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**NEW DATA ABOUT SYSTEMIC COMPOSITION AND STRATIGRAPHIC
DISTRIBUTION OF LATE TOURNAISIAN-EARLY VISEAN ALGAE
OF DONETS BASIN**

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The systematic composition of the late Tournaisian-early Visean algal flora of the Donbass has been studied and analyzed. The knowledge about distribution, change of systematic composition, correlative significance and facial timing of fossil calcareous algae at the turn of late Tournai-early Visé for different regions is refined and supplemented. The ontogenetic changes within the genera Palaeoberesellaceae Mamet et Roux have been revealed and its systematic composition have been adjusted.

Keywords: Lower Carboniferous, Tournaisian stage, Visean stage, calcareous algae, green algae, red algae, algal complex, family Palaeoberesellaceae Mamet et Roux.

The deposits of the Visean stage of the Lower Carboniferous are of considerable planetary distribution. It was probably the time of the greatest maritime transgression in the Carboniferous time. The rocks are predominantly limestones with limestone clay and sandy outcrops and contain a variety of marine fauna characteristic for the warm seas shelf zone (mosses, corals, krinoids, shellfish, brachiopods, etc.)

Particularly numerous are the findings of various foraminifera and calcareous algae, which play an important role in the formation of biogermic buildups associated with the location of oil and gas fields. Algae also make it possible to determine the age of the rocks and to correlate perennial sediments in other regions. To one degree or another, the issues of systematic and stratigraphical distribution and facial timing of Visean algae are reflected in many articles and monographs by both foreign and Ukrainian authors.

In Donbass, Visean deposits are spread by a narrow strip south of Donetsk in the form of natural deflections in beams and quarries, as well in boreholes.

The review of thin sections from wells 74, 9017 within the state-funded topic 0118U003433 “Substantiation of the boundaries of Paleozoic regional and local units for next-generation geographical maps” made it possible to clarify the stratigraphical distribution and systematic position of the calcareous algae of the Late Tournaisian-Early Visean deposits and to make more reliable comparison with the complexes of other coal basins and to clarify their stratigraphical values.

The algal complexes of Late Tournaisian- Early Visean time are largely composed of representatives of fossil organisms, which, to some extent of doubts, placed by the majority of researches to green algae of the family Palaeoberesellaceae Mamet et Roux, which were an important biotic component of shallow water areas of the Late Devonian-Lower Carboniferous Seas. In thin sections, these organisms have the appearance of perforated calcareous tubes often segmented within partitions. The very fact of studying these algae in thin sections led to establishment of an unjustifiable large number of genera and species, complicating

their determination and the possibility of correlation of coeval sediments with these organisms. Despite a large number of attempts to classify and revise these groups, their taxonomy is very chaotic. Particularly interesting from this point of view are the works of S. Skompski [1] and V.I. Parchenko [2, 3] who managed chemically to prepare the remains of these organisms. In view of the results of these publications, present author examines previously established families and species in terms of their recognition and circumstances that have opened up.

Tournaisian stage (upper part)

Karpivsky horizon of the Donbass (zone C_{1d}^l) is characterized mainly by the green tubular algae *Kamaena delicata* Antropov, *K. awirsi* Mamet et Roux, *Kamaenella denbighi* Mam. et Roux, *Parakamaena irregularis* Berchenko, *Pseudokamaena armstrongi* Mamet, *Ps. atypica* Berchenko, and also *Kulikaella minima* Berchenko, *K. unistratosa* Berchenko, *Petchoria antiqua* Berchenko, *Coelosporella delicata* Berchenko (= *Hypocaustella cartimandue* Elliot = mesh ostracode), of which the genera *Parakamaen* Mamet et Roux and *Pseudokamaena* Mamet are found in the more lower sediments of the Tournaisian stage [4].

Dokuchaevsky horizon (C_{1a}^v , former lower most Visé). Is characterized by numerous *Issinella*-like tubular algae and tubular algae with partition, kamaenids. Among them are identified *Kamaena donbassica* Sukh., *K. delicata* Antropov, *K. magna* R. Ivan., *K. minuta* R. Ivan., *Anthracooporellopsis machaevi* Maslov (= *K. tobolensis* R. Ivan. = *K. pirleti* Mamet et Roux), *Kamaenella denbighi* Mam. et Roux, *Issinella grandis* Tchuv., *Palaeoberesella lahuseni* (Moeller), *Exvotarisella index* (Moeller), *Pseudokamaena* sp., *Kulikaella* sp., for the first time in the Donbass sediments identified *Evlania* sp.?, *Koninckopora antiqua* Berch. (= mesh ostracod?) microproblematics known from late Devonian sediments. The complex of this horizon is characterized by quantitative and qualitative increase of representatives of the genus *Kamaena* Antropov, the emergence of numerous *Issinella* Reitlinger, *Exvotarisella* Elliot (= *Nodosinella* Ehrenberg non *E. maponi*), and also *Palaeoberesella* Mamet et Roux identified by Mamet [5] two genera that are often difficult to distinguish, as well as genus referred in previous publications to *Anthracooporellopsis* Maslov (a group of large tubular algae widespread in the Viséan sediments of Donbass with a wide internal cavity and infrequent septum which obviously requires revision and selection of a new taxonomic unit. The facial type of limestone with algae belongs to the packstone (SMF facial belts 3 and 4) [6].

Visean stage (lower part)

The Early Visean complex is defined in sediments corresponding to the Hlybokinsky and Sukhinsky horizons (C_{1b-d}^v zones). Microfacial types of limestone with algae are grainstone to the lesser extent packstone (facial belts 3 and 4, SMF-5) and sometimes framestones (facial belt 5, SMF-7) with numerous foraminifera, remains of brachiopods, ostracods, corals, green algae of the families *Palaeoberesellaceae* Mamet et Roux та *Dasycladaceae* (Kutzing, 1843) and the red algae family *Stacheinaceae* Loeblich et Tappan, 1961. The complex contains *Issinella grandis* Tchuv (numerous of two types with a smooth matt and very large with radially radiant wall), numerous *Palaeoberesella-Exvotarisella*-like, *Kamaena-Palaeoberesella*-like, *?Anthracooporellopsis machaevi* Masl., *Palaeoberesella lahuseni* (Moeller), *Kamaena delicata* Antropov, *K. awirsi* Mam. et Roux, *K. magna* R. Ivan., *K. lata* R. Ivan., *Kamaena minuta* R. Ivan., *Issinella grandis* (?) Tchuvashov, few *Pseudoissinella* sp., *Pseudonanopora stockmansii* Mamet et Roux. Characteristic for underlying Tournaisian deposits *Pseudokamaena armstrongi* Mamet., *Pseudokamaena* sp., *Kamaenella denbighi* Mamet et Roux, *Proninella* sp., *Parakamaena* sp. *Cribrakamaena* sp., a genera known from Meramec and Late Visean of Northern America is identified for the first time in deposits of

zones C₁^v_{b-c}. For the first time for these deposits are identified ?*Anthracoporella* aff. *baschkirica* Kulik known from upper Visean deposits of the Ural, red algae *Stacheoides? meandri-formis* Mamet et Rudloff, *Aoujgalia variabilis* Termier et Termier, *Pseudostacheoides loomisi* Petryk et Mamet, as well as known from the late Devonian deposits of France *Labyrinthoconus clausmuelleri* Langer, *Evlania* sp., *Pokorninella* sp.

In Dono-Dnipro Depression (DDD), the Early Visean complex of Donbass is compared with the complex characteristic of the XIV micro-facial horizon (MFH) [7] where green siphonocladal algae such as *Palaeoberesella lahusei* Mamet et Roux, *Kamaena delicata* Antropov, *K. minuta* R. Ivanova, *K. awirsi* Mamet et Roux *Exvotarissella index* (Ehrenberg), *Crassikamaena aculeata* R. Ivanova, *Subkamaena* aff. *sibirica* R. Ivanova predominate. As well, a red algae such as *Pseudostacheoides loomisi* Petryk et Mamet was detected. And also is compared with the complex characteristic of XIII MFH. It is characterized by the fact that along with already known siphonocladal *Palaeoberesella lahusei* Mamet et Roux, *Exvotarissella maponi* Elliott *E. aff. index* (Ehrenberg), *Kamaena delicata* Antropov, *K. itkillikensis* Mamet et Roux, *K. awirsi* Petryk et Mamet, *K. pirloti* Mamet et Roux, *Pseudokamaena* sp., *Parakamaena armstrongi* Petryk et Mamet, *Subkamaena sibirica* R. Ivanova, *Crassikamaena* sp., already known in the Donbass sediments dasycladal algae such as *Issinella grandis* Tchuvashov, *Issinella? sainsii* Mamet et Roux appear, as well as algae identified in other parts of the Paleothetical region of the Northern Hemisphere in Visean time such as *Pseudoissinella alaskensis* Mamet et Rudloff, *Zidella* sp., *Asphaltinella gorowitzi* Mamet et Roux, *Asphaltinella? bangorensis* Mamet et Roux. In DDD significantly increases the systematic composition of the red algae of stacheacia, among which are identified *Stacheoides polytrematoides* (Brady), *Stacheoides tenuis* Petryk et Mamet, *Epistacheoides connorensis* Mamet et Rudloff, *E. nephroformis* Petryk et Mamet, *E. chantoni* Mamet et Roux, *Pseudostacheoides loomisi* Petryk et Mamet, *Pseudostacheoides* sp., *Aoujgalia richi* Mamet et Roux, *A. variabilis* Termier et Termier, *Mametella chautauquae* Brenkle.

In the Urals, the Lowe Visean complex of Donbass is compared with the V, VI, VII algal complexes [8] dominated by green dasycladal and siphonocladal algae of families Palaeoberesellaceae Mamet et Roux, and Dasycladaceae (Kützing, 1843). It is also dominated by representatives of genera *Kamaena* Antropov, *Kamaenella* Mamet et Roux, *Exvotarissella* Elliot, *Palaeoberesella* Mamet et Roux, *Issinella* Reitlinger Nanopora (Wood) but not defined *Anthracoporellopsis* Maslov. Red algae such as *Epistacheoides connorensis* Mamet et Roux, *Fourstonella fusiformis* (Brady), *Stacheoides tenuis* Petryk et Mamet, *Ungdarella uralica* Maslov which in Ural sections are known only in the VII algal complex, which by age corresponds to the Sukhinsky horizon of Donbass. In these Uralian complexes, algae known from Early Tornaisian such as *Subkamaena* Berchenko та *Parakamaena* Mamet et Roux continue to occur.

The present research made it possible to expand the knowledge about the systematic composition and distribution of fossil algae on the border of the Tornaisian and Visean stages. The systematic composition of the Dondassian Early Visean complex was supplemented and corrected. This allowed it to be more properly compared with other such complexes of the Northern Hemisphere. It is concluded that a significant change in the complexes occurs on the border of the Karpivsky and Dokuchaevsky horizons (the former border of the Tournai and Visé). Green tubular algae of the family Palaeoberesellaceae were the characteristic feature of the transitional Tornaisian-Visean complexes within appearance of red algae staceacea. Ontogenetic changes within the family Palaeoberesellaceae are analyzed. Their

greatest quantitative and qualitative blossom in the Lower Visean deposits was revealed. Along with the green, tubular algae at this level appear red algae of the family Stacheinacea Loeblich et Tappan which have flourished in overlying sediments.

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EXPLANATION OF PLATES

Plate 1. *?Anthracoporellopsis machaevi* Maslov, longitudinal sections

Fig. 1. Hlybokinsky horizon, zone $C_1^v d^1$, depth 159–153.3 м

Fig. 2. Sukhinsky horizon, zone $C_1^v d^2$, depth 144.4–148.2 м

Plate 2

Fig. 1. *?Anthracoporellopsis machaevi* Maslov, Hlybokinsky horizon, zone $C_1^v c$, depth 188.4 м

Fig. 2. *?Anthracoporellopsis machaevi*, Hlybokinsky horizon, zone $C_1^v c$, depth 156.4–160 м

Fig. 3. *?Anthracoporellopsis machaevi* Maslov (*?Uraloporella* Korde), Hlybokinsky horizon, zone $C_1^v d^1$, depth 154.4–156.4 м

Plate 3

Fig. 1. *Cribrikamaena* sp. longitudinal section, Sukhinsky horizon, zone $C_1^v d^2$, depth 124 м

Fig. 2. *Cribrikamaena* sp., longitudinal section, Sukhinsky horizon, zone $C_1^v d^2$, depth 116 м

Fig. 3. *Labyrinthoconus clausmuelleri* Langer longitudinal section, Hlybokinsky horizon, zone $C_1^v c$, depth 200–202.1 м

Fig. 4. *Anthracoporella* aff. *baschkirica* Kulik transversal section, Hlybokinsky horizon, zone $C_1^v d^1$, depth 144.4–148.2 м

Plate 4. Longitudinal slightly oblique sections

Fig. 1. *Pokorninella* sp., Hlybokinsky horizon, zone $C_1^v_b$, depth 202.1–203.9 м

Fig. 2. *Proninella* sp., Hlybokinsky horizon, zone $C_1^v_c$, depth 186.3–186.5 м

Fig. 3. *Koninckopora antiqua* Berch, Dokuchayevsky horizon $C_1^v_a$, depth 230.2–231.7 м

Fig. 4. *?Evlania* sp., Hlybokinsky horizon, zone $C_1^v_b$, depth 202.1–203.9 м

Plate 5. Transversal sections

Fig. 1. *Stacheoides cannindahensis* Mamet et Roux, Hlybokinsky horizon, zone $C_1^v_d^1$, depth 164–168.5 м

Fig. 2. *Aoujgalia variabilis* Termier et Termier, Sukhinsky horizon, zone $C_1^v_d^2$, depth 124 м

Fig. 3. *Stacheoides? meandriiformis* Mamet et Rudlof, depth 119.5 м

Fig. 4. *Stacheoides? meandriiformis* Mamet et Rudlof, Hlybokinsky horizon, zone $C_1^v_c$, depth 154.4–156.4 м

**НОВІ ДАНІ ПРО СИСТЕМАТИЧНИЙ СКЛАД ТА СТРАТИГРАФІЧНЕ
ПОШИРЕННЯ ПІЗНЬОТУРНЕЙСЬКИХ-РАННЬОВІЗЕЙСЬКИХ ВОДОРОСТЕЙ
ДОНБАСУ**

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Вивчено та проаналізовано систематичний склад пізньотурнейської-ранньовізейської альгофлори Донбасу. Уточнено та доповнено пізнання про поширення, зміну систематичного складу, корелятивну значущість та фаціальну приуроченість викопних вапнистих водоростей на рубежі пізнього турне та раннього візе різних регіонів. Виявлено онтогенетичні зміни всередині родини *Palaeoberesellaceae* та проревізовано її систематичний склад.

Ключові слова : турнейський ярус, візейський ярус, вапнисті водорості, зелені водорості, червоні водорості, водоростеві, родина *Palaeoberesellaceae* Mamet et Roux.

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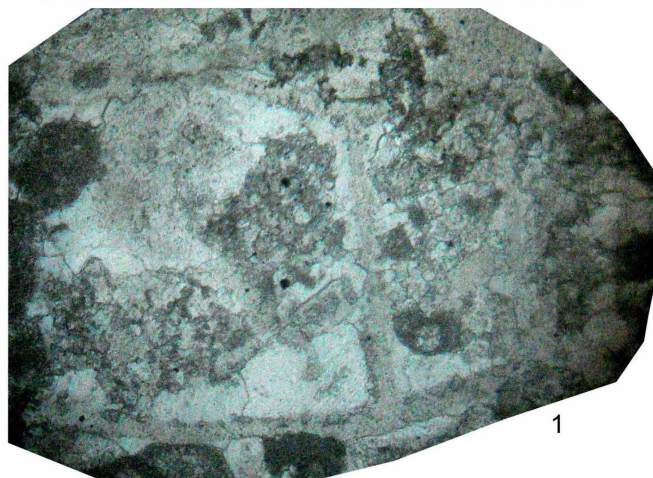
Прийнята до друку 18.04.2019

ТАБЛИЦІ

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tournaisian-early visean algae of Donets basin”

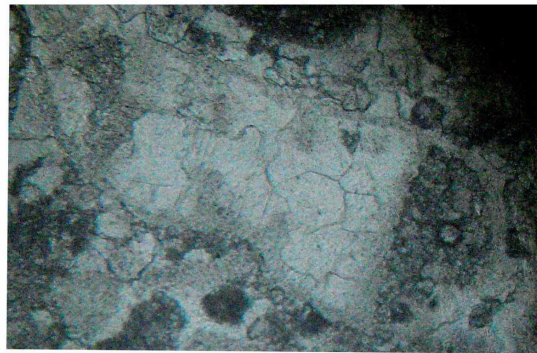
Таблиця І

600 мкм



До статті До статті *Oleg Sukhov*

Таблиця II



1



2

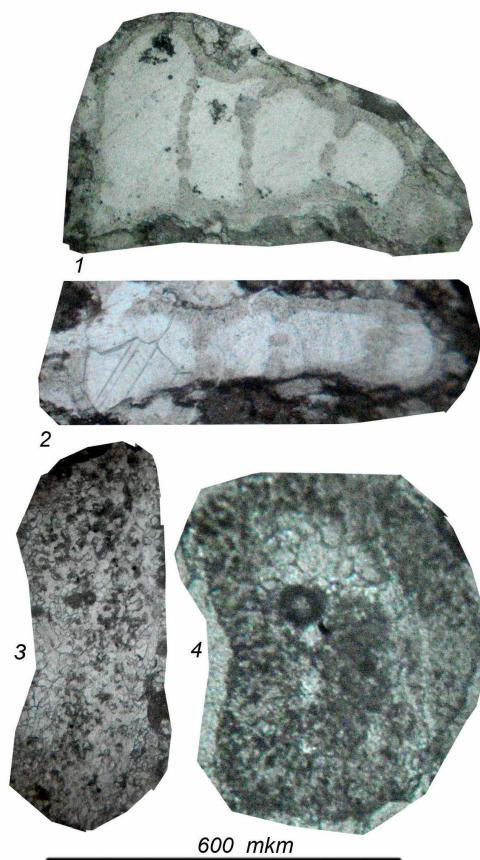


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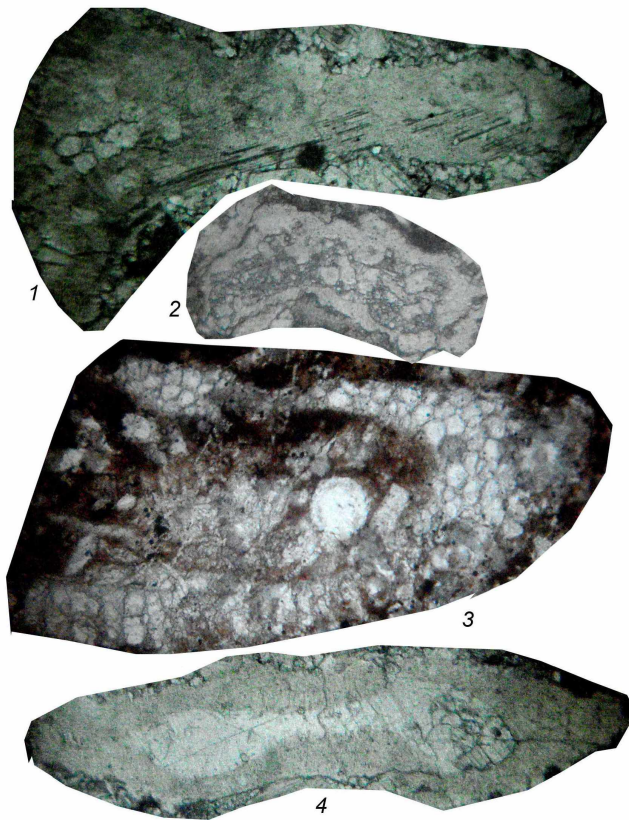
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Таблиця III



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Таблиця IV



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Таблиця V

