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Post-Tremadoc Ordovician sediments of the Polish-Ukrainian boundary

Basing on borehole data post-Tremadoc deposits of the Ordovician in the Polish-Ukrainian boundary area are characterized. Given are their actual distribution in the Lublin Upland, Volhynia and Podolia. Litho- and biostratigraphy as well as the correlation of these deposits are presented.

INTRODUCTION

In 1991, close cooperation began between the Polish Geological Institute and the Rovne Geological Expedition in a study of the geological structure of the Lublin Upland in Poland and southwestern Ukraine (Z. Modliński, A. M. Żelichowski, 1993).

Within the framework of this cooperation, the results of the newest stratigraphic research, borehole data, and comparative samples for lithologic and micropalaeontological studies have been exchanged. This has allowed closer correlation of coeval Palaeozoic sediments.

The present paper offers the results of studies of the post-Tremadoc sediments encountered in profiles of several dozen boreholes (Fig. 1). A dozen or so of them are boreholes of the Polish Geological Institute and the Oil Industry of Poland executed in the Lublin region. The others (over 20 of them) were pierced in Podolia and Volhynia during deep geological mapping in the Luboml, Kovel, Novovolynsk and other sheets as well as during hydrogeological work.

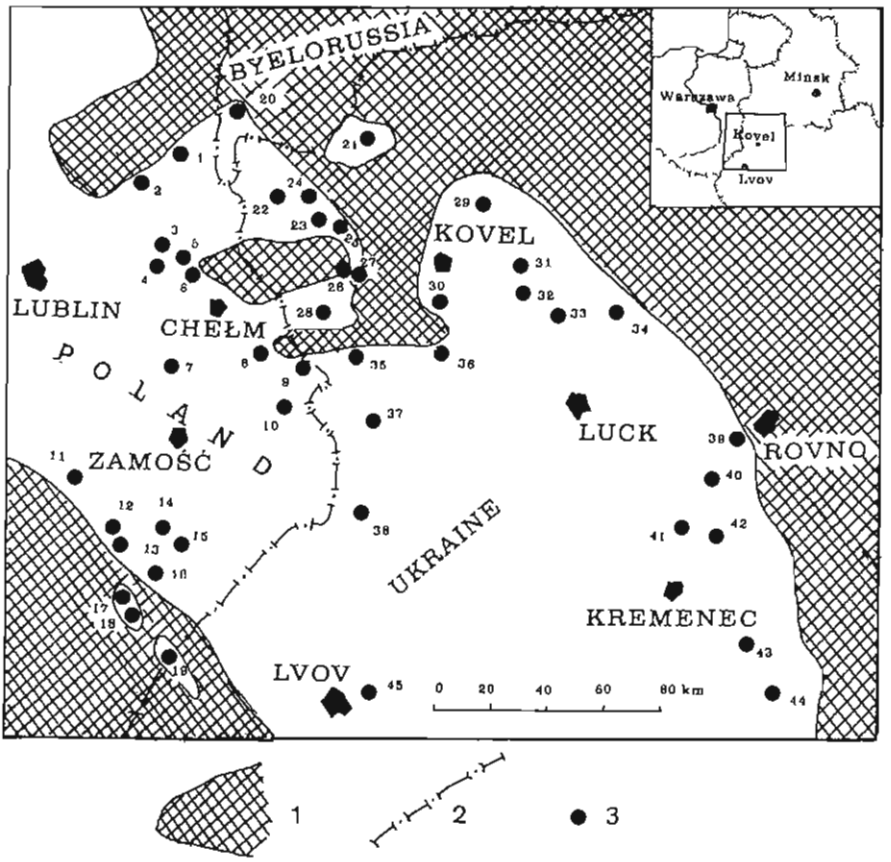

Fig. 1. Location map of the investigated area

1 — area devoid of Ordovician deposits; 2 — state boundaries; 3 — boreholes that reached Ordovician deposits (*1* — Kaplonosy IG 1, *2* — Krowie Bagno IG 1, *3* — Bachus 1, *4* — Busówno IG 1, *5* — Wierzbica 1, *6* — Niwa 1, *7* — Łopiennik IG 1, *8* — Białopole IG 1, *9* — Horodło 1, *10* — Terebin IG 5, *11* — Dyle IG 1, *12* — Kozaki 1, *13* — Osuchy 1, *14* — Narol PIG 2, *15* — Narol IG 1, *16* — Doliny 1, *17* — Uszkowce 4, *18* — Uszkowce 1, *19* — Lubaczów 14, *20* — 1873 (Charsy), *21* — 5510, *22* — 5509, *23* — 5504, *24* — 5711 (Hołovno), *25* — 5438 (Chvorostov), *26* — 5433, *27* — 5368, *28* — 5411, *29* — 1752, *30* — 5416, *31* — 6602, *32* — 6610, *33* — 6606, *34* — 1437, *35* — 5399, *36* — 3429, *37* — Litowież 1, *38* — Wielkie Mosty 30, *39* — 1511, *40* — 13GF (Żomov), *41* — 9GD (Nosovica), *42* — 1513, *43* — 3365, *44* — 3641, *45* — Dublany 4)

Szkic lokalizacji obszaru badań

1 — obszar pozbawiony osadów ordowiku; 2 — granice państw; 3 — otwory wiertnicze osiągające osady ordowiku (patrz tekst angielski)

STRATIGRAPHY

ARENIG

The carbonate-clayey deposition of Ordovician sediments in the study area begins with the Arenig. They rest on a washed out surface of various Cambrian and Tremadoc levels.

The most complete and palaeontologically best documented profiles of the Arenig have been encountered in the southern part of the Lublin area near Biłgoraj and Narol PIG 2. They begin with transgressive glauconitite or claystone full of glauconite from 0.1 up to several metres thick in the Kozaki 1 borehole. Higher up there are laminated claystones consisting of black laminae with abundant organic substance and grey-greenish ones almost devoid of organic substance.

Abundant and diverse graptolites allowed distinction of four graptolite zones in the Latorp: *Tetragraptus phyllograptoides, Didymograptus balticus, Phyllograptus densus* and *P. angustifolius elongatus*, and in the Volkhov — the *Didymograptus hirundo* Zone. Total thickness of the Arenig deposits in the area is 20–85 m.

In the remaining part of the Lublin region (Fig. 1) the Arenig embraces the lowermost part of the Uherka Limestone Formation consisting of glauconitic-conglomeratic sediments and the overlying carbonates (Z. Modliński, 1984). The glaukonitic-conglomeratic sediments consist of weakly rounded fragments of silty-arenaceous rocks, sandstones with phosphatic cement, claystones, black phosphatic rocks and glauconite grains (A. Langier-Kuźniarowa, 1977). The cement is calcareous, recrystallized, and enriched in phosphatic substance.

Higher up, in the Lower and Upper Arenig there are dolomitic and marly limestones containing interbeds with numerous bioclasts (mainly trilobites, brachiopods and echinoderms) and admixture of glauconite grains. There are numerous clayey striae and many nonconformities. The rocks are reddish-brown, grey to dark grey in colour. Not very abundant macrofauna, mainly index trilobites, document the age of these rocks: *Symphysurus angustatus* (Sars et Boeck), *S. dorsatus* Poulsen, *S. palpebrosus* (Dalman), *Megistaspis* sp. (Z. Modliński, 1984). The Arenig sediments are only 1.5–2.5 m thick.

In the conterminous Ukraine, the occurrence of Arenig deposits is limited to the western areas of Volhynia and Podolia. These are the lower part of the Smidyń Suite, comprising the lower subsuite and a part of the upper subsuite (Fig. 1).

The Smidyń Subsuite (lower part) consists of green to dark green, poorly sorted quartz-glauconitic sandstones with clayey cement. There are thin (2–5 mm) inliers of grey to brownish claystones. There occur phosphatized fragments of brachiopod valves. The subsuite is 0.20–6.55 m thick in borehole 5438. The Lower Smidyń Subsuite is classified as Latorp on the basis of lithological and geophysical correlation to the analogous complex in borehole Nowosiełki 29 near Brest in Byelorussia. There, the age of these sediments has been documented by conodonts (S. A. Kruczek *fide* V. F. Ropot, V. N. Pushkin, 1987). D. M. Drygant correlates the above quartz-glauconitic sandstones with the Volkhov Stage (the Upper Arenig) on the basis of the same conodont assemblage.

The lower part of the Upper Smidyń Subsuite is represented by glauconitic limestones. The glauconite grains, 0.1–0.2 mm in diameter, frequently make microaggregates. Rounded, silt-size quartz grains and thin (0.5–2.0 cm), dark, marly interbeds are frequent. The limestones contain abundant fragments of large, straight cephalopod shells, trilobite carapaces and brachiopod valves. The conodonts found by P. D. Cegielniuk (1972) in borehole 5929, *Scolopodus rex* Lindström and *S. rex paltodiformis* Lindström, indicate Upper Arenig or Lower Llanvirn age for those sediments.

A better conodont assemblage has been found in the lower part of the Smidyń Subsuite in borehole 5711 (Hołovno) at a depth of 237.65 m by M. Nehring-Lefeld. The conodonts

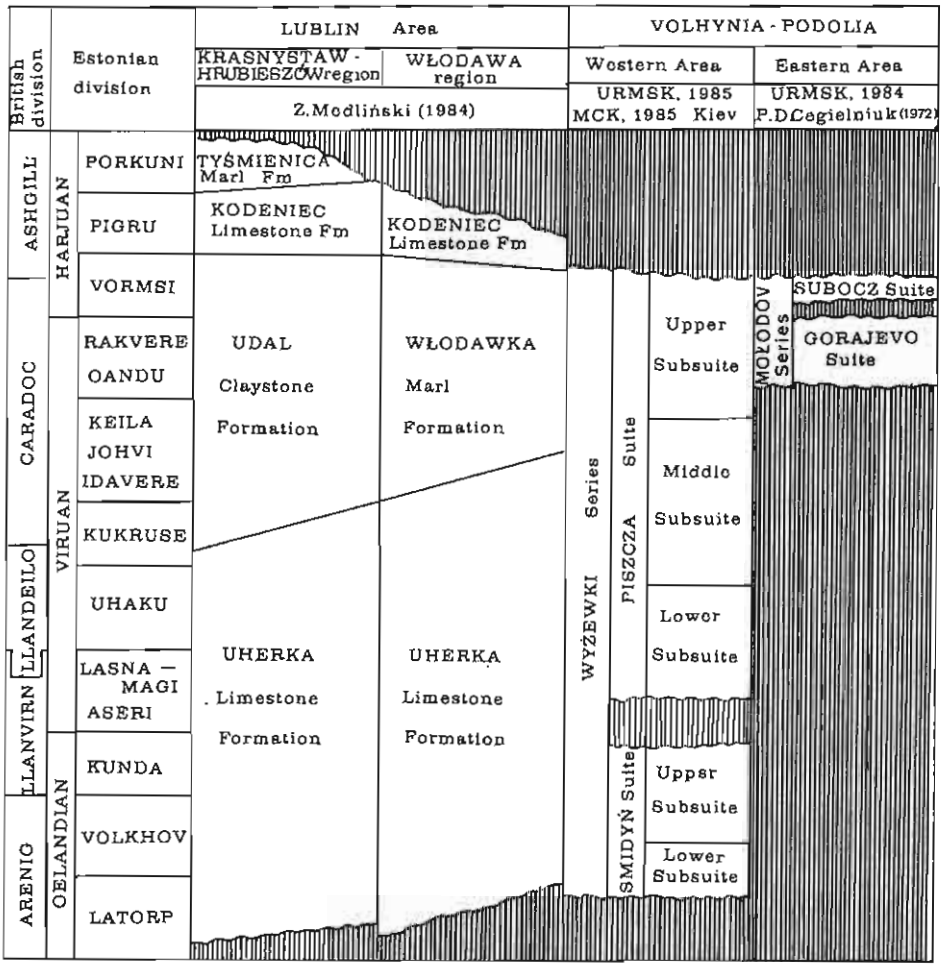

Fig. 2. Lithostratigraphic correlation of post-Tremadoc deposits in the boundary areas of Poland and Ukraine
Korelacja litostratygraficzna potremadockich osadów ordowiku pogranicznych obszarów Polski i Ukrainy

found there are: *Drepanoistodus basiovalis* (Sergeeva), *Cornuodus longibasis* (Lindström), *Ambalodus planus* Sergeeva s. f., *Prioniodus (Baltoniodus) prevariabilis* Fahraeus s. f. and *Amorphognathus* sp. indet.

The stratigraphic range of *Ambalodus planus* Sergeeva s. f. is confined to the upper part of Volkhov and Kunda Stages (V. Viira, 1974). The appearance of *Prioniodus (Baltoniodus) prevariabilis* Fahraeus s. f. also points to an age at least Middle Arenig (not older) (Middle Volkhov) (M. Lindström, 1971; A. Löfgren, 1978). Thus, the presence of the above taxa suggests that the lower part of the Smidyń Subsuite may correlate with the Upper Arenig or Lower Llanvirn.

Total thickness of the Arenig deposits in the western areas of Volhynia and Podolia is only several metres, but the eastern areas are primarily devoid of sediments of that age.

LLANVIRN

In the northern and eastern parts of the Lublin Upland the Llanvirn is represented by the middle part of the Uherka Limestone Formation (Z. Modliński, 1984). These are organodetrital limestones which in places (borehole Terebin IG 5) contain numerous brown, ferruginous oolites. There are also some thin clayey inliers and interbeds of intraformational conglomerates as well as abundant unconformities. The rock colour varies from grey (borehole Łopiennik IG 1) to brown, pink and cherry red (borehole Terebin IG 5). Conodonts identified by M. Nehring-Lefeld in the Łopiennik IG 1 profile (at bottom — *Drepanoistodus basiovalis* (Sergeeva), *Protopanderodus rectus* (Lindström), and at top — *Eoplacognathus* sp. indet. Hamar, *Polyplacognathus* sp. indet. Stauffer together with *Prioniodus* (*Baltoniodus*) *prevariabilis prevariabilis* Fahraeus document Lower and Upper Llanvirn. Macrofossils are of lesser importance: *Megistaspis* sp., *Illaenus* sp., *Nileus* sp., *N. armadillo* Dalman etc. (Z. Modliński, 1984). These are relatively long-ranged genera and species that give no grounds for precise age determination. These sediments are about 4 up to 8 m thick.

In the southern part of the Lublin Upland there is strong reduction in thickness of the Llanvirn deposits (e.g. the Narol IG 1 and PIG 2 boreholes) and in some profiles (Dyle IG 1, Kozaki 1) these deposits are absent. Determinable fragments of macrofossils are scarce but the Llanvirn age has been established on the basis of conodonts: *Prioniodus* (*Baltoniodus*) *prevariabilis* Fahraeus, *Drepanoistodus basiovalis* (Sergeeva), *Cornuodus longibasis* (Lindström) and *Drepanodus arcuatus* Pander. The typical Llanvirn conodont *Eoplacognathus* Hamar has been found as well. State of preservation makes specific determination impossible, nevertheless the presence of this genus proves that the sediments cannot be older than lowermost Llanvirn.

In Volhynia and Podolia, the occurrence of the Llanvirn and Arenig sediments is limited to the western areas. This is the upper part of the Smidyń Subsuite (Upper) and lower part of the Lower Piszcza Subsuite (Fig. 1).

The Upper Smidyń Subsuite is developed as variegated organodetrital, dolomitized limestones and massive, fine cavernous dolomites. Common are ferruginous coneentrations irregularly dispersed. Characteristic are also numerous hydrogoethite pseudooolites. Macrofossils are badly preserved as a result of dolomitization and iron content. There are brachiopods: *Orthambonites* sp., *O.* cf. *callactis* (Dalman) and *Lycophoria globosa* (Eichwald).

The top of these sediments at the contact with the Piszcza Suite is evidently washed out. This can be observed in borehole 5429 in whieh the top part of the Smidyń Suite is eroded and the underlying sediments were subject to intensive weathering. The wash out is associated with short-lasting marine regression and a sedimentary gap.

The most complete profile of the Piszcza Suite has been found in borehole 5438 (Chvorostov). The lower part of this profile consists of massive, grey organodetrital limestones with white ooids. The latter are best observed at contacts with thin dark grey

marl and claystone interbeds. Nodular texture occurs in limestone that shows frequent claystone inliers.

Stratigraphic position of the Piszcza Subsuite (lower part) has been determined on the basis of correlation with facies of analogous sediments in the Brest Depression (G. V. Zinovenko, 1968). The latter contain brachiopods, conodonts and bryozoans. The lower part of the Piszcza Subsuite is 0.2–5.5 m thick.

LLANDEILO

The Llandeilo deposits developed in graptolite facies are to be found in the southern part of the Lublin Upland near Biłgoraj and Narol. These are dark grey claystones which are frequently limy with marly limestone interbeds. Abundant graptolites of *Glyptograptus teretiusculus* Zone have been encountered there. Also present is the very characteristic *Gymnograptus linnarssoni* Tullberg, the vertical range of which is limited to Llandeilo only. These deposits are 3.5 m thick in boreholes Narol IG 1 and PIG 2 up to over 50 m at Dyle IG 1.

In the remaining part of this area Llandeilo is represented by the upper part of the Uherka Limestone Formation embracing a member of recrystallized organodetrital limestones formed of bioclasts of trilobites, echinoderms and bryozoans. The rocks are grey to brownish-grey in colour. There are some clayey and marly-clayey interbeds, grey to almost black, and in the lower part of the profile also brown ferruginous oolites. Sedimentary discontinuities are observed sporadically. Among graptolites, the most important is *Glyptograptus teretiusculus* Hisinger. Palaeontologic documentation is very good due to conodonts — primarily *Amorphognathus inaequalis* Rhodes, which is associated with Llandeilo only. The range of this species corresponds to the *inaequalis* Subzone and to the lowermost part of the *variabilis* Subzone. The latter is correlated with the lowermost Caradoc. In concurrence with the above index taxon, the subspecies *Prioniodus* (*Baltoniodus*) *prevariabilis prevariabilis* Fahracus, the range of which ends slightly above the lower Llandeilo boundary (S. M. Bergström, M. J. Orchard, 1985), shows that these sediments should be correlated with the Llandeilo. The series is 2 up to 7 m thick.

In Volhynia and Podolia, the Llandeilo is known from western areas only and where it embraces the uppermost part of the above mentioned Piszcza Subsuite (Lower) and the lower part of the Middle Piszcza Subsuite. The last mentioned member is composed of massive, grey limestones with marly interbeds. Lithologically the boundary between these two subsuites is indistinct but is clearly noted on geophysical drilling logs. A strong increase of gamma radiation is observable: 4–6 μR per hour in sediments of the lower subsuite and up to over 10 μR per hour in the upper subsuite. The deposits are only a few metres thick there.

CARADOC

In the southern part of the Lublin Upland near Biłgoraj and Narol, there occur dark grey and black clayey sediments with subordinate limestone interbeds. Graptolites are abundant. On the basis of this fauna, the following biostratigraphic zones have been shown, there:

Nemagraptus gracilis, *Diplograptus molestus-Climacograptus wilsoni*, *Dicranograptus clingani* and *Climacograptus styloideus*. These sediments are about 120 up to 200 m thick.

Near Krasnystaw and Hrubieszów the lowermost Caradoc, coeval with Kukruse Stage, is still carbonaceous. It corresponds to the uppermost part of the Uherka Limestone Formation which contains cystoid fauna with *Echinosphaerites* as well as brachiopods *Nicolella* sp. and *N.* cf. *alliku* Oraspyld. The remaining part of the Caradoc is represented by Udal Claystone Formation (Z. Modliński, 1984). These are somewhat silty claystone, dark grey, grey and greenish-grey in colour with some limestone and marly inliers. Scarce graptolites are as follows: *Diplograptus* cf. *molestus* Thorslund, *Dicranograptus clingani* Carruthers, *Amplexograptus vasae* Tullberg, *Climacograptus diplicanthus* Bulman and *Orthograptus* cf. *truncatus* Lapworth as well as a brachiopod assemblage. The above fossils document Lower and Upper Caradoc.

In the northeastern part of the Lublin Upland near Włodawa, clayey sediments are replaced by marly ones of the Włodawka Marl Formation. The rocks are grey to greenish-grey marls with interbeds of organodetrital and marly limestones. They contain trilobites *Chasmops macrourus* (Sjögren), *Ch. wesenbergensis* Schmidt and others as well as brachiopods. The Caradoc sediments are about 30 up to 60 m thick.

In Western Ukraine Caradoc deposits are known both from the western and eastern areas in Volhynia and Podolia.

In the west, the Caradoc embraces the upper part of the Middle Piszcza Subsuite and the Upper Piszcza Subsuite. In the Middle Piszcza Subsuite P. D. Cegielniuk identified the following brachiopods: *Cyrtonotella* sp., *C. kukersiana* (Wysogórski), *Howellites* sp., *H. wesenbergensis* (Alichova), *H.* cf. *vilniusensis* (Alichova), *Leptelloidea leptelloides* (Bekker) and *Cliftonia dorsata* (Bekker). This part of the profile corresponds to the Kukruse and Keila Stages in the Baltic Ordovician.

The Upper Piszcza Subsuite, which represents Upper Caradoc, contains greenish-grey marls with limestone interbeds. In some profiles in its lowermost part, gravelly quartz admixture appears. In the profile of borehole 1873 (Charsy), P. D. Cegielniuk has found the following brachiopods: *Shampo* cf. *hiiunensis* Öpik, *Boreadorthis crassa* Öpik, *Nicolella* aff. *oswaldi* (Buch), *Howellites wesenbergensis* (Alichova) and *Onniella longa* Hints. These fossils show that the deposits correspond to the Oandu-Rakvere-Nabala-Vormsi Stages of the Baltic Ordovician, i.e. Upper Caradoc and possibly to the lowermost Ashgill.

In the eastern areas of Volhynia and Podolia the Molodov series belongs to the Caradoc. It embraces the Gorajevo and Subocz Suites (P. D. Cegielniuk, 1972).

The Gorajevo Suite is widespread in eastern Volhynia and Podolia. It rests on Lower Cambrian sandstones and siltstones. Lithology is diversified. In its lowermost part there are poorly sorted sandstones passing into gravelstones with well rounded quartz pebbles and grains as well as siliceous rocks. In some cases, fine glauconite grains are encountered as well as phosphorite concretions. Higher up in the profile there are fine- to medium-grained sandstones with siliceous and siliceous-carbonate cement (sometimes with grey siltstone intercalations) and less frequently — limestones. In these sediments in borehole 13GF (Żornov), M. Nehring-Lefeld has found *Prioniodus* (*Baltoniodus*) *variabilis* Bergström the stratigraphic range of which is Llandeilo-lowermost Caradoc. In the conodont zonation the occurrence of this species is limited to *inaequalis-variabilis* Subzones (S. M. Bergström, M. J. Orchard, 1985). The associated *Panderodus gracilis* (Branson et Mehl) and *P.* sp.

indet. are known from the Middle Ordovician up to the Lower Devonian. A conodont found in borehole 9GD (depth 985.8 m) cannot be determined due to poor preservation state, nevertheless it seems probable that it belongs to *Proniodus* (*Baltoniodus*) *variabilis* Bergström as well.

The suite is 0.6–6.0 m thick, but it has been most probably reduced as a result of later erosion. In the majority of cases, the Gorajevo Suite is overlain by marls of the Furmanowa Suite of Silurian age, or less frequently by limestones of the Subocz Suite.

The Subocz Suite crops out in the central and southern parts of the eastern Volhynia and Podolia (e.g., boreholes 1511 and 9GD). It rests everywhere on terrigenous sediments of the Gorajevo Suite and is covered by the Lower Silurian marls. The age has been determined on the basis of conodonts found by M. Nehring-Lefeld in boreholes 6619/1 (depth 180.0 m). The taxa *Aulacognathus kuehni* Mostler and *A. ? latus* (Nicoll et Rexroad) point to Upper Llandovery. In the Silurian conodont zonation (O. H. Walliser, 1971) these species occur within the *celloni* Zone which makes up the lower part of the *Apsidognathus* conodont stage. *Aulacognathus kuehni* Mostler was never found in the upper part of *celloni* Zone (R. J. Aldridge, 1985).

They are accompanied by abundant: *Panderodus gracilis* (Branson et Mehl), *P. unicostatus* (Branson et Mehl) and *P. simplex* (Branson et Mehl). These taxa, however, are useless for stratigraphy as their range is very broad (Middle Ordovician-Lower Devonian).

The Subocz Suite consists of silicified, grey recrystallized limestones with frequent pyrite concentrations.

ASHGILL

Relatively complete Ashgill profiles embracing the Lower and Upper Ashgill are known from the southern part of the Lublin Upland near Biłgoraj and Narol, as well as from the northern part in the area of Krasnystaw – Hrubieszów.

The Lower Ashgill, which corresponds to the Pirgu Stage of the Baltic Ordovician, is widespread in the Lublin Upland. In the north it is the Kodeniec Limestone Formation, which is represented by organodetrital and marly limestones, with numerous bioclasts and marly interbeds in places. The rocks are grey, dark grey, pinkish-grey to reddish-brown in colour. In the south near Biłgoraj and Narol these are limy claystones with marly limestone interbeds and marls. The age of these sediments is documented by trilobites: *Nankinolithus granulata* (Wahlenberg), *Panderia megalophthalma* Linnarsson, *Liocnemis recurvus* (Linnarsson) and other forms. The above mentioned species are from the Lower Ashgill of the Holy Cross Mts. (Z. Kielan, 1959) and of northeastern Poland (Z. Modliński, 1973) and from other areas of the Baltic-Scandinavian province (R. M. Männil, 1966).

The Upper Ashgill in borehole Łopiennik IG 1 localized near Krasnystaw is represented by the Tyśmienica Marl Formation, i.e., by dark grey marls with lenses of compact, recrystallized marly limestones. Farther south near Narol there occur dark grey somewhat greenish claystones, in part marly with irregular laminae, lenses and interbeds of silty-sandy claystones (somewhat limy) as well as poorly sorted silty sandstones. The clastic material consists of quartz grains (up to 1.5 mm in diameter) feldspars, biotite and muscovite (A. Langier-Kuźniarowa, 1993). The age has been determined by *Mucronaspis mucronata*

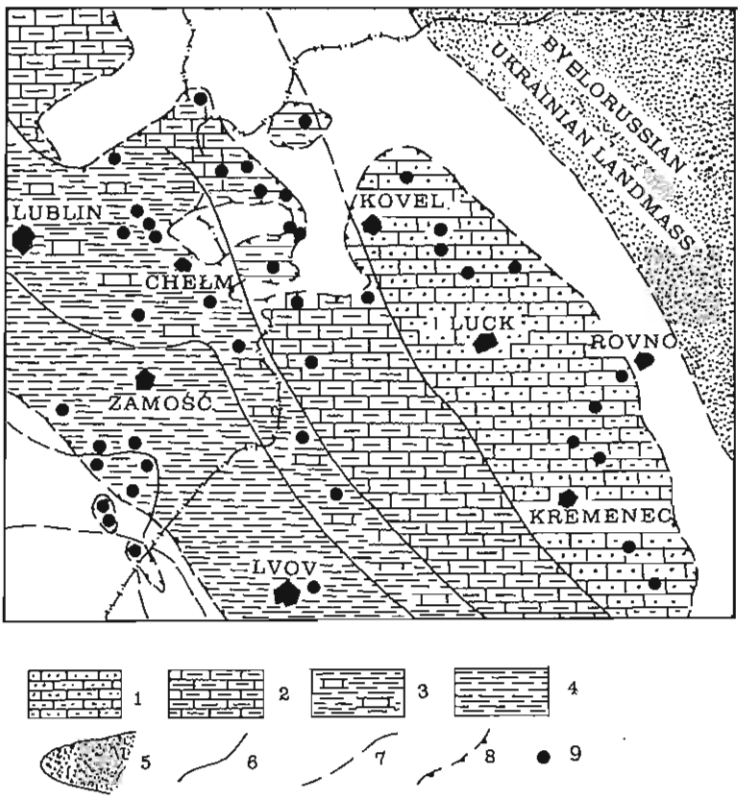

Fig. 3. Sketch-map of lithofacies pattern of the post-Tremadoc deposits in the Polish-Ukrainian boundary area
1 — arenaceous-carbonate sediments, 2 — marly-carbonate sediments, 3 — clayey-carbonate sediments, 4 — silty-clayey sediments, 5 — land area, 6 — lithofacies boundaries, 7 — reconstructed lithofacies boundaries, 8 — present-day extent of the sediments, 9 — boreholes that reached Ordovician sediments
Szkic rozmieszczenia litofacji potremadockich osadów ordowiku na pograniczu Polski i Ukrainy
1 — osady piaszczysto-wapienne, 2 — osady węglanowo-margliste, 3 — osady ilasto-węglanowe, 4 — osady ilasto-mułowcowe, 5 — obszar lądowy, 6 — granice litofacji, 7 — zrekonstruowane granice litofacji, 8 — obecna granica rozprzestrzenienia osadów, 9 — otwory wiertnicze osiągające osady ordowiku

(Brongniart), *Platymena* (?) *polonica* Temple, *Eostropheodonta* sp., which are the fossils found in boreholes Łopiennik IG 1 and Narol IG 1.

Total thickness of the Ashgill deposits is about 20–25 m near Krasnystaw and Narol but quickly diminishes eastward as a result of primary wedging out and partial removal by early-epigenetic pre-Silurian erosion. In the nearby Ukraine there are no Ashgill sediments at all or only the uppermost part of the Upper Piszcza Subsuite which is of small thickness.

Sediments of that age crop out probably in more southerly areas of Ukraine. In the Peremyshlany borehole, located SE of Lvov, a bed of dark grey compact limestone containing conodonts has been pierced. D. M. Drygant has identified *Amorphognathus ordovicicus* Branson et Mehl, which points to Ashgill.

OUTLINE OF LITHOFACIES VARIABILITY

The area in question embraced the western slope of Byelorussia-Ukraine land area as well as the extremely southern part of the marine epicontinental, Baltic Basin, during the Ordovician (R. M. Männil, 1966) with passage to a deeper sea in the west (Z. Modliński, M. Nehring-Lefeld, 1994). A distinct zonality maybe noted in the distribution of sediments (Fig. 3). The lithofacies zones run almost NW–SE which seems to have been controlled to some extent by inclination of the Byelorussian-Ukrainian land surface and by depressions resulting from palaeotectonics associated with the Teisseyre-Tornquist zone that showed strong subsidence compensated by deposition.

The following zones can be traced from east to west (Fig. 3):

1. Thin arenaceous-carbonate sediments occur in the area between Kovel, Rovne and Kremenec on the slopes of the Byelorussia-Ukraine land area. According to Ukrainian geologists, this is the eastern zone of the Volhynia-Podolia facies structural zone (B. J. Volovnik, 1989) which embraces the Caradoc-lowermost Ashgill only (?) (the Gorajevo and Subocz Suites).

In the Baltic Basin, coarse- and medium-grained sediments (thus littoral) are rare (R. M. Männil, 1966). It is generally accepted that in the majority of cases the carbonate facies existed almost up to the very coast or were separated from it by zero accumulation. This may be explained by extremely low relief of that land and lack of denudation.

2. Farther west in the zone between Kaplonosy – Litowież and farther southeast there occur marly-carbonate sediments that were laid down in the shallow part of the basin within the zone of wave action and bottom currents (Z. Modliński, 1984). Here, bioclastic and biogenic material dominates with admixture of the finest terrigenous fraction.

3. A zone of clayey-carbonate sediments laid down beneath the wave action zone stretches from Lublin – Chełm – Wielkie Mosty southeastward. The sediments consist of finest clastic and micritic material of basinal origin.

Farther west within the zone stretching from Biłgoraj – Narol and Lvov there occur dark clayey-silty sediments which seem to represent deep-neritic or even deeper basinal conditions.

Translated by Jerzy Lefeld

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POTREMADOCKIE OSADY ORDOWIKU POGRANICZA POLSKI I UKRAINY

S t r e s z c z e n i e

Sedymentację węglanowo-ilastych osadów ordowiku rozpoczynają osady a r e n i g u . Najpełniejsze jego profile zostały stwierdzone w południowej części Lubelszczyzny, w rejonie Biłgoraja – Narola. Rozpoczynają się one warstwą transgresywną z licznym glaukonitem, powyżej której występują osady ilaste z graptolitami poziomów od *Tetragraptus phyllograptoides* po *Didymograptus hirundo*. Na pozostałej części Lubelszczyzny arenig obejmuje najniższą część formacji wapieni Uherki, zawierającą przewodnie trylobity (fig. 2). Na pograniczny terenie Ukrainy występowanie arenigu ograniczone jest do zachodniego Wołynia i Podola i obejmuje

niższą część *swity* (formacji) smidyńskiej, reprezentowaną przez piaskowce kwarcowo-glaukonitowe oraz wapienie glaukonitowe z konodontami.

Lanwirn w północnej i wschodniej Lubelszczyźnie reprezentowany jest przez środkową część formacji wapieni Uherki wykształconą w postaci wapieni organodetrytycznych z przewodnimi konodontami oraz niezbyt licznymi trylobitami. Na Wołyniu i Podolu osady tego wieku występują jedynie w zachodnich obszarach i obejmują wyższą część *podswity* (ogniwa) smidyńskiej górnej oraz niższą część *podswity* piszczańskiej dolnej. Są to głównie wapienie organodetrytyczne i dolomityczne z brachiopodami i konodontami.

Landeil w rejonie Biłgoraja i Narola wykształcony jest w postaci osadów iłastych z graptolitami, wśród których stwierdzono m.in. charakterystyczny gatunek *Gymnograptus linnarssoni* Tullberg. Na pozostałej Lubelszczyźnie występują wapienie organodetrytyczne (wyższa część formacji wapieni Uherki) z graptolitami i konodontami. Na Wołyniu i Podolu landeil znany jest jedynie z zachodnich obszarów i obejmuje środkową część *swity* piszczańskiej zbudowanej z masywnych, szarych wapieni.

W karadoku w rejonie Biłgoraja i Narola notowane są ciemnoszare osady iłaste z graptolitami poziomów od *Nemagraptus gracilis* po *Climacograptus styloideus*. Również w rejonie Krasnegostawu i Hrubieszowa występują osady iłaste formacji iłowców z Udala, które dopiero na NE w rejonie Włodawy zastąpione są przez osady margliste z trylobitami z rodzaju *Chasmops* i brachiopodami (formacja margli Włodawki). W Zachodniej Ukrainie karadok znany jest zarówno z zachodnich, jak i wschodnich obszarów Wołynia i Podola. Na zachodzie obejmuje on wyższą część *swity* piszczańskiej, zbudowanej z wapieni przechodzących ku górze w margle, z licznymi brachiopodami, natomiast na wschodzie serię mołodowską, obejmującą *swity* gorajewską i suboczańską. Są to różnoziarniste osady piaszczyste przechodzące ku górze w wapienie. Wiek tych osadów został udokumentowany nielicznymi, słabo zachowanymi konodontami.

Dobrze udokumentowane osady aszgilu znane są jedynie z Lubelszczyzny. Aszgil dolny w rejonie Biłgoraja i Narola wykształcony jest w postaci osadów iłasto-marglistych, a w części północnej — wapieni (formacja wapieni z Kodeńca). Wiek tych osadów dokumentuje przewodni zespół trylobitów, zawierający m.in. *Nankinolithus granulata* (Wahlenberg). Występowanie aszgilu górnego ograniczone jest do południowo-zachodniej Lubelszczyzny i obejmuje formację margli Tyśmienicy, a w rejonie Narola osady iłaste i iłasto-wapniste. Wiek osadów jednoznacznie wyznacza przewodnia fauna *Mucronaspis mucronata* (Brongniart). Na pogranicznych obszarach Ukrainy prawdopodobnie brak jest osadów aszgilu lub należy do niego znikomej miąższości najwyższa część *swity* piszczańskiej. Pojawiają się one zapewne dopiero na południe od Lwowa (otwór Pieremyszlany).

Na omawianym obszarze w rozmieszczeniu litofacji osadów ordowickich obserwuje się bardzo wyraźną strefowość (fig. 3). Na skłonach lądu białorusko-ukraińskiego występują znikomej miąższości osady piaszczysto-węglanowe, przechodzące ku zachodowi w osady węglanowo-margliste, a następnie w iłasto-węglanowe aż po wyłącznie iłaste w strefie ciągnącej się od Biłgoraja poprzez Narol w kierunku Lwowa.