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MICROFOSSILS OF THE LATE PROTEROZOIC DEBENGDINSKAYA FORMATION OF THE OLENEKSKIY UPLIFT

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Microfossils from the Middle Riphean Debengdinskaya formation of the Olenekskiy uplift have been studied. Various stenoorganic forms of acritarchs and cyanobacteries are described. Morphological groups which are preliminary compared with large flora taxons are allocated among acritarchs : brown and green seaweed, mushrooms, seaweed located in symbiotic relations (?) with cyanobionts. The prematurity of radical conclusions about age of the deposit based on majority of Proterozoic microfossils is underlined.

Discoveries of cyanobacterial forms from syngenetic silicon of stromatholitic dolomites of Kyutingdinskaya [1] and Debengdinskaya [2] formations were made from the Riphean cut of the Olenekskiy uplift (Figure). Few kinds of stenoorganic acritarchs are described from the well core sample of Debengdinskaya, Khapayskaya and overlying formations [3]. We have extracted a rich microphytologic material from aleuroagrillites of this series. A significant part of taxons of this material is known in the world only from the level of Neoproterozoic. A variety of the obtained association of forms has enabled to isolate few morphological groups of microfossils and to plan their most probable position in systematization of modern plants. The establishment of biological accessory of microfossils is one of the main problems of microphytology of Precambrian. To the greatest degree it is related to the stenoorganic forms considered in the classification of acritarchs – a group uniting vegetative microremains with uncertain systematic position [4, 5]. Questions regarding their nature and natural variability of morphological rows in time are still at the initial stage of studying, which causes the known uncertainty of the majority of results of microphytologic correlation of Precambrian stratons.

Riphean deposits of the Olenekskiy uplift compose the basal part of the Siberian platform cover (see Figure). Their capacity is unsteady and changes from 1200 up to 2150 m [6–8]. Basal layers of Riphean deposits with angular unconformity lie on granitoids and broken through by them metamorphic slates of the Lower Proterozoic [6]. Deposits of the Khorbusuonskaya series, overlapping carbonates and slates of the Khapakhskaya formation with a washout, contain prints of medusoids of the Ediakarskiy type, fine-shell faunae and are related to Vendian [8].

The structure and the sequence of layers of the Debengdinskaya formation have been fully studied by V.Yu. Shenfil, and others [9]. The formation has been divided by them into five sub-formations based on cuts of the river Ochchuguy-Sololi and the watershed with the river Khorbusuonka. The pack of the lower sub-formation, from which the association of microfossils is obtained, is presented by aleurolites and argillites, less often by sandstones, with low-capacity sgtromatolithic horizon (lens). Higher deposits of the formation are characterized by different parity of aleuroargillithic, arenaceous layers and bodies of stromatolithic carbonates which replace each other upwards along the cut and, possibly, in the lateral direction. Despite of bad exposure of sedimentary rocks of the whole Riphean cut, sharp facies variability is predicted as a result of observable changes in structure of stromatolithic constructions and replacement of sandstones by aleuroargillites along the strike [7, 9]. In the lower sub-formation there are structures of wave influence and resedimentation of the deposit. The combination of these attributes specifies existence in Debengdinskiy time of relatively superficial and hydrodynamic restless condition of the proximal shelf. Judging by pinching-out capacities of the whole cut of the Olenekskiy uplift to the West and its presence of formational analogues in cuts of the Udzhinskiy and Anabarskiy areas [6, 8], the whole in Anabaro-Olenekskaya area represented a system of intercommunicating and changing configuration shallow intracratonnal pools.

Age position of the Debengdinskaya formation traditionally leans on two groups of data. Comparison of sequence of form change of stromatolites upwards along the cut with similar trends in the cut of the Anabarskaya area was used for comparison with the age change of their taxons in the stratotypical cut of the Riphean of Ural Mountains and Siberian regions [6, 7]. At stromatolithic correlation the Debengdinskaya formation was deduced by the majority of researchers on the level of the average Riphean or less often concerned to bottoms of the upper Riphean [7]. The radiochronological dating, obtained in the 60th of the last century by the K-Ar by a method by glauconites, makes for the Debengdinskiy formation a consistently increasing number from 1140 up to 1020 million years [7]. The latest isotope researches of clay fractions [10] have shown high probability of formation of Debengdinskiy deposits in the interval 1200...1300 million years. At the same time, it is impossible to exclude the influences on the last result of terrigenous impurity, which make the age of sedimentation older [11]. Then known data on microfossils does not come to an agreement with generally accepted view on middle Riphean age of the Debengdinskaya formation. Most of all it is discoveries of arcitarchs Chuaria Walc., Tawuia Hofm. based on which the conclusion on Neoproterozoic age of the formation [3] has been made.

Morphological variety of the forms taken from the same layers predetermines the allochthonous character

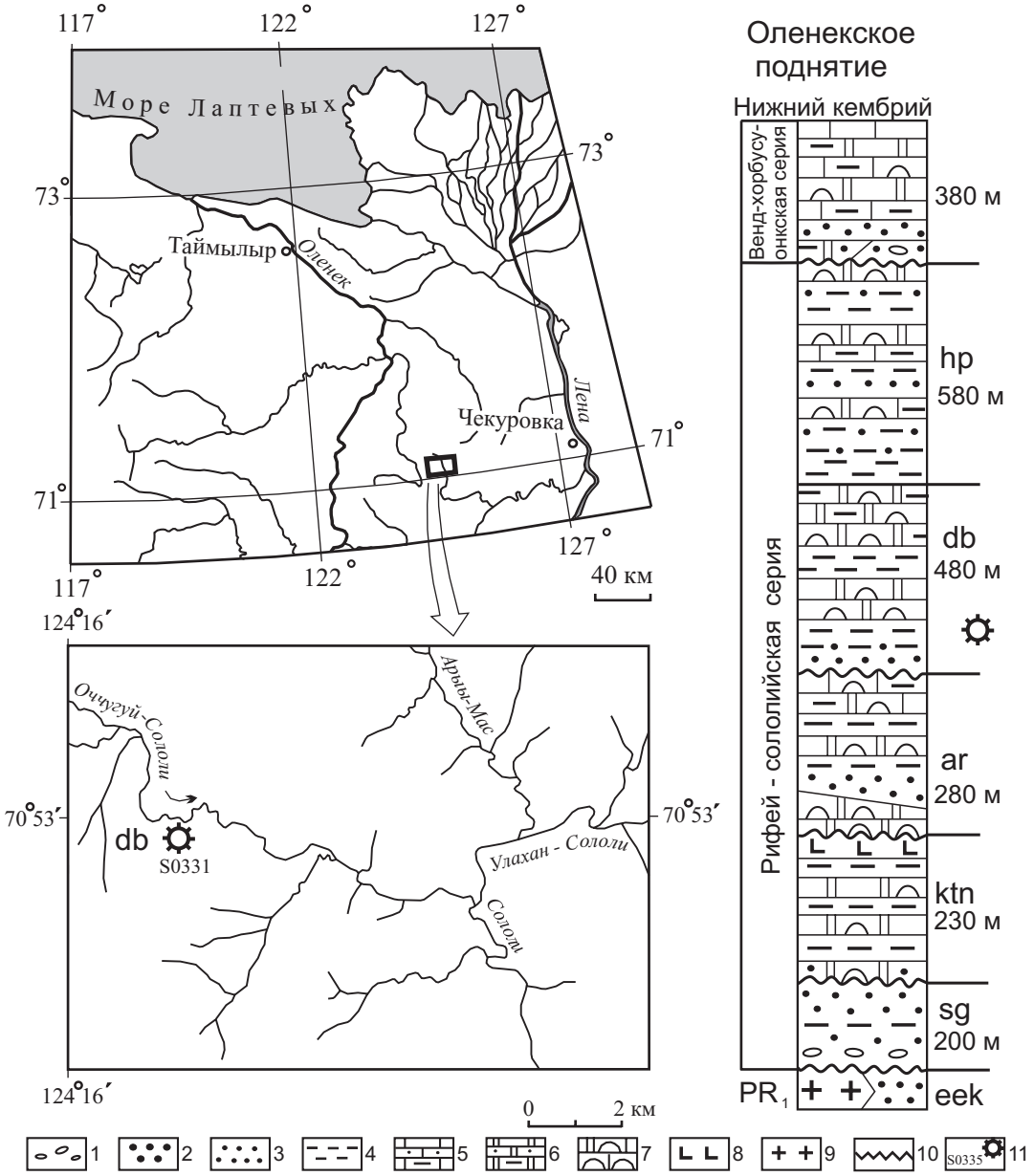

Figure. *The scheme and the stratigraphic column with location of microfossils: 1) conglomerates; 2) gritstones; 3) sandstones; 4) aleurolites, argillites; 5) limestones, arenaceous and aleurolitic limestones, interstratifications of limestones and sandstones, aleurolites; 6) dolomites, arenaceous and aleurolitic dolomites, interstratifications of dolomites and sandstones, aleurolites; 7) stromatolithic limestones and dolomites; 8) diabases; 9) granites; 10) unconformity; 11) location of microfossils and exposure number*

of microfossil sites, and together with the analysis of the burial place environment allows to present possible character of vital activity and the nature of microfossils.

Well preserved remains obviously belong to several various vegetative communities dwelling in shallow conditions of the Debengdinskiy Sea (table I, II).

A significant part of the forms is undoubtedly belongs to cyanobacterial community of stromatolithic constructions (table II, Figs. 1–3, 8, 11–13). Their sizes (up to 150 microns) do not come to an agreement with representations about occurrence of large forms *Obruchevella* only in the Vendian [12]. At the same time, huge sizes of stromatolite columns of the *Conophyton* group, biostromes of which along the lateral replace the layers with microfossils, suggest an idea of favorable conditions for development of hypertrophic developed forms of organisms and constructions produced by them. Short trichomes (table II, Figs. 11, 13), most likely, represent hormohoniums and hormocysts or intergrown akinetes *Oscillatoriales.* Most likely, hormocysts were not a constant compound of cyanobacterial mat, but at the certain reproductive stage of development they abandoned it. Because of that they could not be settled by means of oscillating movement providing faster movement in space [13].

The main background set of microfossils is presented by simple leiospheric forms (table I, Figs. 1–3, 13) and their colonies, and also by shreds of thallus. In a

Table 1. *Microfossils of the Debengdinskaya formation*

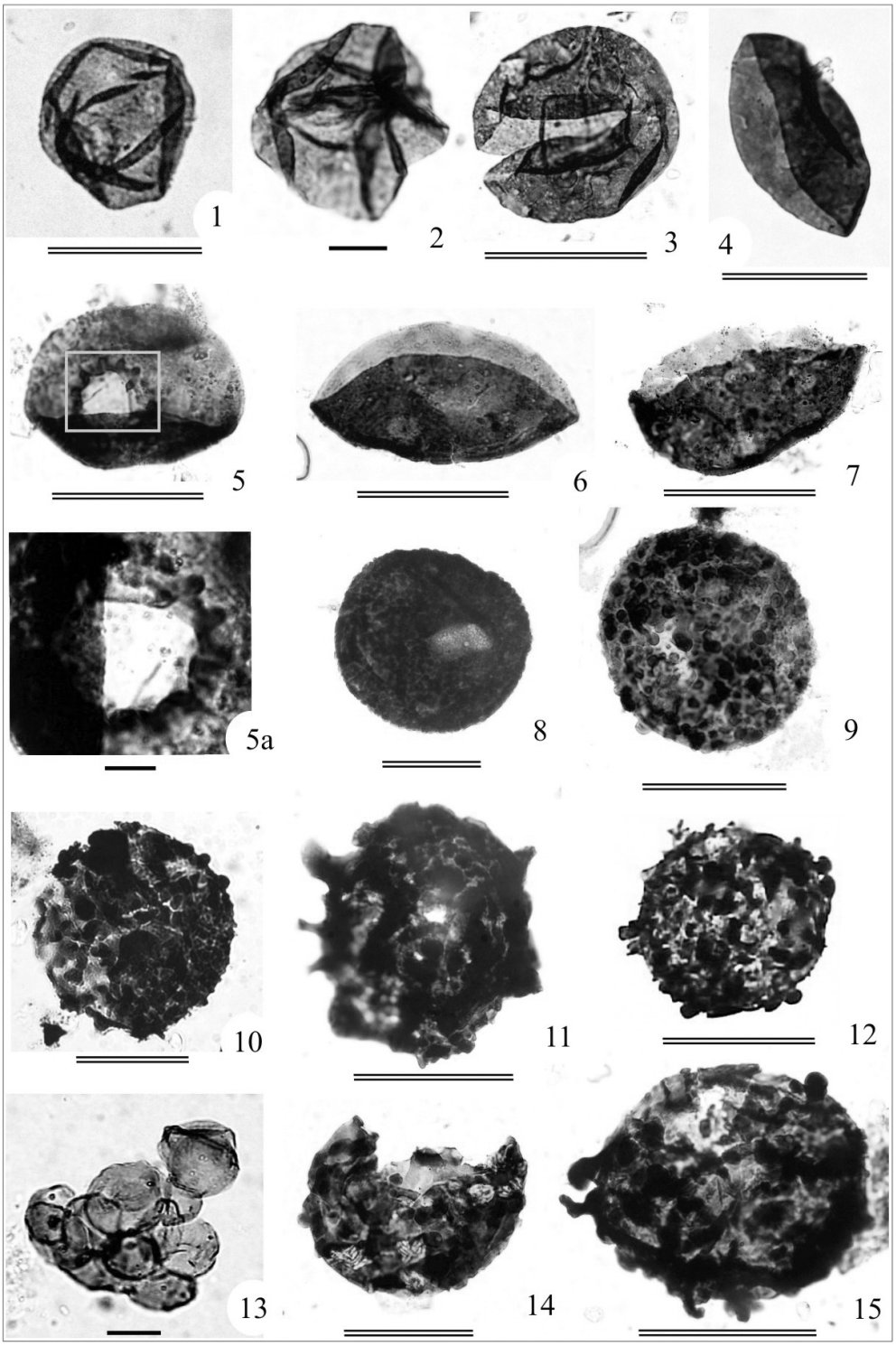

Fig. 1. Leiosphaeridia tenuissima Eis. Specimen №№ 748-Б4б.
Fig. 2. Leiosphaeridia minutissima (Naum.), em. Jank. Specimen № 756-В10б.
Fig. 3. Leiosphaeridia atava (Naum.), em. Jank. Specimen № 755-В9.
Fig. 4, 6, 7. Scaphyta eniseica Tim. 4 – Specimen № 748-Б6; 6 – № 754-Бг; 7 – № 753-А3.
Fig. 5, 8. Leiosphaeridia kulgunica Jank. 5 – Specimen № 753-А4а; 8 – № 748-Б25.
Fig. 9–12, 14, 15. Lophosphaeridium sp. 1 (Nagov.). 9 – Specimen № 753-В4б; 10 – № 747-Б13; 11 – 756-В19а1; 12 – № 748-А12; 14 – № 748-Б11о2; 15 – № 756-В8б.
Fig. 12. Symplassosphaeridium div. sp. Specimen № 756-Д6в.

Dimensional rulers: unary – 10 microns, double – 50 microns

Table 2. *Microfossils of the Debengdinskaya formation*

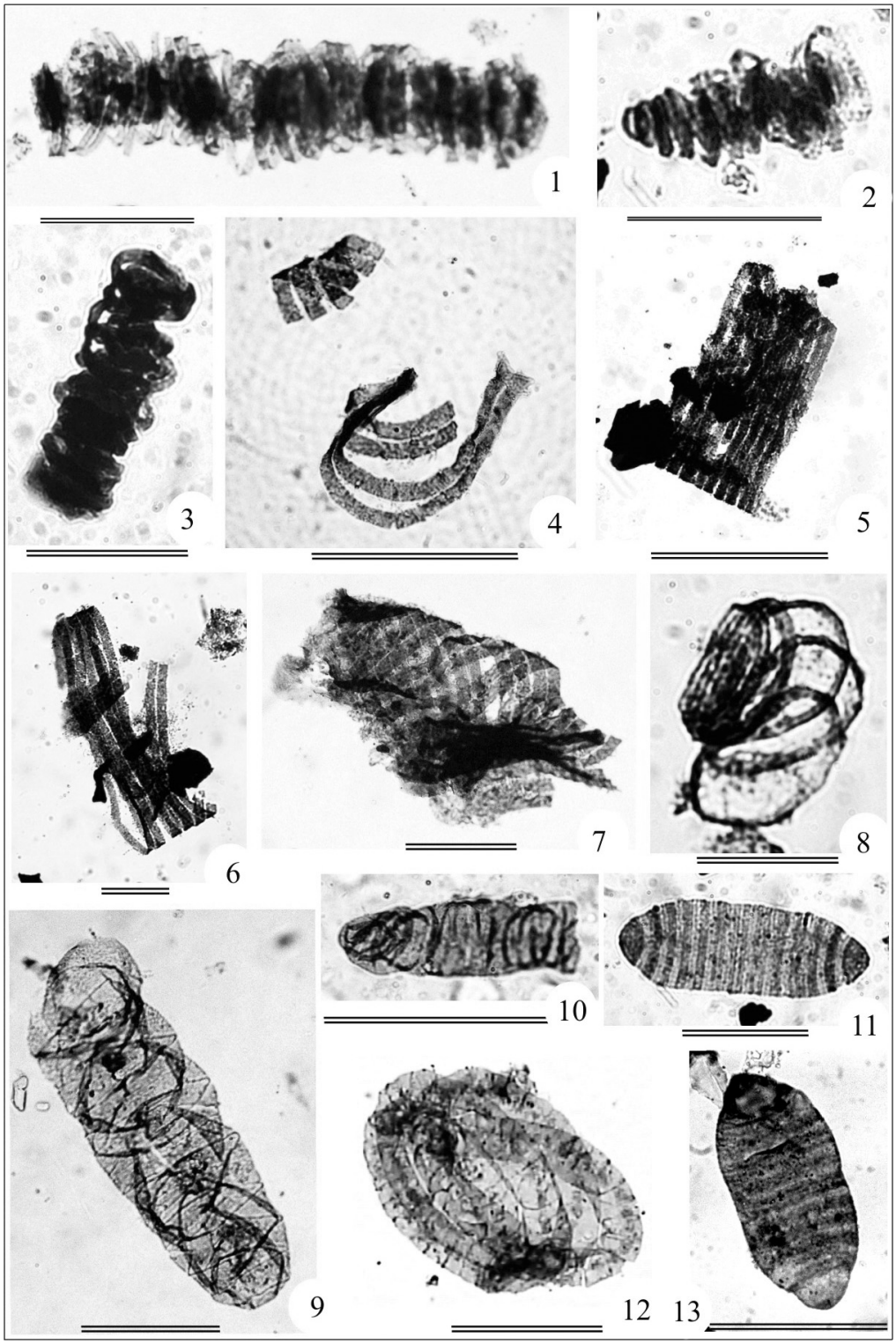

Fig. 1–3. Obruchevella aff. valdaica (Schep. ex. msc.) Ass. 1 – Specimen № № 747-Б1а; 2 -№ 747-В4; 3 – № 747-Г19а.
Fig. 4–7. Glomovertella sp. (ad lib. Plicatidium sp.). 4 – Specimen № 748-Б10б; 5 – № 747-Б16; 6 – № 747-Б18; 7 – № 748-Б10а.
Fig. 8. Glomovertella eniseica Herm. Specimen № 747-А8.
Fig. 9, 10. Elatera rotundata Herm. Tubular forms with a cross-section-helicoid structure; 9 – Specimen № 748-Б18; 10 – № 755-Б7.
Fig. 11, 13. Orculiphycus sp. (ad lib. Tortunema sp.). Hormogonium of oscillating cyanophytes. 11 – Specimen № 747-В25; 13 – № 747-Б7б.
Fig. 12. Glomovertella rotundata (Kolos). Specimen № 748-В5.

Dimensional rulers: unary – 10 microns, double – 50 microns

complex, all of them, most likely, reflect fragments of uniform biocoenosis of brown seaweed [14] representing benthos lithorales, thickets remains of which we can observe only in the form of repeatedly transferred fragments. Forms with warty and rod-like outgrowths (table I, Figs. 9–12, 14, 15) it is possible to compare to sporangiums of lower mushrooms of the class *Zygomycetes* of the order *Mucorales*. Presumably, their outgrowths can be considered as spores or specialized formations which are carrying out protective function. These characteristics and high density of casings testify to dwelling of these organisms in a deposit together with community of brown seaweed.

Segments of the strings twirled in a spiral (table II, Figs. 4–7) would not be logical to compare with taxons of cyanobacteria. But, the discovered large form having the form of a leaf, consisting of spirally located strings similar to described in fragments, entitles for comparison of these remains with benthos of eucaryotic seaweed having symbiotic relations with stromatolith-forming cyanobionts. More specific interpretation demands more extensive material. The group of forms with characteristic scaphoid form in the flattened condition and, probably, during lifetime representing floating «cups» (table I, Figs. 4–7) is of interest for biological interpretation. Among them there are forms with rounded apertures, one of which is framed with proper bumps (table I, Figs. 5, 8). The latter structure can be interpreted as the conjugating channel, characteristic at syngenesis of modern green seaweed of order *Desmidiales*. Proceeding from comparison with modern representatives of green seaweed [15], all these scaphoid forms, most likely, represent a community, reproductive organs which during the certain moment of development come off and convert to planktonic or facultative planktonic condition in order to expand community area.

The group of large remains, with characteristic tubular structure, formed by the system of cross spirals (see table II, Figs. 9, 10) is considered separately. In some specimens there are alternating compressions and expansions which can be interpreted as relicts of chambers. By morphological features these formations are compared with nowadays living foraminifers with similar structure type [16]. They are known since Cambrian mainly as sea organisms.

Thus, even if to consider an inaccuracy of briefly resulted interpretations, sites microfossils of the Debengdinskiy formation contain representatives of different groups of the vegetative and, probably, animal world. The main set of taxons and morphotypes was not earlier known in deposits of the Neoproterozoic [17]. Cited above radiological data testify about Mesoproterozoic age of the Debengdinskaya formation. Similar contradictions are usually resolved in favor of traditional adherence of the expert. In this case it is necessary to pay attention to the general tendency of change of views for the period of occurrence of highly-organized representatives of eucariote. If to consider the data about presence of the latter at a level of the Early Mesoproterozoic [18], then middle Riphean position of the Debengdinskaya «microbiota» is represented quite natural. On the other hand, such conclusion levels the majority of existing views on stratigraphic value of the offered and some other taxons of Precambrian microfossils. It is possible to draw a conclusion on prematurity of application of the majority of known forms of Precambrian acritarchs for the purposes of direct definition of deposit age. The given problem should be solved discretely, in process of isolation of phylogenetic groups and the subsequent establishment in their limits of evolutionary morphological changes.

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EARLY GIVETIAN RUGOSAS OF THE EAST PART OF SALAIR

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The rugosa complexes of several cuts of the Mamontovskiy and Safonovskiy horizons of Salair have been selected and monographically described. Descriptions of deposits are given and their age is specified by the rugosa complexes. Monographic descriptions and photos of fauna are enclosed.

Rugosa complexes of Mamontovskiy and Safonovskiy horizons have been studied by the author during the researches conducted in 2005–2006. The studied collection was collected by the author during field researches in 2003–2004 in structure of the expedition of Kuznetsk Pedagogical Academy. Within the limits of the Altai-Sayanskaya folded area the deposits of Eifel and Early Givetian are more or less widespread only on territories of Salair, which, apparently, is explained by regional regress that had taken place during this time on its territory. Uniqueness for the Altai-Sayanskaya area of deposits of this age makes their all-round studying especially important and actual. Mineral fauna of deposits, allocated as Mamontovskiy and Safonovskiy horizons, is presented by brachiopods, ostracodes, trilobites, pearlsides and corals rugosas. In the past it was studied and described by: E.Z. Bulvanker [1], E.A Yolkin [2], V.A. Ivaniey and S.K. Cherepnina [3, 4], M.A. Rzhonsnitskaya [5], N.Ya. Spasskiy [6], Yu.V. Udodov, O.P. Mezentseva and N.V. Gumerova [7]. In 2006 the researches were continued by the author, rugosas of Mamontovskiy and Safonovskiy horizons were studied and monographically described. The cuts, were the described faunae was picked out, are cited in the given work.

Prokopyevskiy cut is located on the western suburb of Prokopyevsk city, Kemerovo oblast in the left bank of the stream Egos. The studied deposits are opened by two small pits. The strike of layers at the studied site is close to meridian, the falling is practically vertical. The total capacity of the opened by the cut deposits is 60 m. On the detailed geological map with the scale 1:50000, these deposits are attributed to the Kerlegeshskiy horizon but, based on results of the studying of faunae of brachiopods and rugosas, they can be attributed to the Saphonovskiy horizon.

Description of the Prokopyevskiy cut:

1. Blue-gray plate-like limestones with thin horizontal lamination contain an insignificant impurity of terrigenous material. The fauna is as follows: fine brachiopods, gastropods, pearlsides, teeth and scales of fishes and rugosas Grypophyllum gracile Wedekind and Dialythophyllum annulatum (Peetz).
2. Argillo-aleurite limestones with prolayers of poorly argillaceous limestones similar to rocks of the previous interval in the ratio – 3:1. Pearlsides, brachiopods, crinoids, and ostracods prevail in the fauna.
3. Massive, strongly shattered and recrystallized limestones.
4. Grey thin-plate limestones. In structure of fossils are shells of brachiopods and bivalve mollusks; moreover: goniatites, tabulates, crinoids, pearlsides. Ya.M. Gutak has defined the kind Indospirifer pseudowilliamsi Rzonsnickaja from brachiopods.
5. Alternating prolayers of grey limestones and strongly schistic aleurolites with capacity up to 10...15 cm. The fauna it is presented by brachiopods and pearlsides.
6. Grey thick-plate limestones with remains of brachiopods, crinoids, tabulates, and pearlsides. Disphyllum pashiense (Soshkina), Heliophyllum aiense Soshkina, Grypophyllum gracile Wedekind, Calceola sandalina Lamarck are defined from rugosas.
7. Dark grey thin-plate limestones with remains of tabulates and pearlsides.