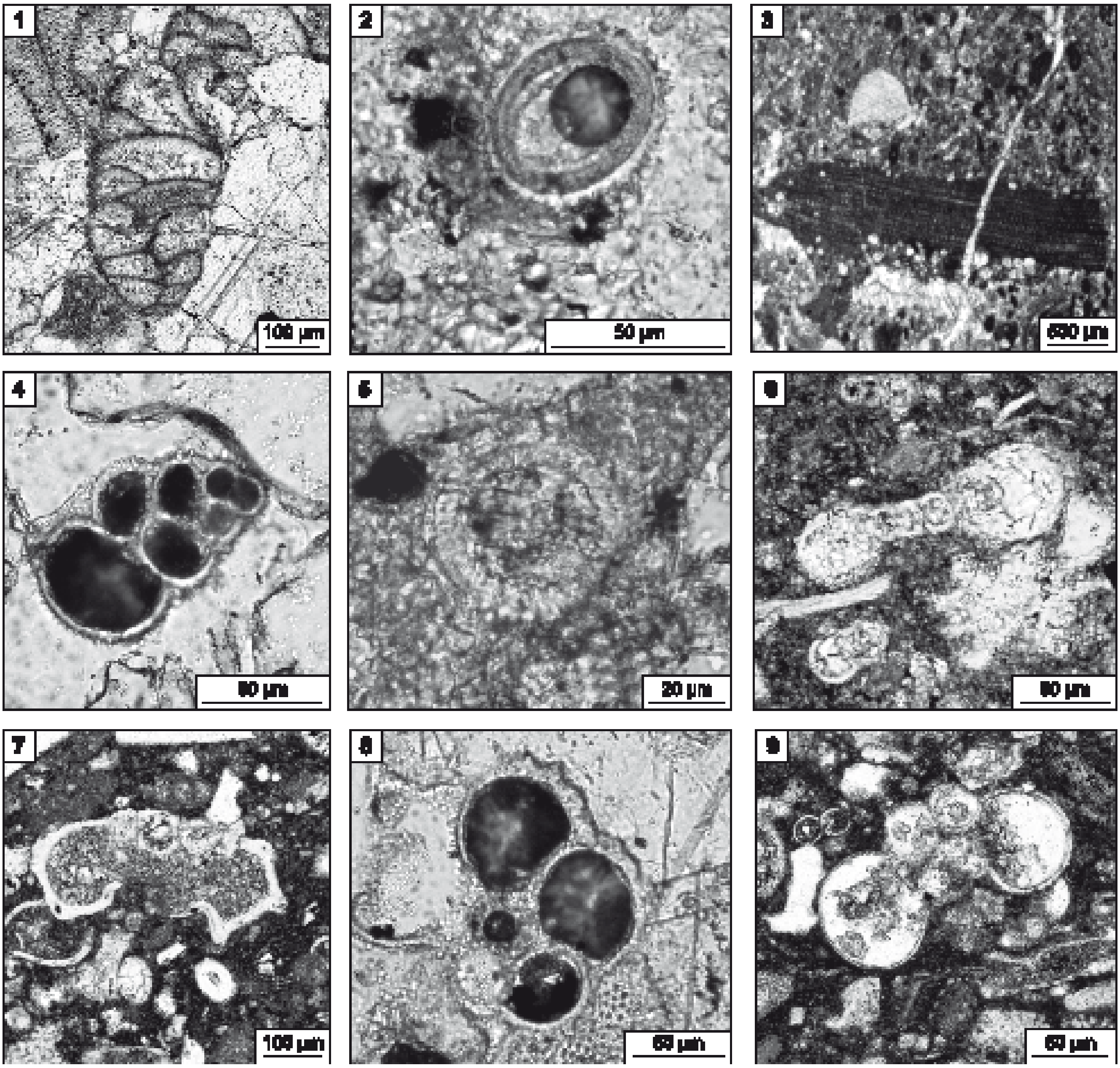

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PLATE X

Foraminifera from the Ukrainian part of the Carpathian Foredeep – Early Cretaceous

Otwornice ukraińskiej części zapadliska przedkarpackiego – wczesna kreda

Fig. 1. *Haplophragmoides joukovskyi* Charollais, Brönnimann & Zaninetti, equatorial section, Verchany 1, depth 1237.4–1247.0 m
Haplophragmoides joukovskyi Charollais, Brönnimann & Zaninetti, przekrój równikowy, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 2. *Mayncina bulgarica* Laug, Peybernes & Rey, oblique section, Verchany 1, depth 1237.4–1247.0 m
Mayncina bulgarica Laug, Peybernes & Rey, przekrój skośny, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 3. *Meandrospira favrei* (Charollais, Brönnimann & Zaninetti), oblique section, Pyatnychany 1, depth 1495.0–1500.0 m
Meandrospira favrei (Charollais, Brönnimann & Zaninetti), przekrój skośny, Pyatnychany 1, głębokość 1495,0–1500,0 m

Fig. 4. *Neotrocholina molesta* (Gorbatchik), axial section, Verchany 1, depth 1237.4–1247.0 m
Neotrocholina molesta (Gorbatchik), przekrój osiowy, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 5. *Nautiloculina bronnimanni* Arnaud-Vanneau & Peybernes, axial section, Verchany 1, depth 1237.4–1247.0 m
Nautiloculina bronnimanni Arnaud-Vanneau & Peybernes, przekrój osiowy, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 6. *Protopeneroplis ultragranulata* (Gorbatchik), oblique section, Verchany 1, depth 1547.1–1563.4 m
Protopeneroplis ultragranulata (Gorbatchik), przekrój skosny, Verchany 1, głębokość 1547,1–1563,4 m

Fig. 7. *Nautiloculina cretacea* Peybernes, axial section, Didushychi 1, depth 1913.0–1923.0 m
Nautiloculina cretacea Peybernes, przekrój osiowy, Didushychi 1, głębokość 1913,0–1923,0 m

Fig. 8. *Scythiloculina confusa* Neagu, transverse section, Didushychi 1, depth 1913.0–1923.0 m
Scythiloculina confusa Neagu, przekrój poprzeczny, Didushychi 1, głębokość 1913,0–1923,0 m

Fig. 9. *Trocholina paucigranulata* Moullade, axial section, Didushychi 1, depth 1913.0–1923.0 m
Trocholina paucigranulata Moullade, przekrój osiowy, Didushychi 1, głębokość 1913,0–1923,0 m

Fig. 10. *Nautiloculina bronnimanni* Arnaud-Vanneau & Peybernes, axial section, Verchany 1, depth 1237.4–1247.0 m
Nautiloculina bronnimanni Arnaud-Vanneau & Peybernes, przekrój osiowy, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 11. *Pseudolituonella* cf. *gavonensis* Foury, oblique section, Didushychi 1, depth 1913.0–1923.0 m
Pseudolituonella cf. *gavonensis* Foury, przekrój skośny, Didushychi 1, głębokość 1913,0–1923,0 m

Fig. 12. *Derventina filipescui* Neagu, transverse section, Didushychi 1, depth 1913.0–1923.0 m
Derventina filipescui Neagu, przekrój poprzeczny, Didushychi 1, głębokość 1913,0–1923,0 m

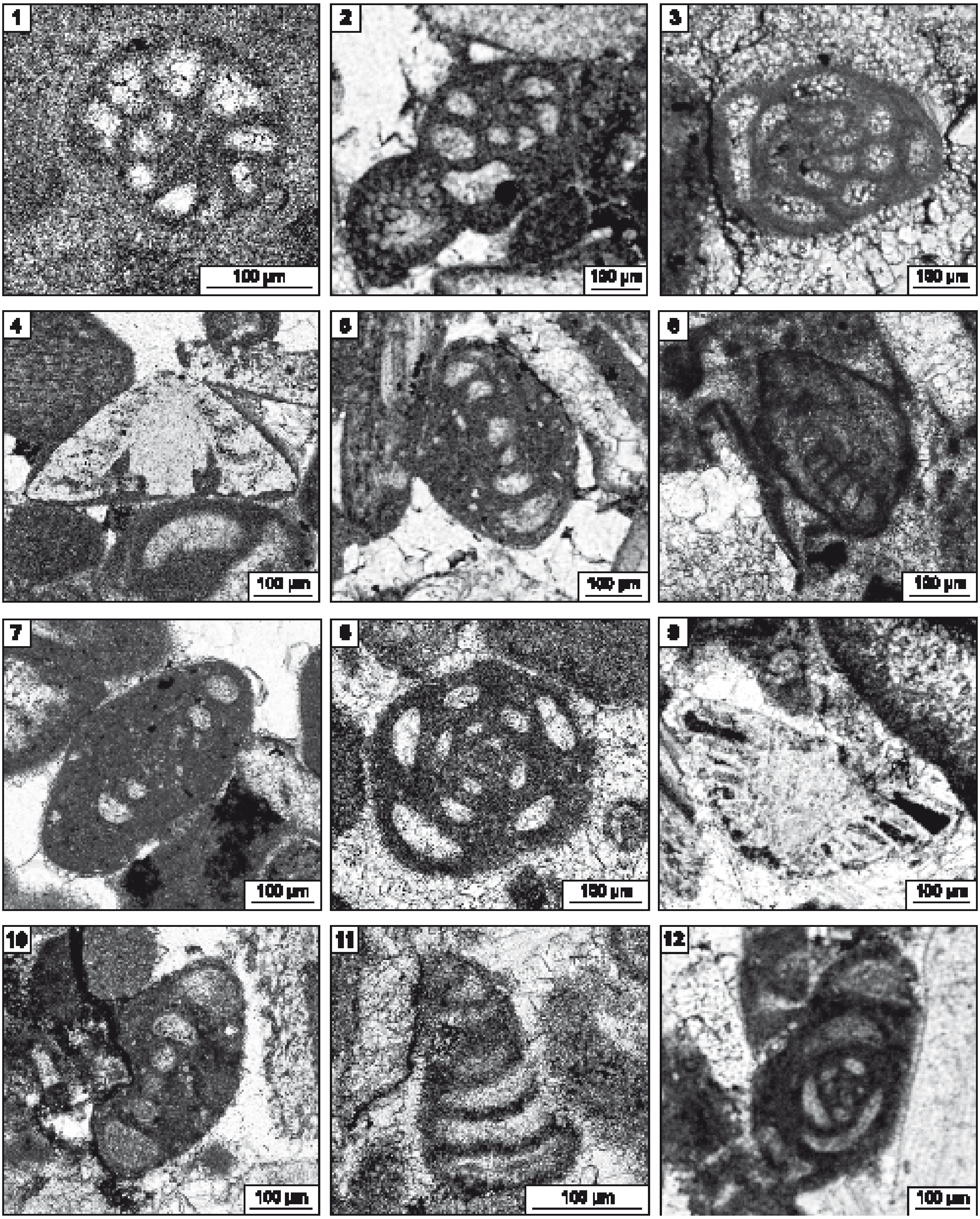
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PLATE XI

Microfossils from the Ukrainian part of the Carpathian Foredeep – Early Cretaceous, continued

Mikroskamieniałości ukraińskiej części zapapdliska przedkarpackiego – wczesna kreda, cd.

Fig. 1. *Praedorothia oxycona* (Moullade), longitudinal section, Verchany 1, depth 1237.4–1247.0 m
Praedorothia oxycona (Moullade), przekrój podłużny, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 2. *Gerochella cylindrica* Neagu, oblique section, Verchany 1, depth 1237.4–1247.0 m
Gerochella cylindrica Neagu, przekrój skośny, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 3. *Pfenderina flandrini* Moullade, oblique section, Verchany 1, depth 1237.4–1247.0 m
Pfenderina flandrini Moullade, przekrój skośny, Verchany 1, głębokość 1237,4–1247,0 m

Fig. 4. *Calpionella alpina* Lorenz, longitudinal section, Pyatnychany 1, depth 1495.0–1500.0 m
Calpionella alpina Lorenz, przekrój podłużny, Pyatnychany 1, głębokość 1495,0–1500,0 m

Fig. 5. *Calpionella elliptica* Cadish, longitudinal section, Podil'tsi 1, depth 1948.8–1959.8 m
Calpionella elliptica Cadish, przekrój podłużny, Podil'tsi 1, głębokość 1948,8–1959,8 m

Fig. 6. *Tintinnopsella doliformis* Colom, longitudinal section, Pyatnychany 1, depth 1495.0–1500.0 m
Tintinnopsella doliformis Colom, przekrój podłużny, Pyatnychany 1, głębokość 1495,0–1500,0 m

Fig. 7. Coprolites, diverse sections, Didushychi 1, depth 2019.0–2030.0 m
Koprolity, różne przekroje, Didushychi 1, głębokość 2019,0–2030,0 m

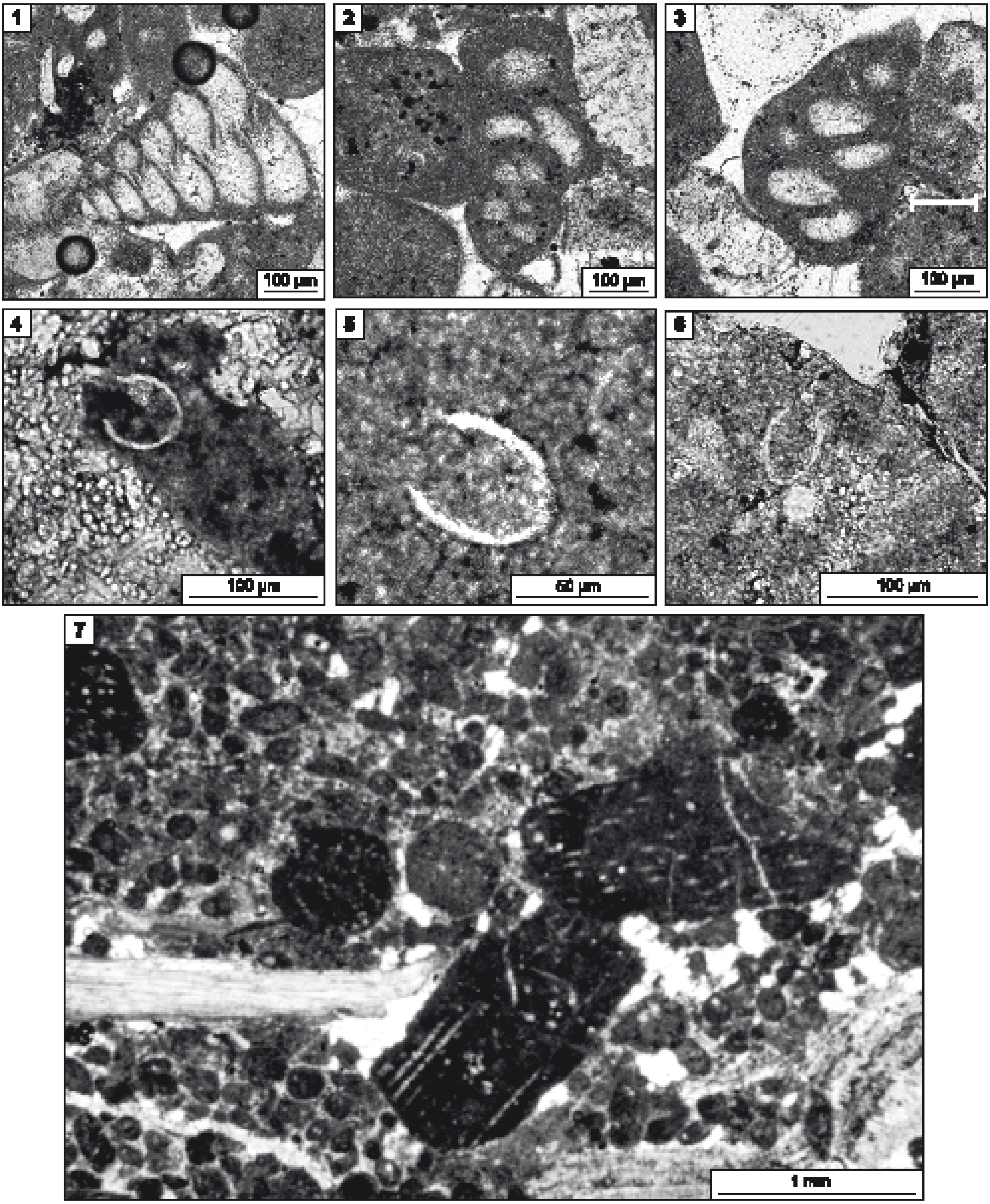
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PLATE XII

Foraminifera from the Ukrainian part of the Carpathian Foredeep – Tithonian

Otwornice ukraińskiej częsci zapadliska przedkarpackiego – tyton

Fig. 1. *Anhispirocyclina lusitanica* (Egger), axial section, Didushychi 1, depth 2425.0–2435.0 m
Anhispirocyclina lusitanica (Egger), przekrój osiowy, Didushychi 1, głębokość 2425,0–2435,0 m

Fig. 2. *Andersenolina alpina* (Leupold), axial section, Didushychi 2, depth 2118.0–2126.0 m
Andersenolina alpina (Leupold), przekrój osiowy, Didushychi 2, głębokość 2118,0–2126,0 m

Fig. 3. *Charentia evoluta* (Gorbatchik, oblique section, Verchany 1, depth 1563.4–1578.4 m
Charentia evoluta (Gorbatchik, przekrój skośny, Verchany 1, głębokość 1563,4–1578,4 m

Fig. 4. *Everticyclammina praekelleri*, axial section, Didushychi 1, depth 2425.0–2435.0 m
Everticyclammina praekelleri, przekrój osiowy, Didushychi 1, głębokość 2425,0–2435,0 m

Fig. 5. *Ichnusella burlini* (Gorbatchik), axial section, Korolyn 6, depth 2143.0 m
Ichnusella burlini (Gorbatchik), przekrój osiowy, Korolyn 6, głębokość 2143,0 m

Fig. 6. *Istriloculina fabaria* (Matsieva & Temirbekova), longitudinal section , Kochanivka 26, depth 1208.0–1310.0 m
Istriloculina fabaria (Matsieva & Temirbekova), przekrój podłużny , Kochanivka 26, głębokość 1208,0–1310,0 m

Fig. 7. *Istriloculina rectoangularia* Matsieva & Temirbekova longitudinal section, Kochanivka 26, depth 1208.0 – 1210.0 m
Istriloculina rectoangularia Matsieva & Temirbekova przekrój podłużny, Kochanivka 26, głębokość 1208,0 – 1210,0 m

Fig. 8. *Melathrokerion spirialis* Gorbatchik, axial section, Kochanivka 26, depth 1157.5–1178.6 m
Melathrokerion spirialis Gorbatchik, przekrój osiowy, Kochanivka 26, głębokość 1157,5–1178,6 m

Fig. 9. *Neotrocholina molesta* (Gorbatchik), axial section, Korolyn 6, depth 2143.0 m
Neotrocholina molesta (Gorbatchik), przekrój osiowy, Korolyn 6, głębokość 2143,0 m

Fig. 10. *Pseudocyclammina lituus* (Yokoyama), axial section, .Verchany 1, depth 1601.0–1611.0 m
Pseudocyclammina lituus (Yokoyama), przekrój osiowy, Verchany 1, głębokość 1601,0–1611,0 m

Fig. 11. *Paleogaudryina magharaensis* Said & Bakarat, longitudinal section, Didushychi 1, depth 2691.0–2692.0 m
Paleogaudryina magharaensis Said & Bakarat, przekrój podłużny, Didushychi 1, głębokość 2691,0–2692,0 m

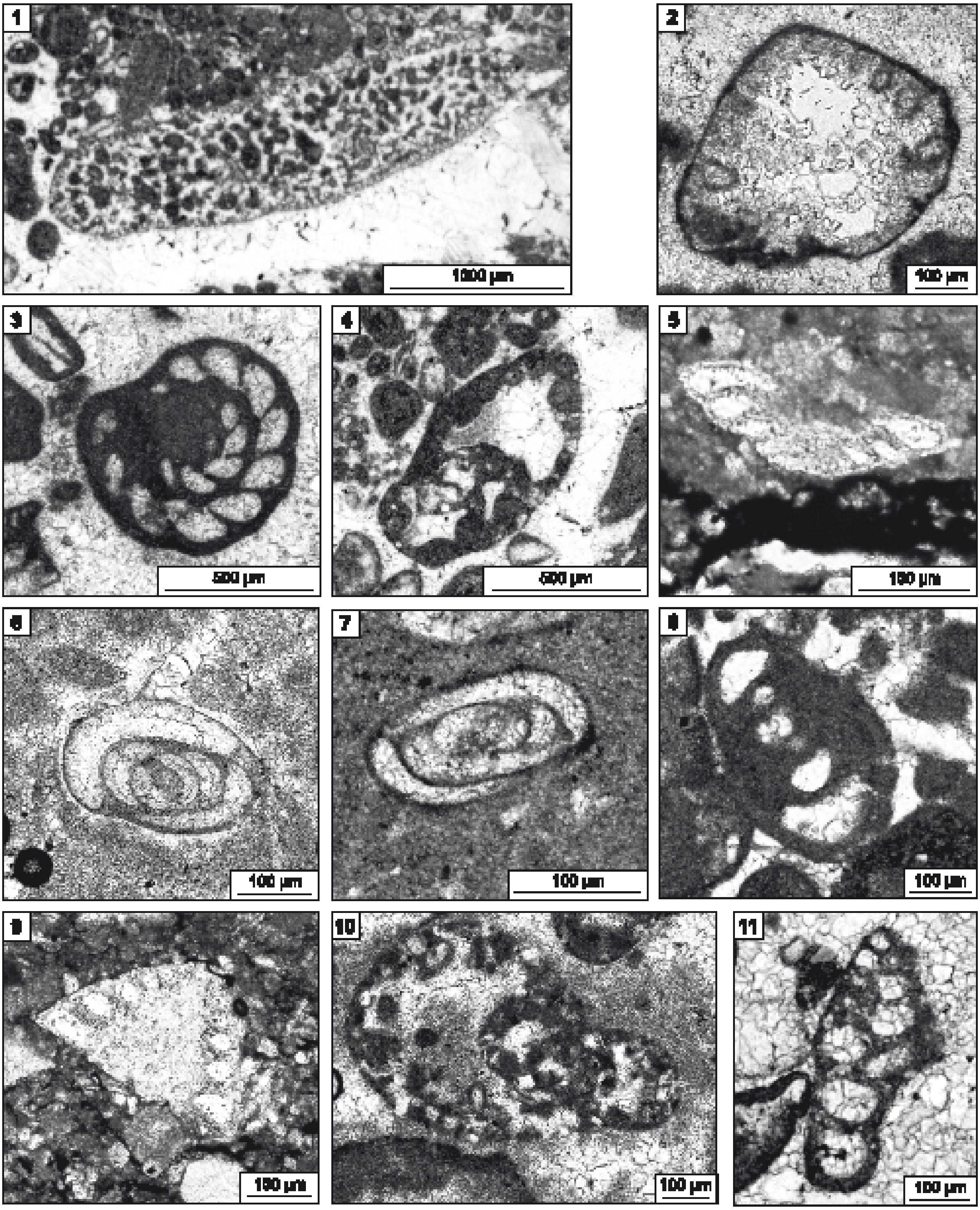

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PLATE XIII

Microfossils from the Ukrainian part of the Carpathian Foredeep – Tithonian, continued

Mikroskamieniałości ukraińskiej części zapadliska przedkarpackiego – tyton, cd.

Fig. 1. *Dobrogelina ovidi* Neagu, axial section, Didushychi 1, depth 2499.0–2510.0 m
Dobrogelina ovidi Neagu, przekrój osiowy, Didushychi 1, głębokość 2499,0–2510,0 m

Fig. 2. *Protomarssonella kummi* (Zedler), longitudinal section, Didushychi 1, depth 2601.0–2611.0 m
Protomarssonella kummi (Zedler), przekrój podłużny, Didushychi 1, głębokość 2601,0–2611,0 m

Fig. 3. *Rumanoloculina mitchurini* (Dan), transversal section, Didushychi 1, depth 2318.0–2322.0 m
Rumanoloculina mitchurini (Dan), przekrój poprzeczny, Didushychi 1, głębokość 2318,0–2322,0 m

Fig. 4. *Verneuilinodes kirillae* Dain, longitudinal section, Didushychi 1, depth 2691,0–2692.0 m
Verneuilinodes kirillae Dain, przekrój podłużny, Didushychi 1, głębokość 2691,0–2692,0 m

Fig. 5. *Semichitinodella sujkowskii* Nowak, longitudinal section, Korolyn 6, depth 2545.0 m
Semichitinodella sujkowskii Nowak, przekrój podłużny, Korolyn 6, głębokość 2545,0 m

Fig. 6. *Calpionella alpina* Lorenz, longitudinal section, Korolyn 6, depth 2228.0 m
Calpionella alpina Lorenz, przekrój podłużny, Korolyn 6, głębokość 2228,0 m

Fig. 7. *Crassicollaria intermedia* (Durand Delga), longitudinal section, Korolyn 6, depth 2244.0 m
Crassicollaria intermedia (Durand Delga), przekrój podłużny, Korolyn 6, głębokość 2244,0 m

Fig. 8. *Colomisphaera cieszynica* Nowak, Korolyn 6, depth 2497.0 m
Colomisphaera cieszynica Nowak, Korolyn 6, głębokość 2497,0 m

Fig. 9. *Colomisphaera misolensis* (Vogler), Korolyn 6, depth 2497.0 m
Colomisphaera misolensis (Vogler), Korolyn 6, głębokość 2497,0 m

Fig. 10. *Colomisphaera radiata* (Vogler), Didushychi 1, depth 2425.0–2435.0 m
Colomisphaera radiata (Vogler), Didushychi 1, głębokość 2425,0–2435,0 m

Fig. 11. *Colomisphaera tenuis* (Nagy), Korolyn 6, depth 2410.0 m
Colomisphaera tenuis (Nagy), Korolyn 6, głębokość 2410,0 m

Fig. 12. *Comittosphaera pulla* (Borza), Kokhanivka 26, depth 1157.0–1178.6 m
Comittosphaera pulla (Borza), Kokhanivka 26, głębokość 1157,0–1178,6 m

Fig. 13. *Parastomiosphaera malmica* (Borza), Korolyn 6, depth 2545.0 m
Parastomiosphaera malmica (Borza), Korolyn 6, głębokość 2545,0 m

Fig. 14. *Comittosphaera sublapidosa* (Vogler), Didushychi 2, depth 1993.0–2001.0 m
Comittosphaera sublapidosa (Vogler), Didushychi 2, głębokość 1993,0–2001,0 m

Fig. 15. *Stomiosphaera moluccana* Wanner, Korolyn 6, depth 2547.0 m
Stomiosphaera moluccana Wanner, Korolyn 6, głębokość 2547,0 m

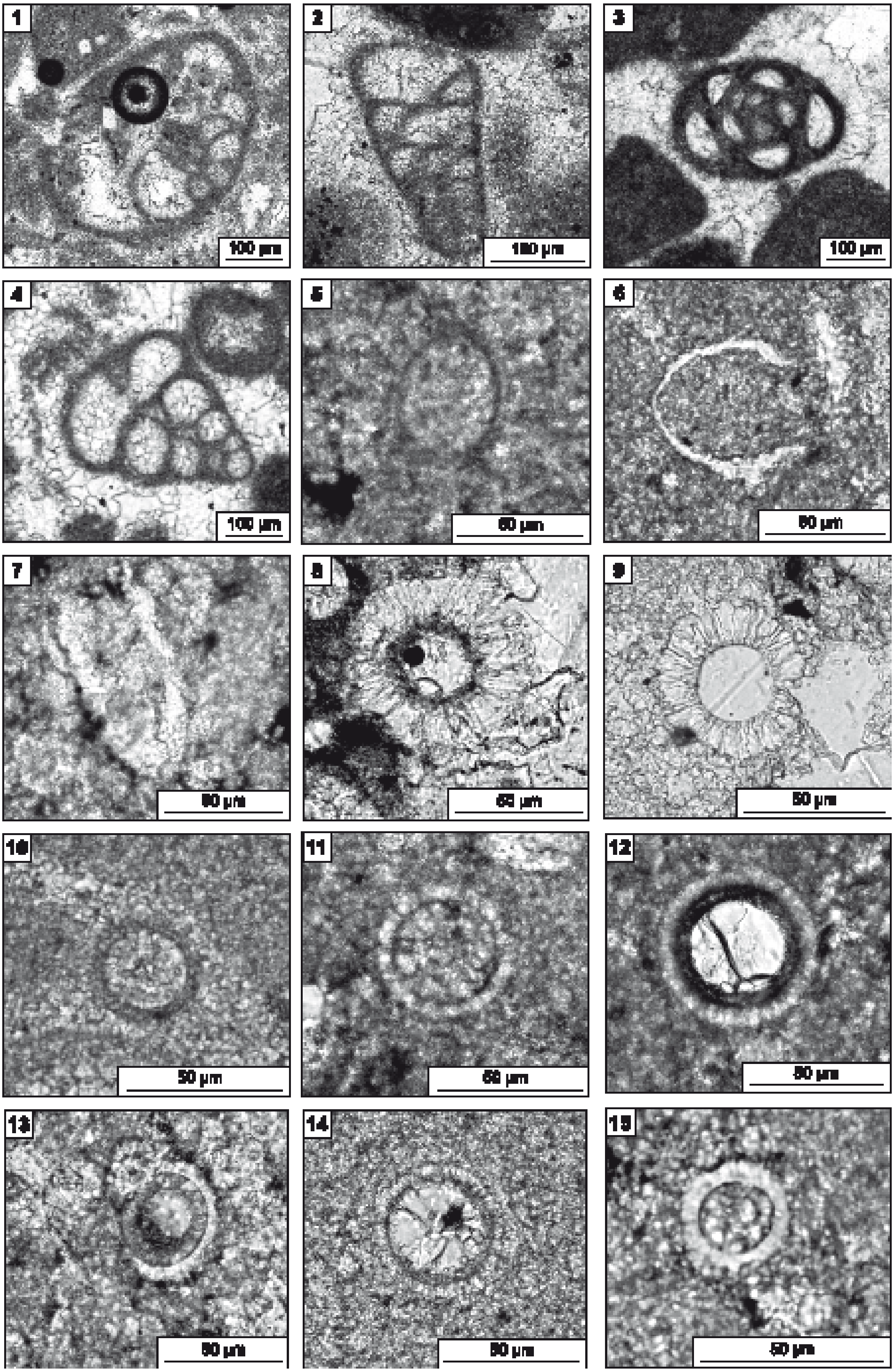
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PLATE XIV

Foraminifera from the Ukrainian part of the Carpathian Foredeep – Kimmeridgian

Otwornice ukraińskiej części zapadliska predkarpackiego – kimeryd

Fig. 1. *Alveosepta jaccardi* (Schrodt), oblique section, Lanivka 1, depth 2300.0–2306.0 m
Alveosepta jaccardi (Schrodt), przekrój skośny, Lanivka 1, głębokość 2300,0–2306,0 m

Figs. 2, 3. *Labirynthina mirabilis* Weynschenk, equatorial sections through initial part, Lanivka 1, depth 2151.0–2156.0 m
Labirynthina mirabilis Weynschenk, przekroje równikowe części początkowej, Lanivka 1, głębokość 2151,0–2156,0 m

Fig. 4. *Mesoendothyra izjumiana* Dain, equatorial section, Korolyn 6, depth 2590.0 m
Mesoendothyra izjumiana Dain, przekrój równikowy, Korolyn 6, głębokość 2590,0 m

Fig. 5. *Neotrocholina conica* (Schlumberger), axial section, Bortiatin 1, depth 2240.0 m
Neotrocholina conica (Schlumberger), przekrój osiowy, Bortiatin 1, głębokość 2240,0 m

Fig. 6. *Protopeneroplis striata* Weynschenk, axial section, Bortiatin 1, depth 1920.0 m
Protopeneroplis striata Weynschenk, przekrój osiowy , Bortiatin 1, głębokość 1920,0 m

Fig. 7. *Protopeneroplis striata* Weynschenk, axial section, Podil'tsi 1, depth 2349.7–2359.7 m
Protopeneroplis striata Weynschenk, przekrój osiowy, Podil'tsi 1, głębokość 2349,7–2359,7 m

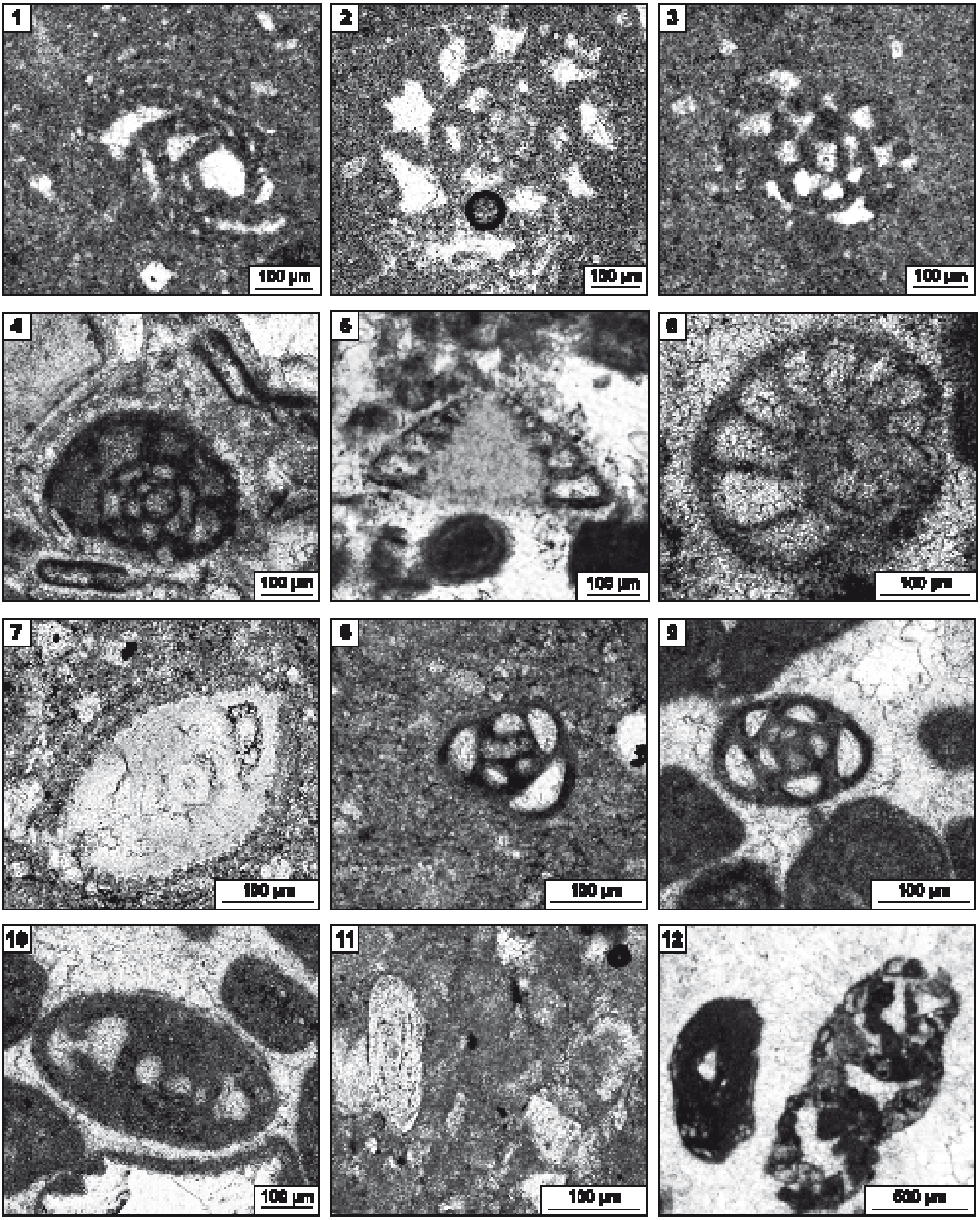
Fig. 8. *Quinqueloculina podlubiensis* Tereschuk, transverse section, Lanivka 1, depth 2036.0–2041.0 m
Quinqueloculina podlubiensis Tereschuk, przekrój poprzeczny, Lanivka 1, głębokość 2036,0–2041,0 m

Fig. 9. *Rumanoloculina verbizhiensis* (Dulub), transverse section, Lanivka 1, depth 2036.0–2041.0 m
Rumanoloculina verbizhiensis (Dulub), przekrój poprzeczny, Lanivka 1, głębokość 2036,0–2041,0 m

Fig. 10. *Nautiloculina oolithica* Mohler, sub-axial section, Korolyn 6, depth 2590.0 m
Nautiloculina oolithica Mohler, przekrój niemal osiowy, Korolyn 6, głębokość 2590,0 m

Fig. 11. *Spirillina elongata* Bielecka & Pożaryski, axial section, Bortiatin 1, depth 2290.0 m
Spirillina elongata Bielecka & Pożaryski, przekrój osiowy, Bortiatin 1, głębokość 2290,0 m

Fig. 12. *Sievoides kocyigiti* Farinacci & Ekmeci, longitudinal section, Bortiatin 1, depth 1920.0 m
Sievoides kocyigiti Farinacci & Ekmeci, przekrój podłużny, Bortiatin 1, głębokość 1920,0 m



Barbara Olszewska, Jacek Matyszkiewicz, Katarzyna Król, Marcin Krajewski — Correlation of the Upper Jurassic–Cretaceous epicontinental sediments in southern Poland and southwestern Ukraine based on thin sections

PLATE XV

Microfossils from the Ukrainian part of the Carpathian Foredeep – Kimmeridgian, continued

Mikroskamieniałości ukraińskiej części zapadliska przedkarpackiego – kimeryd, cd.

Fig. 1. *Textularia depravatiformis* Bielecka & Kuznetsova, longitudinal section, Voloscha 1, depth 2255.0 m
Textularia depravatiformis Bielecka & Kuznetsova, przekrój podłużny, Voloscha 1, głębokość 2255,0 m

Fig. 2. *Neokilianina rahonensis* (Foury & Vincent), subaxial section, Lanivka 1, depth 1950.0–1956.0 m
Neokilianina rahonensis (Foury & Vincent), przekrój niemal osiowy, Lanivka 1, głębokość 1950,0–1956,0 m

Fig. 3. *Carpistomiosphaera borzai* (Nagy), Korolyn 6, depth 2590.0 m
Carpistomiosphaera borzai (Nagy), Korolyn 6, głębokość 2590,0 m

Fig. 4. *Colomisphaera nagyi* (Borza), Korolyn 6, depth 2616.0 m
Colomisphaera nagyi (Borza), Korolyn 6, głębokość 2616,0 m

Fig. 5. *Colomisphaera pieniniensis* (Borza), Korolyn 6, depth 2755.0 m
Colomisphaera pieniniensis (Borza), Korolyn 6, głębokość 2755,0 m

Figs. 6, 7. Fragments of secundibranchia of planktonic crinoids *Saccocoma*, Podil'tsi 1, depth 2550.0–2560.0 m
Fragmenty secundibranchiów planktonicznych liliowców z rodzaju *Saccocoma*, Podil'tsi 1, głębokość 2550,0–2560,0 m

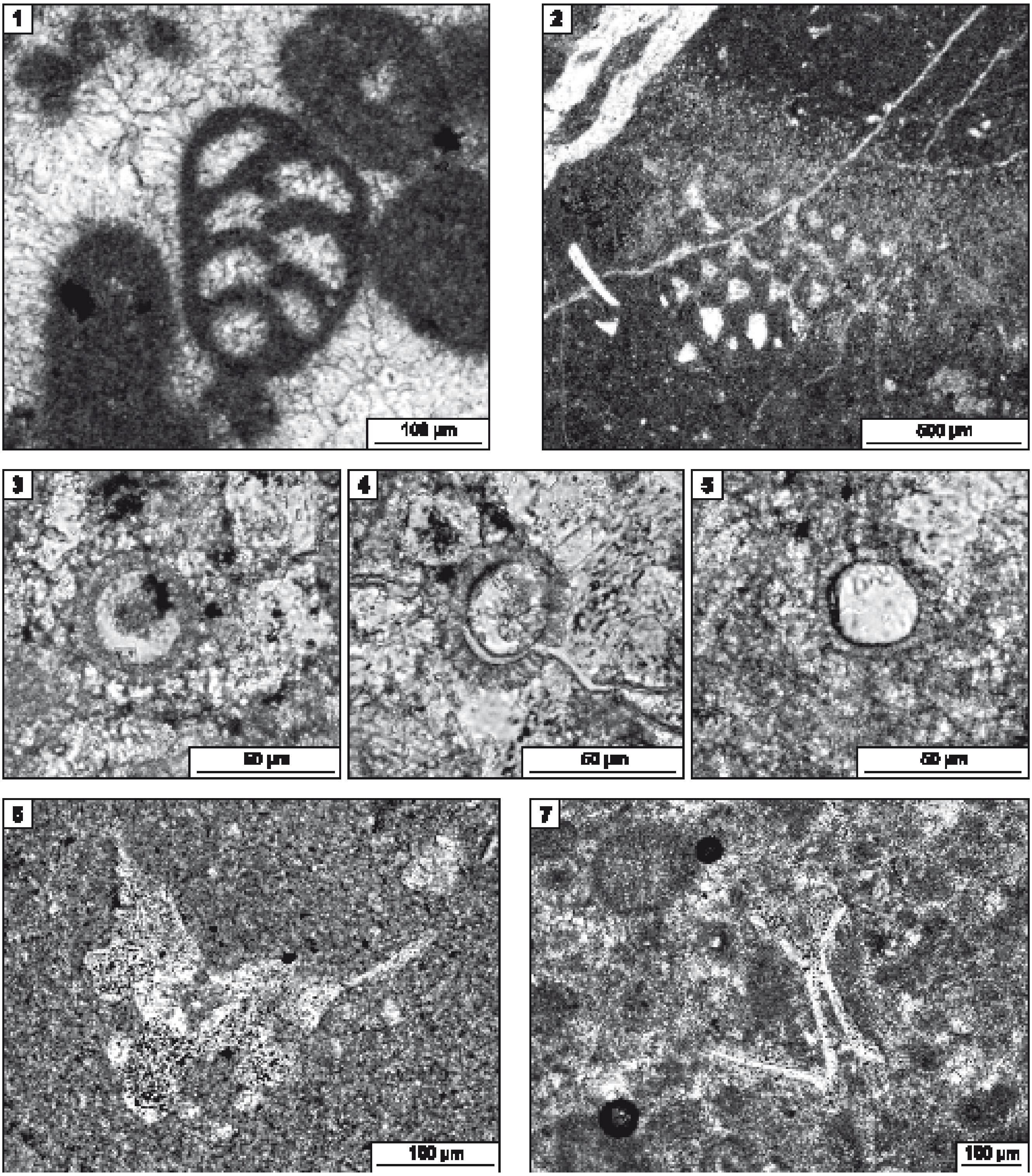

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PLATE XVI

Foraminifera from the Ukrainian part of the Carpathian Foredeep – Oxfordian

Otwornice ukraińskiej części zapadliska przedkarpackiego – oksford

Fig. 1. *Cornuspira eichbergensis* Kübler & Zwingli, Podil'tsi 1, axial section, Podil'tsi 1, depth 2908.0–2915.0 m
Cornuspira eichbergensis Kübler & Zwingli, Podil'tsi 1, przekrój osiowy, Podil'tsi 1, głębokość 2908,0–2915,0 m

Fig. 2. *Crescentiella morronensis* (Crescenti), oblique section, Korolyn 6, depth 3021.0 m
Crescentiella morronensis (Crescenti), przekrój skośny, Korolyn 6, głębokość 3021,0 m

Fig. 3. *Eomarssonella paraconica* Levina, longitudinal section, Podil'tsi 1, depth 2908.0–2915.0 m
Eomarssonella paraconica Levina, przekrój podłużny, Podil'tsi 1, głębokość 2908,0–2915,0 m

Fig. 4. *Globuligerina oxfordiana* Grigelis, oblique section, Moryantsi 1, depth 3055.0–3067.0 m
Globuligerina oxfordiana Grigelis, przekrój skośny, Moryantsi 1, głębokość 3055,0–3067,0 m

Fig. 5. *Mohlerina basiliensis* (Mohler), axial section, Korolyn 6, depth 3021.0 m
Mohlerina basiliensis (Mohler), przekrój osiowy, Korolyn 6, głębokość 3021,0 m

Fig. 6. *Nautiloculina* cf. *circularis* (Said & Bakarat), axial section, Korolyn 6, depth 3021.0 m
Nautiloculina cf. *circularis* (Said & Bakarat), przekrój osiowy, Korolyn 6, głębokość 3021,0 m

Fig. 7. *Opthalmidium oxfordianum* (Deecke), longitudinal section, Podil'tsi 1, depth 2903.0–2908.0 m
Opthalmidium oxfordianum (Deecke), przekrój podłużny, Podil'tsi 1, głębokość 2903,0–2908,0 m

Fig. 8. *Ophthalmidium strumosum* (Gümbel), transverse section, Moryantsi 1, depth 3055.0–3067.0 m
Ophthalmidium strumosum (Gümbel), przekrój poprzeczny, Moryantsi 1, głębokość 3055,0–3067,0 m

Fig. 9. *Paalzowella turbinella* (Gümbel), axial section, Korolyn 6, depth 3021.0 m
Paalzowella turbinella (Gümbel), przekrój osiowy, Korolyn 6, głębokość 3021,0 m

Fig. 10. *Paleogaudryina varsoviensis* (Bielecka & Pożaryski), longitudinal section, Bortiatin 1, depth 2490.0 m
Paleogaudryina varsoviensis (Bielecka & Pożaryski), przekrój podłużny, Bortiatin 1, głębokość 2490,0 m

Fig.11. *Protomarssonella jurassica* (Mityanina), longitudinal section, Bortiatin 1 depth 2490.0 m
Protomarssonella jurassica (Mityanina), przekrój podłużny, Bortiatin 1 głębokość 2490,0 m

Fig. 12. *Opthalmidium pseudocarinatum* (Dain), transverse section, Moryantsi 1, depth 3055.0 m
Opthalmidium pseudocarinatum (Dain), przekrój poprzeczny, Moryantsi 1, głębokość 3055,0 m

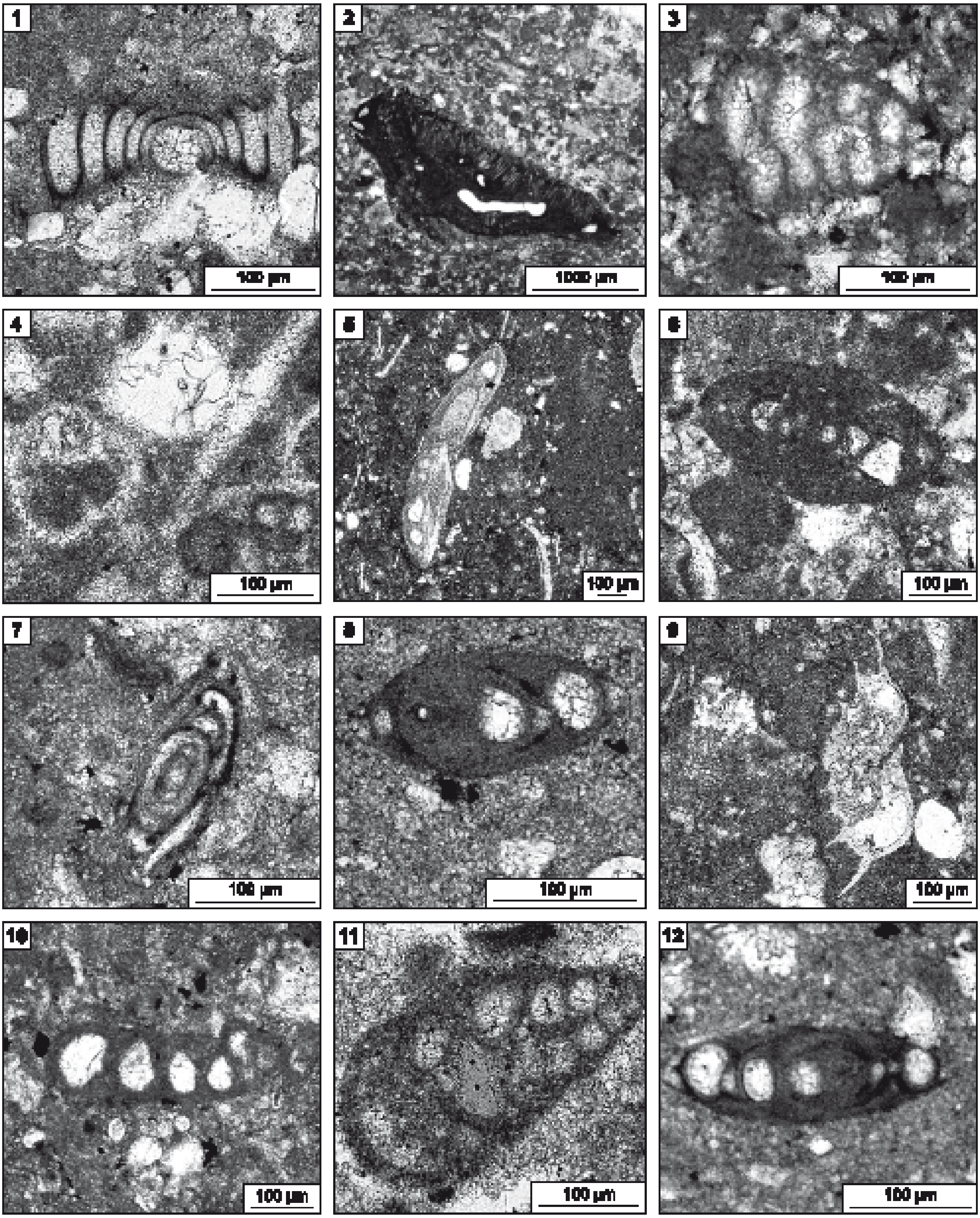
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PLATE XVII

Microfossils from the Ukrainian part of the Carpathian Foredeep – Oxfordian, continued

Mikroskamieniałości ukraińskiej częsci zapadliska przedkarpackiego – oksford, cd.

Fig. 1. *Quinqueloculina semisphaeroidalis* (Dain), axial section, Podil'tsi 1, depth 3001.0–3012.0 m
Quinqueloculina semisphaeroidalis (Dain), przekrój osiowy, Podil'tsi 1, głębokość 3001,0–3012,0 m

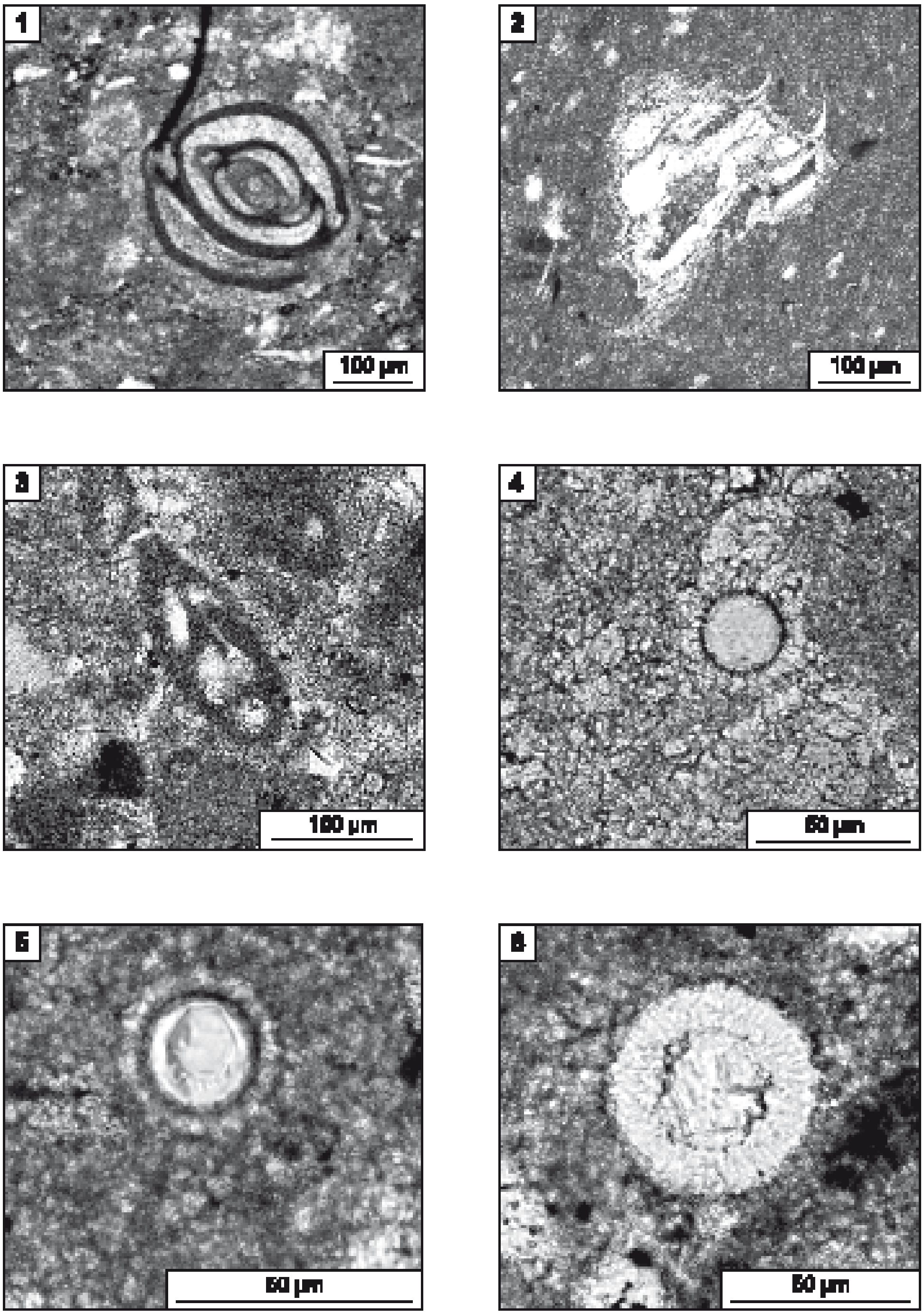
Fig. 2. *Rumanolina seiboldi* (Lutze), axial section, Bortiatin 1, depth 2455.0 m
Rumanolina seiboldi (Lutze), przekrój osiowy, Bortiatin 1, głębokość 2455,0 m

Fig. 3. *Uvigerinammina uvigeriniformis* (Seibold & Seibold), longitudinal section, Podil'tsi 1, depth 23903.0–2908.0 m
Uvigerinammina uvigeriniformis (Seibold & Seibold), przekrój podłużny, Podil'tsi 1, głębokość 23903,0–2908,0 m

Fig. 4. *Colomisphaera lapidosa* (Vogler), Podil'tsi 1, depth 3001.9–3012.0 m
Colomisphaera lapidosa (Vogler), Podil'tsi 1, głębokość 3001,9–3012,0 m

Fig. 5. *Comittosphaera czestochowiensis* Řehanek, Moryantsi 1, depth 3055.0–3067.0 m
Comittosphaera czestochowiensis Řehanek, Moryantsi 1, głębokość 3055,0–3067,0 m

Fig. 6. *Orthopithonella gustafsonii* (Bolli), Yuryiv 1, depth 1990.0 m
Orthopithonella gustafsonii (Bolli), Yuryiv 1, głębokość 1990,0 m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