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CONODONTS FROM THE SEDIMENTS OF THE LOWER FAMENNIAN KUZMICH AND TONEZH HORIZONS OF THE PRIPYAT TROUGH (BELARUS)

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*The paper presents data on conodonts from the sediments of the Lower Famennian Kuzmichi and Tonezh horizons of the Pripyat Trough. Conodont assemblages with taxa typical for the zones of the Standard Conodont Scale are defined. The conodont assemblage from the sediments of the Kuzmichi horizon corresponds to the *Palmatolepis triangularis*, *Pa. delicatula platys* and *Pa. minuta minuta* zones; and that of the Tonezh horizon sediments corresponds to the *Pa. minuta minuta*, *Pa. crepida crepida* and *Pa. termini* zones [13]. The time of appearance of *Icriodus alternatus hemialternatus* Drygant 2010, *Polygnathus communis larysazimae* Drygant 2010, *P. delenitor* Drygant 1986 has been clarified. Paleogeographic reconstructions based on the biofacies analysis have been performed. Stratigraphic correlations of this part of the section with Volyn-Podolia, the central regions of the East European Platform and the Volgograd-Volga region were carried out.*

Keywords: conodonts, Upper Devonian, Lower Famennian, Belarus, Pripyat Trough, biostratigraphy, biozonation.

INTRODUCTION

The Pripyat Trough is located within the Russian plate of the East European platform, is a component of the Pripyat-Dnieper aulacogen (a part of the planetary system of the Saratian-Turanian lineament), is a sublatitudinally elongated, deeply submerged, and complexly composed graben [68].

According to the Stratigraphic Charts of the Devonian deposits of Belarus 2010, the Lower Famennian section includes (from bottom to top): Domanovichi horizon; Zadonsk superhorizon with Kuzmichi, Tonezh, Tremliya and Vishany horizons; Yelets superhorizon with Turov and Drozdov horizons; Petrikov horizon [51].

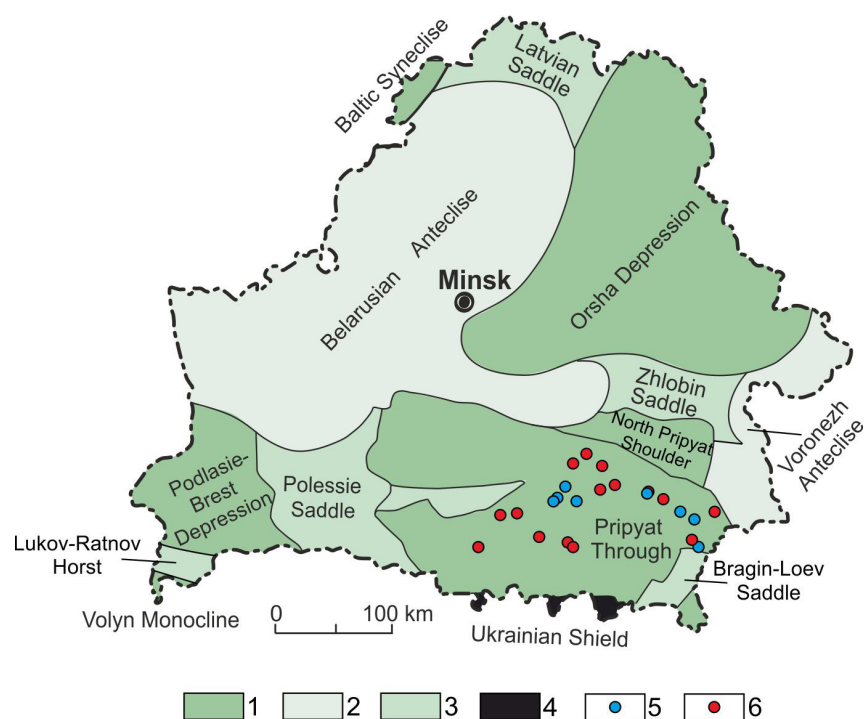
Lower Famennian sediments are distributed over almost the entire area of the Pripyat Trough, except of narrow areas of latitudinal extension in fault zones; they have significant thickness and a multi-facies appearance, and are the main oil-bearing complex of the trough.

The main groups of organic remains that allow detailed dissection of the Lower Famennian strata of the Pripyat Trough are miospores, brachiopods, ostracods and conodonts [64].

MATERIAL AND RESEARCH METHODS

Lower Famennian conodonts from the sediments of the Pripyat Trough were first found by S.A. Kruchek in the mid-1960s [55–57]. Further studies of conodont assemblages from this part of the section, carried out by T.V. Strelchenko [35; 66; 67], made it possible to expand their systematic composition and clarify their stratigraphic distribution. The revision of the conodont collection and the analysis of new factual material allowed the author to update the taxonomic composition, to correspond the identified conodont complexes with the zones of the Standard Conodont Scale 2017, to carry out additional stratigraphic correlations with remote sections, and to perform paleogeographic reconstructions based on biofacies analysis.

Conodonts from the sediments of the Kuzmichi horizon have been found in eight borehole sections, and from the Tonezh horizon – within 29 borehole sections of the Pripyat Trough (Figure 1). Samples were taken mainly from carbonate and clay-carbonate rocks (limestone, clayey limestone, marl, dolomites) and processed using standard methods with 10 % acetic acid. The collection is stored in the Institute of Geology, branch of the State Enterprise "Research and Production Center for Geology"; photos of the elements were taken using a Chongqing Optec SZ780 stereoscopic microscope.



1 – troughs, depressions, synclises; 2 – antecclises; 3 – saddles, uplifts, horsts; 4 – crystalline shield; 5 – boreholes with conodonts from the sediments of the Kuzmichi and Tonezh horizons; 6 – boreholes with conodonts from the sediments of the Tonezh horizon

Figure 1 – Location of boreholes in the Pripyat Trough, characterized by conodonts from the sediments of the Kuzmichi and Tonezh horizons

RESULTS AND DISCUSSION CONODONT COMPLEXES

The Kuzmichi sediments lie on the Domanovichi horizon rocks with different facies: clay-sulphate-carbonate in the western part of the Pripyat Trough (Domanovichi suite); sulphate-carbonate in the northern part (Borisov suite); volcanogenic in the east (Malodusha suite); salt-bearing in the middle part (Savichi suite) [51]. Conodont elements within the Domanovichi horizon sediments have not been found; organic remains are represented by ostracods, bivalvia, ichthyofauna, algae, and miospores [49].

The age of the Kuzmichi sediments is determined by ostracods (beds with *Belorussina tschizhovae*) and miospores of the *Geminospora notata microspinosus* Regional zone [51; 58; 64]. The formation thickness varies from 20–30 m in the northern and northwestern parts, 50–60 m in the central part, and up to 90 m in the south. The rocks are lithologically heterogeneous and are divided into two members: the lower member, represented by interbedded marls, clays and limestones (in the southern and western regions there are layers of sandy and silty material, and in the northern region the rocks are dolomitized); and the upper member, composed of clayey and dolomite limestones with layers of clays, marls, sandstones, and sometimes anhydrites

(in the southwestern and southern parts there are also layers of sandy and silty material). Based on the ratio of sand-silt, carbonate and sulfate components in the section, the Kuzmichi, Pritoki and Barsuki suites are defined [51].

The age of the overlying Tonezh sediments is substantiated by the presence of brachiopods of the *Sinotectirostrum fursenkoi* – *Iloerhynchus tichomirovi* Regional Zone and miospores of the *Geminospora notata microspinosus* Regional Zone [51; 64]. Within the horizon, the following suites are defined: Igraev (or Tonezh) suite in the western regions of the Pripyat Trough, represented by a stratum of uniform alternation of limestones and sandstones, interlayers of cyanobacteria overfilled with oncolites and fragments of brachiopod shells; Molchany suite in the northern zone of the trough, composed of organogenic massive and hummocky-layered limestones and dolomites; Novoselki suite in the central zone of the Pripyat Trough, represented by a uniform stratum of dark-gray marls with thin (5–15 cm) interlayers and lenses of gray clayey limestones; Vyshemir suite in the eastern part of the trough, represented by clayey-carbonate rocks with interlayers of brachiopod shell rock, clays, tuffs and tuffites [51]. The Tonezh rocks are overlain by the clay-carbonate sediments of the Tremliia horizon of the Zadonsk superhorizon [51].

Conodonts from the sediments of the Kuzmichi horizon were found within the northern, central and eastern lithofacies zones of the Pripyat Trough, have varying degrees of preservation, color index 1–2 [12] and are represented by *Icriodus*, *Polygnathus* and *Palmatolepis* genera. The conodont complex of the horizon includes 19 taxa with a predominance of representatives *Polygnathus* and *Icriodus*: *Polygnathus brevillaminus* Branson et Mehl, 1934 [1]; *P. communis solididentatus* Drygant 2010 [52]; *P. delicatulus* Ulrich et Bassler, 1926 [37]; *P. lennarti* Drygant 2010 [52]; *P. normalis* Miller et Youngquist 1947 [26]; *Icriodus alternatus alternatus* Branson et Mehl, 1934 [1]; *I. ex. gr. cornutus* Sannemann, 1955 [31]; *I. deformatus* Han, 1987 [15]; *I. iowaensis ancylus* Sandberg et Dreesen, 1984 [30]; *I. iowaensis iowaensis* Youngquist et Peterson, 1947 [39]; *I. subterminus uyeno* Savage, 1992 [32]; *I. aff. vitabilis* [27]. There are also three endemic species described by T. V. Strelchenko – *Polygnathus admirandus* Strelchenko 2000 [66] *P. chegodaei* Strelchenko 2013 [35]; *P. inaequilateralis* Strelchenko 2013 [35]. The composition of the assemblage is supplemented by few *Palmatolepis* specimens – *Pa. delicatula* Branson et Mehl, 1934 [1], *Palmatolepis subperlobata helmsi* Ovnatanova, 1976 [60] and *Pa. werneri* Ji et Ziegler, 1993 [14] (plate 1, figures 2, 3a).

In addition to conodont elements, the rocks of the Kuzmichi horizon contain remains of foraminifera, worms, ostracods, brachiopods, as well as charophytes and miospores [49; 51; 64].

Conodonts from the sediments of the Tonezh horizon were found within the northern, central, eastern and southwestern lithofacies zones of the Pripyat Trough, have varying degrees of preservation, color index 1–5 [12] and are represented by five genera: *Polygnathus*, *Icriodus*, *Palmatolepis*, *Neopolygnathus* and *Ancyrognathus*. The conodont assemblage of this horizon is of a significant taxonomic diversity: 40 taxa were identified based on 825 elements. The number of representatives of the *Palmatolepis* genus increases significantly. From the underlying Kuzmichi horizon *Icriodus alternatus alternatus*, *I. iowaensis iowaensis*, *I. subterminus uyeno*, *I. cornutus*, *I. iowaensis ancylus*, *I. deformatus*, *Polygnathus admirandus*, *P. brevillaminus*, *P. chegodaei*, *P. communis solididentatus*, *P. lennarti*, *P. inaequilateralis*, *P. delicatulus*, *Palmatolepis werneri* continue their existence. For the first time in the section appear *Ancyrognathus sinelaminus* (Branson et Mehl, 1934) [1], *Icriodus aff. symmetricus* Branson et Mehl, 1934 [1], *I. aff. vitabilis*, *I. alternatus hemialternatus* Drygant, 2010 [52], *I. deformatus deformatus* Han, 1987 [15], *I. alternatus* Branson et Mehl, 1934 [1], *Neopolygnathus vorontzovae* Kuzmin, 1998 [62], *Palmatolepis crepida* Sannemann, 1955 [31], *Palmatolepis circularis* Szulczewski, 1971 [36], *Pa. minuta loba* Helms, 1963 [18], *Pa. minuta minuta* Branson et Mehl, 1934 [1], *Pa. minuta wolskae* Szulczewski, 1971 [36], *Pa. perlobata perlobata* Ulrich

et Bassler, 1926 [37], *Pa. quadrantinodosalobata* Sannemann, 1955 [31], *Pa. subperlobata subperlobata* Branson et Mehl, 1934 [1], *Pa. tenuipunctata* Sannemann, 1955 [31], *Pa. triangularis* Sannemann 1955 [31], *Pa. wolskae* Ovnatanova, 1969 [59], *Polygnathus barskovi* Strelchenko 2013 [35], *P. communis communis* Branson et Mehl, 1934 [1], *P. communis larysazimae* Drygant 2010 [52], *P. delenitor* Drygant, 1986 [53], *P. izhmensis* Kuzmin, 1998 [62], *P. lagoviensis* Helms et Wolska, 1967 [19], *P. lanceolus* Vorontsova, 1993 [38], *P. nodocostatus nodocostus* Branson & Mehl, 1934 [1], *P. semeni* Strelchenko 2013 [35], *P. subapertus* Drygant, 1986 [53], *P. subinornatus* Strelchenko, 2000 [66]. The assemblage lacks *Palmatolepis subperlobata helmsi*, *Pa. delicatula* and *Polygnathus normalis* that are typical for underlying sediments of Kuzmichi horizon (plates 2–3, fig. 2, 3b).

In addition to conodonts, the rocks of the Tonezh horizon contain numerous and diverse organic remains of foraminifera, ostracods, bivalvia, brachiopods, cephalopods, bryozoans, algae and miospores [44; 45; 49; 51; 63; 64].

The conodont assemblage from the Kuzmichi horizon sediments is comparable to the conodonts from the lower part of the Varezhanka suite of the Sado horizon of Volyn-Podolia [65]. Common taxa are: *Icriodus alternatus alternatus*, *I. iowaensis ancylus*, *I. iowaensis iowaensis*, *I. subterminus uyeno*, *Polygnathus brevillaminus* [52]. Also, the considered part of the Pripyat Trough section correlates with the lower part of the Zadonsk horizon of the Volgograd-Volga region: *Icriodus iowaensis*, *Polygnathus brevillaminus* are found in coeval sediments [48]; and with the lower part of the Zadonsk horizon of the central regions of the East European platform – common taxa are *Icriodus alternatus alternatus*, *I. cornutus*, *Pa. subperlobata*, *Polygnathus brevillaminus* [46].

The conodont assemblage from the sediments of the Tonezh horizon is comparable to the conodonts from the middle part of the Varezhany suite of the Sado horizon in the Volyn-Podolia region [65]. Common taxa are: *Icriodus alternatus alternatus*, *I. deformatus deformatus*, *I. iowaensis ancylus*, *I. iowaensis iowaensis*, *I. subterminus uyeno*, *Palmatolepis circularis*, *Pa. triangularis*, *Pa. wolskae*, *Polygnathus brevillaminus*, *P. communis communis*, *P. communis solididentatus*, *P. lagoviensis*, *P. lanceolus*, *P. subapertus* [52]. Also, the considered part of the Pripyat Trough section correlates with the middle part of the Zadonsk horizon of the Volgograd-Volga region where *Icriodus iowaensis*, *Polygnathus brevillaminus*, *Palmatolepis circularis*, *Pa. wolskae* were found in coeval deposits [48]; and with the middle part of the Zadonsk horizon of the central regions of the East European platform where *Icriodus alternatus alternatus*, *I. iowaensis iowaensis*, *I. cornutus*, *Pa. subperlobata*, *P. brevillaminus*, *Pa. circularis*, *Pa. wolskae* are common [46].

Plate 1 – Conodonts from the sediments of the Kuzmichi Horizon of the Pripyat Trough. The length of the scale bar is 0,2 mm



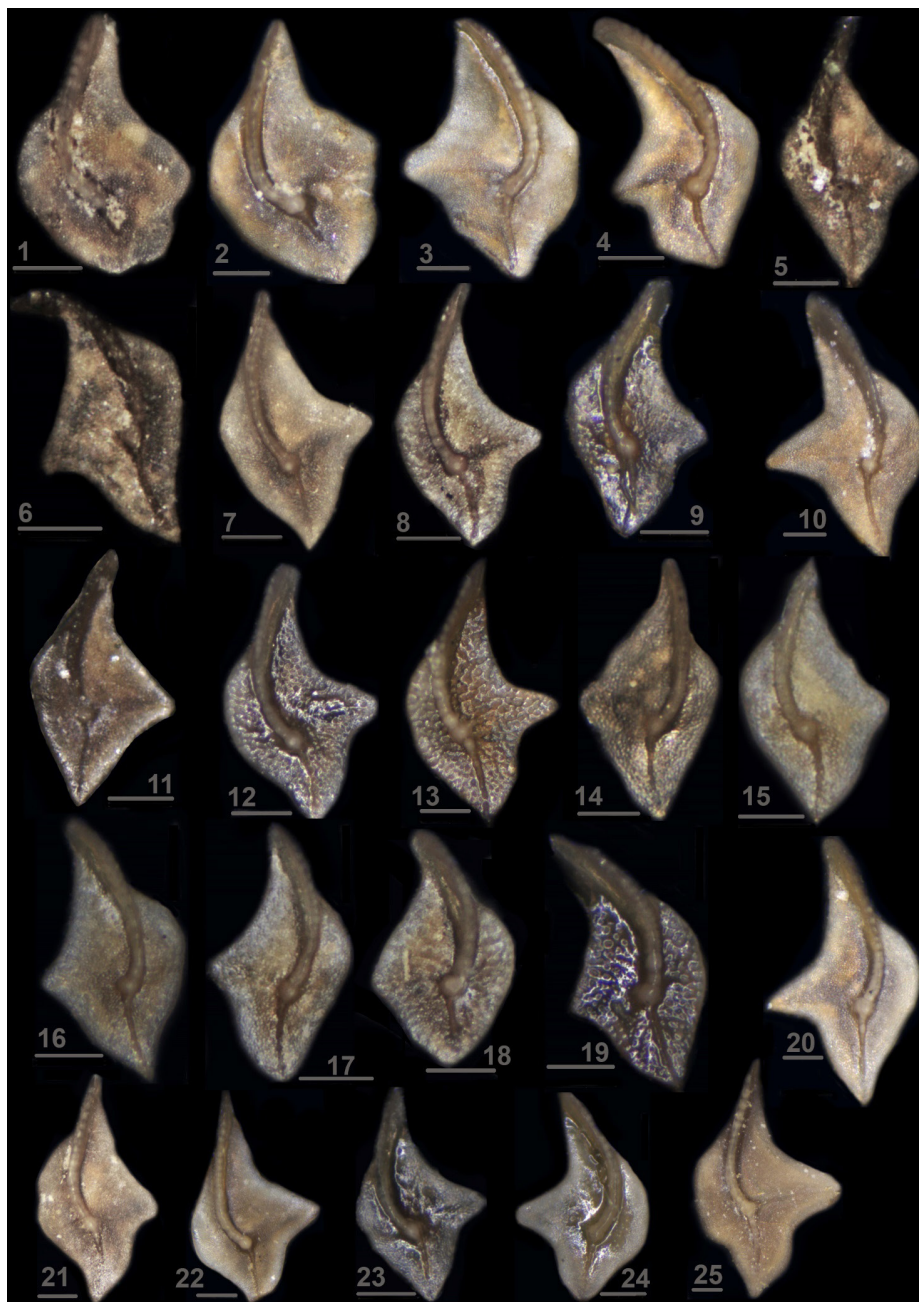
- 1 – *Palmatolepis delicatula* Branson et Mehl, 1934, borehole Komarovichskaya 2, depth 3154,7 m, specimen № 2-3; 2 – *Palmatolepis werneri* Ji et Ziegler, 1993, borehole Komarovichskaya 2, depth 3154,7 m, specimen № 2-4; 3 – *Palmatolepis subperlobata* helmsi Ovnanova, 1976, borehole Komarovichskaya 2, depth 3097,9 m, specimen № 2-6; 4 – *Polygnathus delicatulus* Ulrich et Bassler, 1926, borehole Zapadno-Bobrovichskaya 4, depth 2573,0 m, specimen № 3-5; 5 – *Polygnathus communis solididentatus* Drygant 2010, borehole Komarovichskaya 2, depth 3086,2 m, specimen № 2-5; 6 – *Polygnathus lennarti* Drygant 2010, borehole Komarovichskaya 2, depth 3097,9 m, specimen № 2-7; 7 – *Polygnathus admirandus* Strelchenko, 2000, borehole Zapadno-Bobrovichskaya 4, depth 2593,2 m, specimen № 3-17; 8 – *Polygnathus chigodaevi* Strelchenko, 2013, borehole Zapadno-Bobrovichskaya 4, depth 2593,2 m, specimen № 3-18; 9 – *Polygnathus inaequilateralis* Strelchenko, 2013, 9 – borehole Yuzhno-Savichskaya 7, depth 2599,2 m, specimen № 5-66; 10 – borehole Ostashkovichskaya 1r, depth 3180,0 m, specimen № 1-1; 11 – *Icriodus deformatus* Han, 1987, borehole Yuzhno-Savichskaya 7, depth 2599,2 m, specimen № 5-68; 12 – *Icriodus alternatus* alternatus Branson et Mehl, 1934, borehole Kopatkevichskaya 5r, depth 2331,8-2336,2 m, specimen № 4-53

Plate 2 – *Ancyrognathus*, *Icriodus* and *Polygnathus* from the sediments of the Tonezh horizon of the Pripyat Trough. The length of the scale bar is 0,2 mm



Explanations for the Plate 2

- 1, 2 – *Ancyrognathus sinelaminus* (Branson et Mehl, 1934), borehole Yuzhno-Savichskaya 7, 1 – depth 2506,9 m, specimen № 9–33; 2 – depth 2509,4 m, specimen № 9–34; 3–7 – *Icriodus alternatus alternatus* Branson et Mehl, 1934, 3 – borehole Rechitskaya 15r, depth 2152,0 m, specimen № 27–155; 4–7 – borehole Petrikovskaya 469, depth 849,0–855,0 m, specimen № 13–209, № 13–211; № 13–212; № 13–214; 8 – *Icriodus alternatus hemialternatus* Drygant, 2010, borehole Vyshemirovskaya 3r, depth 2365,0–2368,0 m, specimen № 10–96; 9 – *Icriodus* aff. *deformatus* Han, 1987, borehole Petrikovskaya 469, depth 849,0–855,0 m, specimen № 13–205; 10–12 – *Icriodus iowaensis ancylus* Sandberg et Dreesen, 1984, 10 – borehole Zapadno-Cherninskaya 6, depth 3347,6 m, specimen № 3–18; 11 – borehole Krasnosel'skaya 215, depth 3901,8 m, specimen № 19–49; 12 – borehole Rechitskaya 15r, depth 2156,0 m, specimen № 27–164; 13 – *Polygnathus admirandus* Strelchenko, 2000, borehole Zapadno-Bobrovichskaya 4, depth 2563,6 m, № 18–324; 14–15 – *Polygnathus barskovi* Strelchenko 2013, borehole Yuzhno-Savichskaya 7, depth 2506,9 m, specimens № 9–27; № 9–30; 16–17 – *Polygnathus brevilaminus* Branson et Mehl, 1933, 16 – borehole Zapadno-Cherninskaya 6, depth 3385,5 m, № 3–25; 17 – borehole Rechitskaya 18r, depth 2284,5–2290,5 m, № 28–187; 18 – *Polygnathus communis solididentatus* Drygant 2010, borehole Zapadno-Bobrovichskaya 4, depth 2533,0 m, № 18–275; 19–20 – *Polygnathus chegodaevi* Strelchenko 2013, 19 – borehole Komarovichskaya 2, depth 3023,0 m, № 11–66; 20 – borehole Zapadno-Bobrovichskaya 4, depth 2547,5 m, № 18–288; 21 – *Polygnathus communis larysazimae* Drygant 2010, borehole Petrikovskaya 469, depth 849,0–855,0 m, № 13–204; 22 – *Polygnathus communis communis* Branson et Mehl, 1934, borehole Zapadno-Cherninskaya 6, depth 3350,8 m, № 3–19; 23 – *Polygnathus delicatulus* Ulrich et Bassler, 1926, borehole Komarovichskaya 2, depth 3023,0 m, № 11–67; 24–26 – *Polygnathus delentit* Drygant, 1986, 24 – borehole Zapadno-Cherninskaya 6, depth 3304,7 m, № 3–15; 25 – borehole Krasnosel'skaya 215, depth 3901,8 m, № 19–47; 26 – borehole Zapadno-Bobrovichskaya 4, depth 2558,1 m, № 18–313; 27 – *Polygnathus lennarti* Drygant 2010, borehole Petrikovskaya 469, depth 849,0–855,0 m, № 13–206; 28–30 – *Polygnathus inaequilateralis* Strelchenko 2013, 28 – borehole Zapadno-Bobrovichskaya 4, depth 2558,1 m, № 18–315; 29 – borehole Krasnosel'skaya 215, depth 3895,2 m, № 19–45; 30 – borehole Kamenskaya 5, depth 3449,1 m, № 19–224; 31 – *Polygnathus lanceolus* Vorontsova, 1993, borehole Rechitskaya 18r, depth 2320,1–2326,1 m, № 28–192; 32 – *Polygnathus nodocostatus nodocostus* Branson & Mehl, 1934, borehole Rechitskaya 15r, depth 2123,0 m, № 27–145

Plate 3 – *Palmatolepis* from the sediments of the Tonezh horizon of the Pripyat Trough. The length of the scale bar is 0,2 mm

Explanations for the Plate 3

- 1, 2 – *Palmatolepis circularis* Szulczewski, 1971, borehole Zapadno-Kamenskaya 1, depth 3270,0 m, specimen № 17-228, specimen № 17-227; 3 – *Palmatolepis wolskai* Ovnatanova, 1969, borehole Zapadno-Kamenskaya 1, depth 3270,0 m, № 17-229; 4 – *Palmatolepis perlobata perlobata* Ulrich et Bassler, 1926, borehole Zapadno-Kamenskaya 1, depth 3268,5 m, № 17-226; 5-7 – *Palmatolepis minuta wolskai* Szulczewski, 1971, 5-6 – borehole Zapadno-Peretokskaya 1, depth 3482,0 m, № 5-230, № 5-231; 7 – borehole Rechitskaya 15r, depth 2156,0 m, № 27-162; 8-9 – *Palmatolepis quadrantinodosalobata* Sannemann, 1955, borehole Zapadno-Bobrovichskaya 4, depth 2530,4 m, № 18-258, № 18-270; 10 – *Palmatolepis minuta loba* Helms, 1963, borehole Ostashkovichskaya 7r, depth 2928,0-2931,7 m, specimen № 1-220; 11 – *Palmatolepis tenuipunctata* Sannemann, 1955, borehole Kormianskaya 4, depth 3479,1 m, № 1-1; 12-13 – *Palmatolepis triangularis* Sannemann 1955, borehole Zapadno-Bobrovichskaya 4, depth 2530,4 m, № 18-254; № 18-257; 14-17 – *Palmatolepis werneri* Ji et Ziegler, 1993, 14 – borehole Rechitskaya 15r, depth 2166,0 m, № 27-177; 15-17 – borehole Zapadno-Bobrovichskaya 4, depth 2530,4 m, № 18-243; № 18-251; № 18-253; 18-19 – *Palmatolepis crepida* Sannemann, 1955, borehole Zapadno-Bobrovichskaya 4, depth 2530,4 m, specimens № 18-241, № 18-248; 20-25 – *Palmatolepis subperlobata subperlobata* Branson et Mehl, 1934, 20 – borehole Komarovichskaya 2, depth 2992,4 m, № 11-65; 21 – borehole Rechitskaya 15r, depth 2166,0 m, specimen № 27-178; 22-24 – borehole Kopatkevichskaya 5r, depth 2261,6-2269,9 m, specimens № 12-76, № 12-72, № 12-73; 25 – borehole Rechitskaya 18r, depth 2338,1-2344,1 m, specimen № 28-193

CORRELATION WITH THE STANDARD CONODONT ZONATION

Famennian Standard Conodont Zonation is based on the works of W. Ziegler and C. Sandberg [28; 29; 40; 41–43]. The problems of the Scale developed in 1990 were later discussed by P. Bultynck, C. Corradini, C. Spalletta, A. Mossoni, H. Matyja, D. Over, S. Hartenfels, R. Becker, S. Kaiser [2; 3; 5; 6; 8; 16; 17; 20] and others. This prompted C. Spalletta, M. Pierri, D. Over and C. Corradini in 2017 to propose a completely new Conodont Zonation for the entire Famennian Stage [13].

The occurrence of index species and typical taxa of the zones of the Standard Conodont Scale [9; 13] within

the sediments of the Kuzmichi and Tonezh horizons of the Pripyat Trough makes it possible to compare the identified conodont complexes with the zones of this Scale.

In the sediments of the Kuzmichi horizon the taxa *Icriodus alternatus alternatus*, *I. iowaensis iowaensis* and *Polygnathus brevillaminus*, typical for the *Pa. triangularis* Zone [13] were found (fig. 2). Taxa *Icriodus cornutus* and *I. iowaensis ancylus*, that appear in the *Palmatolepis delicatula platys* Zone [2; 13; 30], and the species *Pa. werner*, that was first recorded at the base of the *Palmatolepis minuta minuta* Zone [13; 14] also present there. Thus, the horizon sediments correspond to three zones: *Palmatolepis triangularis*, *Pa. delicatula platys* and *Pa. minuta minuta* (fig. 2).

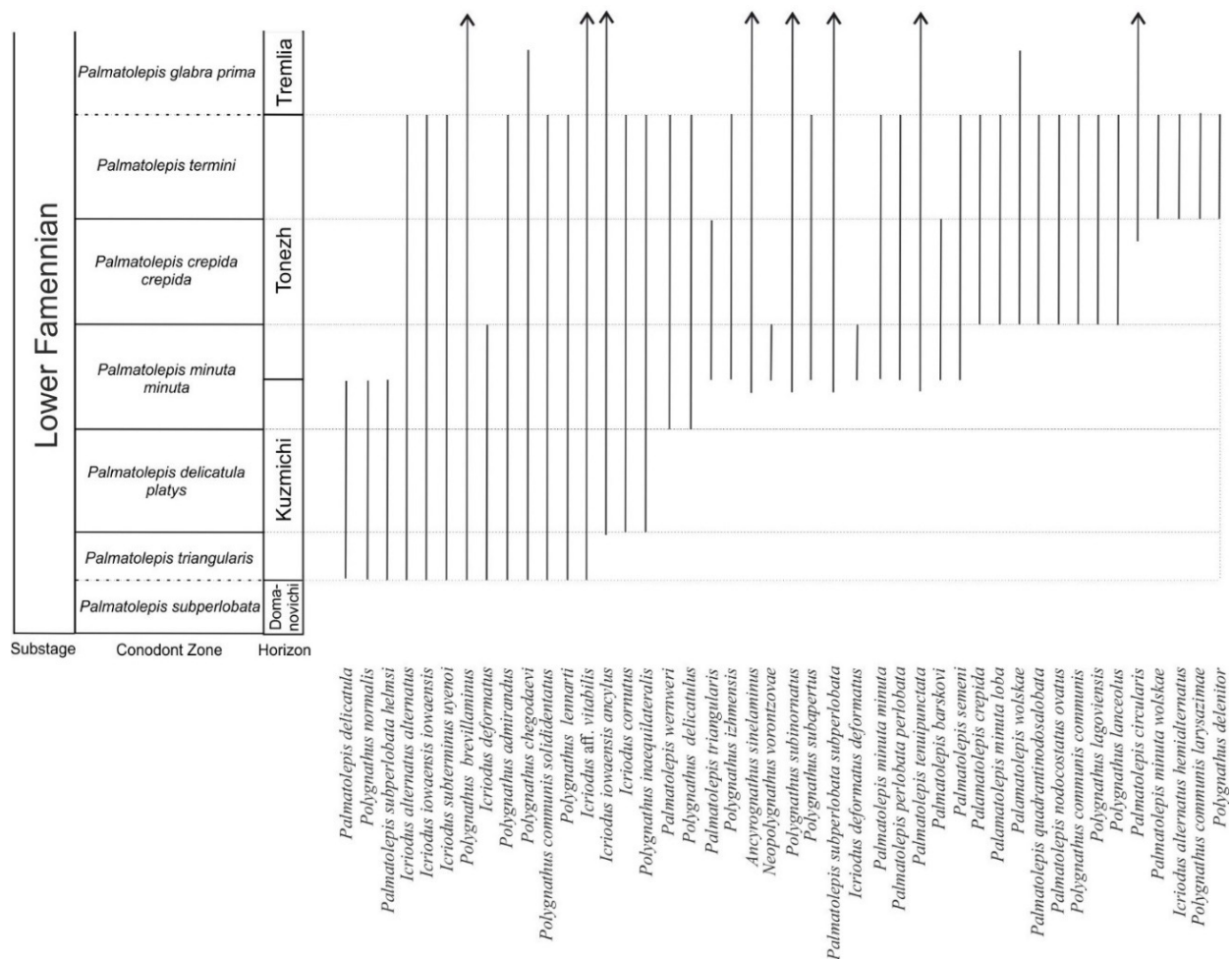


Figure 2 – Stratigraphic distribution of conodonts from the sediments of the Lower Famennian Kuzmichi and Tonezh horizons of the the Pripyat Trough¹

In the sediments of the Tonezh horizon, index subspecies *Palmatolepis minuta minuta* and typical taxa *Icriodus deformatus deformatus* and *Neopolygnathus*

vorontzovae for *Pa. minuta minuta* Zone are found [14; 23; 35]. Index species *Palmatolepis crepida* and typical taxa of *Pa. crepida crepida* Zone – *Pa. minuta loba*,

¹ The distribution of taxa within the sediments of the Tremilia horizon is given according to the data of T. V. Strel'chenko [35].

Pa. wolskae, *Pa. quadrantinodosalobata*, *Polygnathus communis communis*, *P. lagowiensis* [4; 14; 33; 34] also present here, as well as the taxa *Palmatolepis circularis*, *Pa. minuta wolskae*, the first appearance of which is recorded at the base of the *Palmatolepis termini* Zone [7; 14]. Thus, the horizon sediments correspond to three zones: *Palmatolepis minuta minuta*, *Pa. crepida crepida* и *Pa. termini* (fig. 2).

Taxa *Icriodus alternatus hemialternatus*, *Polygnathus communis larysazimae*, *P. delenitor* (plate 2), that are found and described by D. Drygant within the sediments of Solokiya and Selets' suits of the Sadov horizon in Volyn-Podolia (*Palmatolepis rhomboidea* Zone) [52], within the Pripyat Trough were found in the sediments of the Tonezh horizon, therefore, their appearance is recorded earlier than described in the original source – at the lower boundary of the *Pa. termini* Zone (fig. 2).

CONODONT-BASED BIOFACIES ANALYSIS

Conodonts are successfully used in paleogeographic reconstructions, since coeval communities differ significantly taxonomically, due to the habitat conditions of conodont animals and the sedimentation features of marine basins. Models of conodont biofacies formation have been developed by M. Lindström [24], G. Merrill [25], E. Druce [11], G. Klapper and D. Barrick [21], G. Klapper and D. Johnson [22], I. Barskov [47], R. Dreesen, Ch. Sandberg and W. Zeigler [10], E. Kirilishina [54] and other researchers.

In general, all models combine two criteria of biofacies formation: the relative depth of the paleobasin and the distance from the coast. The following conodont biofacies are distinguished for the Famennian marine basins: [61]:

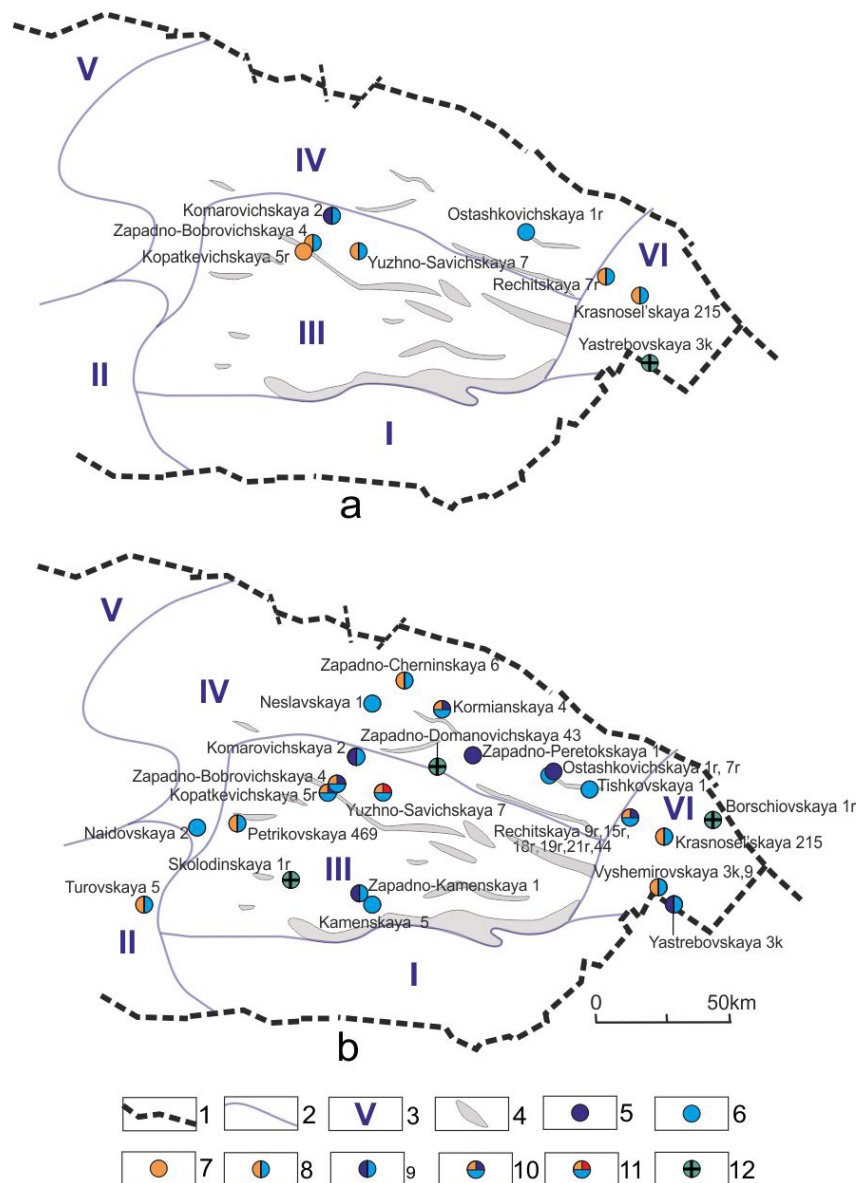
- extremely shallow water icriodid-polygnathid with the subordinate role of *Pelekygnathus* genus;
- shallow water polygnathid;
- relatively deepwater palmatolepid;
- reef with the presence of *Ancyrognathus* genus.

It is suggested that in extremely shallow, isolated, bay-lagoon, coastal settings, endemics predominated (mainly representatives of the genera *Icriodus* and *Pelekygnathus*), that makes it difficult to correspond such sediments with a Standard Zonal Scale, while widespread taxa were carried by flows and, accordingly, are associated with deep open sea facies (representatives of *Palmatolepis*) [61].

The sediments of the Kuzmichi and Tonezh horizons of the Pripyat Trough were formed under the open sea conditions, since representatives of the genus *Palmatolepis* are present in the studied sections. However, the depth of the sea basin wasn't constant, but varied territorially and changed over time.

Thus, during the Kuzmichi time, a shallow sea existed in the northern, western and eastern parts of the Pripyat Trough. Shallow-water *Icriodus* (46 %) and *Polygnathus* (36 %) predominate in conodont assemblages, only within the borehole Komarovichskaya 2 section the representatives of *Palmatolepis* (9 %) are found (fig. 3a). This is also confirmed by the presence of benthic organisms remains and numerous and diverse algae that form organogenic structures [50]. The central zone of the depression, based upon the fauna, was deeper, where relatively deep-water conditions alternated with shallow ones. Thus, the Kopatkevichskaya area is characterized by an extremely shallow-water *Icriodus* assemblage, Zapadno-Bobrovichskaya and Yuzhno-Savichskaya by an *Icriodus-Polygnathus* assemblage of coastal shallow waters, and Komarovichskaya by a relatively deep-water *Palmatolepis-Polygnathus* assemblage (fig. 3a). This facies alternation indicates active tectonic movements.

During the Tonezh time, the paleobasin deepened, especially in its northeastern and southern parts (Zapadno-Peretokskaya, Ostashkovichskaya, Yastrebovskaya, Zapadno-Kamenskaya areas (fig. 3b)), as it evidenced by the predominance of *Palmatolepis* representatives (38 %); quantity of *Icriodus* and *Polygnathus* decrease to 29 % each. Also, in the central zone (Yuzhno-Savichskaya area) a reef taxon *Ancyrognathus sinelaminus* was identified.



1 – deep faults that limit the Pripyat Trough; 2 – boundaries of lithofacies zones; 3 – lithofacies zone numbers [69]: I – South; II – Southwest; III – Central; IV – North; V – Northwest; VI – East; 4 – zones of absence of lower Famennian sediments; 5 – boreholes where *Palmatolepis* were found; 6 – boreholes where *Polygnathus* were found; 7 – boreholes where *Icriodus* were found; 8 – boreholes where *Polygnathus* and *Icriodus* were found; 9 – boreholes where *Polygnathus* and *Palmatolepis* were found; 10 – boreholes where *Icriodus*, *Polygnathus* and *Palmatolepis* were found; 11 – boreholes where *Icriodus*, *Polygnathus* and *Ancyrognathus* were found; 12 – boreholes with indefinable conodont elements

Figure 3 – Distribution of conodont genera found in the sediments of the Kuzmichi (a) and Tonezh (b) horizons of the Pripyat Trough

CONCLUSIONS

The sediments of the Lower Famennian Kuzmichi and Tonezh horizons of the Pripyat Trough contain representative conodont assemblages found from 29 wells sections and represented by 43 taxa, that makes it possible to correspond the identified complexes with zones of the Standard Conodont Scale [13], perform paleogeographic reconstructions, and conduct correlations with remote sections.

The presence of index species and typical taxa of Standard Conodont Zones in the sediments of the Kuzmichi and Tonezh horizons of the Pripyat Trough makes it possible to compare the identified conodont communities with Zones of Standard Conodont Scale. The sediments of the Kuzmichi horizon correspond to *Palmatolepis triangularis*, *Pa. delicatula platys* and *Pa. minuta minuta* Zones; and the Tonezh one correspond to *Palmatolepis minuta minuta*, *Pa. crepeida crepida* and *Pa. termini* Zones.

The Pripyat Trough during the Kuzmichi and Tonezh time period developed in normal marine conditions; the presence of the *Palmatolepis* group indicates the open type of paleobasin. During the Kuzmichi time period, shallow-water *Icriodus* and *Polygnathus* groups predominated throughout the area, with the rare presence of *Palmatolepis*, indicating the depth of certain areas. During the Tonezh time period, the deep-sea *Palmatolepis* group became predominant, that indicates the continued subsidence of the sea basin bottom, with the central zone of the depression being the lowest. The alternation of deep-water oryctocoenoses with shallow-water ones indicates the active tectonic processes.

The conodont assemblage identified from the sediments of the Kuzmichi horizon is comparable to conodonts from the lower part of the Varezhan suite of the Sadov horizon in the Volyn-Podolia and the lower part of the Zadonsk horizon of the central regions of the East European Platform and the Volgograd-Volga region. The conodont co assemblage defined from the sediments of the Kuzmichi horizon is comparable to conodonts from the middle part of the Varezhan suite of the Sadov horizon in the Volyn-Podolia and the middle part of the Zadonsk

horizon of the central regions of the East European Platform and the Volgograd-Volga region.

Taxa *Icriodus alternatus hemialternatus*, *Polygnathus communis larysazimae*, *P. delenitor*, that were found and described by D. Drygant within the sediments of Solokiya and Selets' suits of the Sadov horizon in Volyn-Podolia (*Palmatolepis rhomboidea* Zone) [52], within the Pripyat trough were found within the sediments of the Tonezh horizon, that suggests that their appearance is recorded earlier – at the lower boundary *Pa. termini* Zone.

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КАНАДОНТЫ З АДКЛАДАЎ КУЗЬМІЧОЎСКАГА І ТОНЕЖСКАГА ГАРЫЗОНТАЎ НІЖНЯГА ФАМЕНА ПРЫПЯЦКАГА ПРАГІНУ (БЕЛАРУСЬ)

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Прыведзены даныя аб канадонтах з адкладаў кузьмічоўскага і тонежскага гарызонтаў ніжняга фамена Прыпяцкага прагіну. Вылучаны комплексы канадонтаў з таксонамі, характэрнымі для зон стандартнай канадонтавай шкалы: комплекс канадонтаў з адкладаў кузьмічоўскага гарызонту адпавядае зонам *Palmatolepis triangularis*, *Pa. delicatula platys* і *Pa. minuta minuta*, а тонежскага – зонам *Pa. minuta minuta*, *Pa. crepida crepida* і *Pa. termini* [13]. Удакладнены час з’яўлення *Icriodus alternatus hemialternatus* Drygant 2010, *Polygnathus communis larysazimae* Drygant 2010, *P. delenitor* Drygant 1986. На падставе біяфацыйнага аналізу выкананы палеагеаграфічныя рэканструкцыі. Прыведзены стратыграфічныя карэляцыі дадзенай часткі разрэзу з Валына-Падоліяй, цэнтральнымі раёнамі Усходне-Еўрапейскай платформы і Валгаградскім Паволжам.

Ключавыя словы: канадонты, верхні дэвон, ніжні фамен, Беларусь, Прыпяцкі прагін, біястратыграфія, біязанаванне.

КОНОДОНТЫ ИЗ ОТЛОЖЕНИЙ КУЗЬМИЧЕВСКОГО И ТОНЕЖСКОГО ГОРИЗОНТОВ НИЖНЕГО ФАМЕНА ПРИПЯТСКОГО ПРОГИБА (БЕЛАРУСЬ)

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Приведены данные о конодонтах из отложений кузьмичевского и тонежского горизонтов нижнего фамена Припятского прогиба. Выделены комплексы конодонтов с таксонами, характерными для зон стандартной конодонтовой шкалы: комплекс конодонтов из отложений кузьмичевского горизонта соответствует зонам *Palmatolepis triangularis*, *Pa. delicatula platys* и *Pa. minuta minuta*, а тонежского – зонам *Pa. minuta minuta*, *Pa. crepida crepida* и *Pa. termini* [13]. Уточнено время появления *Icriodus alternatus hemialternatus* Drygant 2010, *Polygnathus communis larysazimae* Drygant 2010, *P. delenitor* Drygant 1986. На основе биофацциального анализа выполнены палеогеографические реконструкции. Проведены стратиграфические корреляции данной части разреза с Воыно-Подоліей, центральными районами Восточно-Европейской платформы и Волгоградским Поволжьем.

Ключевые слова: конодонты, верхний девон, нижний фамен, Беларусь, Припятский прогиб, биостратиграфия, биозонирование.