Kazan Golovkinsky Stratigraphic Meeting 2020

Kazan Federal University
Institute of Geology and Petroleum Technologies

Kazan Golovkinsky Young Scientists' Stratigraphic Meeting 2020

Sedimentary Earth Systems: Stratigraphy, Geochronology, Petroleum Resources

October 26-30, 2020, Kazan, Russia

ABSTRACT VOLUME

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International Stratigraphic Meeting is dedicated Earth systems, stratigraphic events, biotic evolution, sedimentary basins and resources.

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Content

Vendian microphytolites of the Buzhuikhta Formation, Lenskaya gold-bearing province (Bodaibo synclinorium, Irkutsk region)

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Carbon-bearing metasedimentary rocks of the Buzhuikhta Formation (Fm) contain ore deposits. The age of the Buzhuikhta Fm is determined as Vendian (600 Ma) according to LA-ICP-MS U – Pb data obtained for the Ondok Fm of the adjacent Olokit polymetallic region. It is assumed that the Ondok and Buzhuikhta FMs accumulated synchronously.

Petrographic description of the rocks in thin sections reveals the remains of variously preserved microphytolites (0.15 to 2 mm). Microphytolites are best preserved in metasandstones; which area of one standard thin section (2 x 2 cm) contains from 3 to 40 specimens. Silty and phyllitic schists usually contain destroyed and recrystallized microphytolites.

Microphytolites are organogenic sedimentation formations, which are the products of the vital activity of bacteria. As a rule, the remains of microphytolites are very rarely preserved, since their rapid decays, enriching the atmosphere with carbon dioxide.

Microphytolites of the Buzhuikhta Fm are represented by two morphological types: concentric laminated and vesicular.

The concentric laminated type includes the genus *Osagia* Twenhofel, 1919 (Osagia sp., *Osagia* cf. *tchaica* Yakschin, 1972, *Osagia* cf. *libidinous* Z. Zhuravleva, 1964) and the genus *Hieroglyphites* Reitlinger, 1959 (*Hieroglyphites* sp.).

The vesicular type includes the genus *Vesicularites* Reitlinger, 1959 with the species *Visicularites kurtunicus* Yakschin, 1972.

Microphytolite occurrence in the Buzhuikhta Fm indicates the destruction of microphytolite-bearing sediments in the shallow water basin and their transfer to the deep-water environment. Metasandstones was formed in the distal part of the shelf of the back-arc basin.

Lower Ypresian of the Suvlu-Kaya reference section (SW Crimea): stratigraphy and sedimentation conditions

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The Paleogene stratotype for the southern part of the former USSR is the Bakhchisarai section of the southwestern Crimea. The conditions of Ypresian sedimentation are very poorly known, despite the well-developed stratigraphy for different groups of macro- and microfauna. Moreover, there is still no general concept of the division of Ypresian and, in particular, the conditions for its formation. Samples of the rocks are from 10 stratigraphic levels of the Suvlu-Kaya reference section and were studied by methods of lithology and paleontology in order to reconstruct paleoenvironments of the lower Ypresian.

M.A. Ustinova identified three nannoplankton zones according to the global zonal scale (Varol, 1998) in the studied outcrop: NP8 (upper Thanetian), NP11 and NP12 (lower Ypresian), one of them has two subzones: NP11a-c and NP11d. The Ypresian stratigraphy of the Suvlu-Kaya section by this group completely coincides with that performed earlier by A.I. Yakovleva (King et al., 2017). The P. ventricosa - E. (E.) aragonensis ostracode Zone according to the scale (Nikolaeva, 2018) was identified in the Ypresian part of the section. Four new beds with ostracods were established by E.M. Tesakova in the section: beds with *M. pterygota – L. tumefacta*, which correspond to the Np8 Zone; beds with *G. paijenborchiana – B. jonesi* (the Np11a-c and lower part of Np11d subzones); beds with *H. lichenophora* (middle part of the Np11d Subzone) and beds with *E. eocaenica – E. lomata* (the upper part of the Np11d Subzone and the Np12 Zone).

Paleoecological reconstructions based on the ratio of morphogroups of ostracods (smooth / sculpted, with / without an eye tubercle), foraminifera (planktonic / benthic, epifauna / infauna, large / small size) and according to the curves of diversity and abundance were made by complex multivariate analysis. Lithological analysis included a description of thin rock sections, X-ray phase analysis of clays and bulk mineral composition. The results of the above analyzes generally coincided. The lower part of the Ypresian (beds with *G. paijenbogchiana-B. jonesi*) was formed at the initial stage of transgression. The middle part of the section (beds with H. lichenophora) corresponds to the high-standing tract. The upper part (beds with E.eocainica-E. Lomata) corresponds to the regressive phase of the cycle. The method of morphogroups by foraminifera and ostracods was used for the first time in the reference section for Ypresian paleoreconstructions.

Foraminifera of the genus *Lituotubella* Rauser – Chernousova, 1948 from the Upper Viséan of the Sikasya River sections, Southern Urals

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Lituotubella Rauser-Chernousova, 1948 is a genus of benthic foraminifers in the subfamily Lituotubellinae A. Mikhluho-Macllay, 1963, the family Lituotubellidae A. Mihluho-Maclay, 1963, and the order Tournayellida Dain, 1953 (Rauser-Chernousova et al., 1996). Foraminifers of the genus Lituotubella have different large bimorph shell, spiral and straight part of which is subdivided by the intersecting walls on pseudocameras (or very short pseudosepths in the straight part), the ostium in a simple spiral and tube straight parts (usually in the last pseudocameras). They are widely distributed in the deposits of the upper Viséan substage of South Urals.

Material for the work was the collection of thin sections from the Upper Viséan substage of the river Sikasi (Sikaza) stored in Ufa Museum of Geology and mineral resources of Bashkortostan Republic (collection # 640) and Ufa Institute of Geology, Federal Research Centre, Russian Academy of Sciences (collection No. 122). In total, more than 100 limestone sections from two sections of the right Bank of the Sikasi river were studied. The first section "Sikaza" is located 0.5 km downstream from the mouth of the Kuk-Karauk river, the second, "Sikaza at the turn", is located downstream, 2-2.5 km from the first (Sinitsyna et al., 1984). The upper Viséan deposits are divided into the following substages (horizons): Tulian, Aleksinian, Mikhailovian and Venevian.

The aim of the research was to study the morphology of the shell of foraminifera of the genus Lituotubella, the structure of the shell wall, and changes in the shell parameters along the section. The upper Visean substage of the Sikasi river is composed of carbonate rocks, in which there are frequent interbeds of foraminiferous grainstones with numerous.shells of lituotubellas. They are represented by two species Lituotubella glomospiroides Rauser-Chernousova, 1948 and L. magna Rauser-Chernousova, 1948. These species appear in sections sequentially, forming an evolutionary line. In the Tulian deposits there are small forms with a diameter of the spiral part up to 1 mm, the number of revolutions up to 4. Higher in the section, the size of the shell increases, the wall becomes thicker, and is clearly divided into two layers. Representatives of Lituotubella magna are found in the Venevian horizon, reaching a length of more than 2 mm and having up to 4.5 turns in the spiral part.

Late Viséan foraminiferal assemblages of the 106 Borehole of the Orenburg region

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Carboniferous deposits of the South-East of the East European Platform were discovered by a series of oil and gas search boreholes. The 106 Oktyabrskaya Borehole is at the junction of the East-European Platform and the western side of the Uralian Foredeep (Orenburg region). The borehole uncovered Devonian, Carboniferous and Permian deposits. The lower Viséan deposits of the section (29 m thick) are characterized by assemblages of foraminifers, ostracodes, conodonts, spores and pollen. A 289 m thick layer of foraminiferal-algae limestones and dolomites are assigned to the Upper Viséan. The Tulian, Aleksinian, Mikhailovian and presumably Venevian regional substages (horizons) are established using foraminifera. The Tulian deposits, the correlation of which is still debatable, are of great interest in the context of this section. The following foraminiferous zones are distinguished in the upper Viséan Substage:

The *Endothyranopsis compressa - Paraarchaediscus koktjubensis* Zone (Tulian Regional Substage) is set in the range of 3253-3286 m. According to geophysical data, the thickness of the Tulian is about 50 m. The strata are composed of fine- bioclastic wackestones and packstones in the lower part, and foraminiferal ones in the upper part. The foraminiferal assemblage includes: *Paraarchaediscus koktjubensis*, *P. convexus*), *Planoarchaediscus eospirillinoides*, *Endothyranopsis* cf. *compressa*, *Omphalotis* spp., *Endothyra* spp., Palaeotextulariida, *Eoparastaffella* spp.

The *Ikensieformis proikensis* Zone is set in the range of 3186-3252 m. It is composed of bioclastic grainstones, bioclastic wackestones, and algal and sometimes crinoidal packstone. The foraminifera assemblage consists of *Endothyra obsoleta* Rauser-Chernousova, *Omphalotis omphalota* (Rauser-Chernousova et Reitlinger), *Cribrospira panderi* Moeller, *Endothyranopsis compressa* (Rauser-Chernousova et Reitlinger) and *Eostaffella* cf. *mosquensis* Vissarionova, *Ikensieformis proikensis* (Rauser-Chernousova). This assemblage characterizes the Aleksinian Regional Substage.

The overlying interval with a thickness of 41 m is not cored.

The *Ikensiformis ikensis* zone is set in the range of 3120-3168 m, where it is represented by carbonate bioclast and lithoclast grainstones. Foraminifers *Archaediscus* ex gr. *moelleri*, *Asteroarchaediscus* spp., *Spinothyra pauciseptata*, *Endothyranopsis crassa* are met. Numerous algae *Koninckopora* spp. are also present. This assemblage characterizes the Mikhailovian Regional sustage, thickness is 48 m.

The assemblage of *Ikensieformis tenebrosa* Zone presumably determine in the coral-algal boundstone at a depth of 3118-3119 m. The foraminifers *Endothyranopsis umbonata*, *Janischewskina* sp., *Ikensieformis* cf. *tenebrosa* are met in this limestone.

The overlying range of 3070-3117 is composed of dolomites. Perhaps this interval refers to the Venevian. The Viséan/Serpukhovian boundary is drawn using lithology at the base of the stromatolite limestones.

Permian biota in back-arc basins of the Okhotsk-Taigonos volcanic arc (Northeast Asia)

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The characteristics of Permian biota in back-arc basins (Okhotsk, Ayan-Yuryakh, Balygychan, Nyavlenga, and Taigonos) of the Okhotsk-Taigonos volcanic arc (OTVD) are considered. Taxonomic composition of faunistic communities is in many respects similar and includes mainly representatives of *Inoceramus*-like bivalves-kolymiids, some nuculids, and gastropods.

The most numerous and diverse Permian communities are from the Okhotsk basin, where almost all groups of organisms known in the Permian of Northeast Asia are found. The relative diversity of the faunistic communities of the Okhotsk basin is probably due not only to the shallower conditions for the existence of the fauna, but also to more "open" nature of this basin, which can be explained by the existence of the nearby strait within the OTVD. The taxonomic composition of communities in other basins of the OTVD is much poorer, which is evidently largely due to their deep water and predominantly clayey nature of the bottom with a relatively low diversity of biotopes. However, the absence in them of such a nektonic fauna group as ammonoids, as well as crinoids, which characterize the normal salinity of the basin, suggests that they are somewhat isolated from the main water area of the World Ocean. At the same time, in the Balygychan and Taigonos basins, indeterminate spherical radiolarians are known, which could not exist in conditions of significant isolation from oceanic sea masses.

Throughout most of the Permian, the OTVD apparently represented a high land and played the role of a large biogeographic barrier separating the basins of Northeast Asia from the Paleopacific. At the end of the Permian, this barrier was largely eliminated, as evidence by the invasion in the Southern Verkhoyansk basin of tethyan bivalves (*Claraioides* and *Eumorphotis*), ammonoids (*Otoceras*), and conodonts (*Hindeodus* and *Clarkina*).

This study was funded by RFBR, project N 20-05-00604.

Geochemical features of Permian terrigenous deposits of the Omolon Massif (North-East Russia)

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In this report we present some results of geochemical study of Permian deposits from the southeastern part of the Omolon Massif. We investigated the Dzhigdali Formation (Artiskian – Kungurian) which consist from dark-grey tuff-siltstones, the Gizhiga Formation (Capitanian) which compose from green tuffs, grey tuff-siltstones and dark grey diamictites, the Khivach Formation (Wuichapingian) which include grey tuff-siltstones and tuff-sandstones. The main aim of our study – a reconstruction of sedimentary environments using geochemical study of the rocks.

To determine the composition of the sedimentary provinces we used the main petrogen oxides diagram (Roser, Korsch, 1988). At this diagram, the figurative points of the Dzhigdali Formation are located into zones quartz province and provinces of intermediate composition. The figurative points of the Gizhiga Formation are located into zones quartz province and provinces of intermediate and basic composition. The figurative points of the Khivach Formation are located of the province of intermediate and basic composition.

Similar results are given Nb/Y – Zr/TiO_2 (Winchester, Floyd, 1977), La/Sc–Th/Co (Cullers, 2002) и Th/Sc – Eu/Eu_{anom}. (Bhatia, Crook, 1986) diagrams. Figurative points on the diagrams Nb/Y – Zr/TiO_2 (Winchester, Floyd, 1977) and La/Sc – Th/Co (Cullers, 2002) showed that all Permian deposits are close to rocks of felsic and intermediate composition, but the rocks of the Khivach Formation are more "basic" than deposits the Dzhigdali and the Gizhiga Formations. The Th/Sc – Eu /$Eu_{anom.}$ diagram are given similar results (Bhatia, Crook, 1986). Here, the figurative points of the rocks of the Dzhigdali and the Gizhiga Formations are related by zones of intermediate-felsic composition, and the figurative points of the rocks of the Khivach Formation are related by zone of basic composition.

U-Pb SHRIMP exploration of zircons from deposits the Dzhigdali and the Gizhiga Formations are showed on several sources in the Omolon Basin (Brynko et al., 2019; 2020). Pre–Cambrian zircons are associated with erosion of basement deposits of the Omolon Massif. Zircons of Carboniferous age are associated with the Middle Paleozoic volcanic rocks of the Kedon series and Permian population of zircons, probably, linked with volcanic activity (pyroclastic and volcaniclastic material) of the Okhotsk-Taigonos volcanic arc.

The above studies suggest that there were several sources of the removal of clastic material into the sedimentary Omolon basin: for sediments of the Dzhigdali Formation, the main sources were the Kedon series of felsic and intermediate volcanic rocks and pyroclastic material from the Okhotsk-Taigonos volcanic arc. The deposits of the Gizhiga Formation had the following sources of demolition: Pre-Cambrian metamorphic deposits, the Kedon series of volcanics, pyroclastic and volcaniclastic material of the Okhotsk-Taigonos volcanic arc. In the late Khivach time, only erosion products of the arc, without pyroclastic material, entered the basin, which, apparently, indicates the attenuation of the activity of the Okhotsk-Taigonos volcanic arc (Biakov, Shi, 2010). The Okhotsk-Taigonos volcanic arc by its geodynamic nature was ensimatic, probably, as evidenced by studies of the rare earth elements of its volcanics deposits (Isbel et al., 2016).

This work was partly supported by the Russian Foundation for Basic Research (Project no. 20-05-00604).

Correlation of geophysical search features of shungite-bearing deposits with geological prerequisites for prospecting (Onega basin, Russia)

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Shungite-bearing formations of the Onega structure of the Fennoscandian Shield are developed within the Ludikovian and Kalevian horizons of the Palaeoproterozoic of Karelia. The most carbon-rich are the nine horizons of shungite-bearing rocks identified in the Zaonega Formation of Ludikovian horizon. The thickness of the horizons is usually the first tens of meters. The genesis of shungite-bearing rocks deposits is considered within the framework of the diapir model. The structural prerequisites for prospecting can be distinguished: the shape of deposits (dome structures), their confinement to third-order anticlines within the synclinal structures of the second order (Tolvuiskaya, Khmelozerskaya and other synclines of the Onega synclinorium), a system of domes located on the same wavelength. Stratigraphic prerequisites are: the formation of dome deposits on to the sixth shungite-bearing horizon, increased radioactivity of the rocks of the seventh shungite-bearing horizon, the presence of a shungite-chert-dolomite complex in the section of the Zaonega Formation.

The work shows how the geological features of shungite-bearing rocks deposits manifest themselves in geophysical fields using the example of two areas within the Tolvuiskaya syncline. At the Ogorovtsi, the shungite-bearing rocks deposit is overlain by Quaternary of low thickness and the shungite-bearing rocks of the seventh-eighth horizons. An intense negative anomaly of self-potential was discovered, presumably caused by the shungite-bearing rocks of the eighth horizon. The isometric anomalous zone is distinguished on the plan of isolines of the exposure dose of gamma radiation, apparently corresponding to the rocks of the seventh shungite horizon, the so-called gamma-reference. At the Tetyugino, on the plan of isolines of the difference of potential of the natural electric field, taking into account the known geological information on the site, it is possible to distinguish the ninth-seventh shungite-bearing horizons. In the southwestern part of the plate, a linear boundary is well recorded, which characterizes the transition between the anticline and syncline. The central part of the diapir structure is fixed by the median gradient method. A regional and local faults are traced across the entire area, most likely formed as a result of the development of the diapir structure.

Thus, using geophysical methods, it is possible to determine the isometricity and size of shungite-bearing rocks deposits (the median gradient method, gamma-spectrometric survey), their confinement to third-order anticlines, and the presence of a marginal syncline (the natural electric field method), as well as the presence of local overdome block tectonics (the median gradient method).

The study was conducted as part of a state project accomplished by Institute of Geology of the Karelian Research Centre of the Russian Academy of Sciences.

Lithochemical features of shungite from Shunga deposit (Onega Basin, Russia)

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Onega basin, Russian Fennoscandia, is stratotipical for shungite-bearing rocks of Precambrian. The c. 2000 Ma, 900-m-thick, Zaonega Formation in the Onega basin, contains one of the greatest accumulations of organic matter (OM) in the early Precambrian during the period known as worldwide Shunga Event. Zaonega Formation rocks are greenschist-facies volcaniclastic greywackes, dolostones, limestones, shungite-bearing rocks, mafic tuffs and lavas intruded by numerous mafic sills. Several sedimentary beds are enriched in OM with the overall content of total organic carbon (TOC) ranging from 0.1 to 16 wt.%. The maksovite and shungite are most rich in TOC (15 to 45 and 45 to 80 wt.%, respectively) and consists of SiO2, Al2O3, S, and minor K, Mg, Fe, Ca and Ti. The shungite-bearing rocks occur in nine stratigraphic levels in the form of stratified beds and dome-like bodies.

The chemical composition of shungites of the Shunga deposit has been studied by many researchers. It was noted that variations in the composition of shungites are quite large even within the same stratified bed both vertically and laterally. With an average carbon content of about 50% in individual parts ("interlayers"), it rises to 80%. At the same time, it is difficult to draw clear boundaries between shungites with different carbon contents. The current work attempts to reveal some major lithochemical features of the shungites within Shunga deposit. Due to a high content of OM, the maksovites appear to be opaque under transmitted-light, thus traditional optical petrography has a limited use for their detailed study and classification. Hence, a geochemical approach has been employed for classifying the rocks and for revealing their major geochemical features. The shungite chemical composition has been calculated for TOC-free basis, and a rock-classification of Yudovich and Ketris has been used to categories TOC-free chemical basis of shungites. Based on a (TiO2+Al2O3+Fe2O3+FeO+MnO)/SiO2 ratio (GM), the classification reviled two groups, namely, miosilites (GM=0.21-0.30) and siallites (GM=0.31-0.55).

Inhomogeneities in the composition of the shungite mineral matter are due to the presence of various micas. Three groups are distinguished, corresponding to samples from the bottom of the lower layer, the roof of the upper layer, and rocks occupying an intermediate position. The rocks of the bottom of the lower layer are similar to schungite-bearing rocks of the eighth schungite horizon of the ZaonegaFormation, the remaining samples are similar to fluidolites of the Melnichnaya schungite deposit.

The free groups of shungite exhibit the following geochemical features:

1. A positive correlation between (Na2O+K2O) and (Al2O3/SiO2), and between TOC and 2O contents, which is also characteristic of maxovites.
2. No distinct boundaries between shungites with different content of carbon.
3. Shungites differ from maxovites in all lithochemical parameters, excluding the iron module.

The established geochemical regularities have a potential to assist in correlation of distant exposures, as well as, drilled section within Onega basin.

This work was carried out as part of the state assignment of IG KarRC RAS.

The garnet-biotite temperature indicator for the Kozhim massif (Subpolar Urals)

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The Kozhim massif is considered to be the group of granite bodies located on the banks of the Kozhim river in the basins of the Epkoshor, Ponyu and Oseyu streams. The massif, which is a formation intrusion consisting of A - type granites (according to Chappell), breaks through the deposits of the middle riphey puivinsky formation in the vaulted part of the Lyapinsky anticlinorium (Subpolar Urals). The rocks of this massif are highly cataclysmic and shale-formed. The most preserved kozhim granites are dense gneiss-like medium-grained rocks of pink color with a greenish-gray tint. The mineral composition of the granites are presented potassium-sodium feldspar (at most 50 %), plagioclase (at most 20 %), quartz (at most 40 %), biotite (at most 5 %), muscovite (at most 7 %). Biotite is represented mainly by marsh-green small scales (up to 0.1 mm) in the main mass of the rock. This mica is sometimes found as inclusions in feldspar grains. According to the chemical composition, the mineral belongs to the high-iron difference of biotite. Zircon, apatite, garnet, orthite, titanite is most often occur among the accessory minerals of the Kozhim massif rocks. Garnet of this massif is represented by translucent and transparent pink crystals of rhombododecahedral habit. The size of the mineral grains is 0.1-0.50 mm. The inclusions of biotite, apatite and titanite growths are observed in the garnet grains. According to the results of microprobe analysis, the mineral belongs to the almandine variety. The average content of garnet in the Kozhim massif granites is 20 g/t (by M. V. Fishman).

Garnet-biotite equilibrium is one of the most common parageneses. The "garnet-biotite" can be used as an indicator of the temperature regime for rocks of the Kozhim massif. The method of L. N. Nikitina was used to calculate the temperatures for the calculated mineral pair. It considers the dependence of the distribution coefficients of iron and magnesium between garnet and biotite on temperature. The applied indicator, unlike many other garnet-biotite geothermometers, does not depend on the content of calcium, manganese in garnet, titanium, aluminum in biotite, and pressure. The temperature of formation of the Kozhim massif granites lies in the range from 713°C to 815°C by means of the Nikitina garnet-biotite geothermometer. The obtained data confirm the author's early conclusions about the high temperature of the rocks of the studied massif.

Changes in seawater chemistry and the long recovery of metazoan reefs in the Early Carboniferous

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The ecological significance of the Late Devonian mass extinctions / taxonomic diversity decline, which considered as the largest biotic crises in Phanerozoic (Sepkoski, 1996; Walliser, 1996; Fan et al., 2020), is illustrated by the further long-term (up to 23 Ma) recovery of metazoan reef ecosystems (Yao et al., 2020). It is believed that the main barriers for rapid resurgence of coral bioconstructions were the anoxic conditions in the mid-Tournaisian seawater, as well as the mid-Tournaisian & early Visean glaciations and the associated sea-level drops (Yao et al., 2020).

Traditional views based on modeling the variations of the Mg^{2+}/Ca^{2+} ratio in the Phanerozoic oceans (spreading rates estimation data) suggest that the "calcite seas" changed to "aragonite seas" in the late Visean (Hardie, 1996; Stanley, Hardie, 1998; Ries, 2010). It was also established that the mineral composition of carbonate sediment depends on the temperature and the content of other ions in seawater (Morse et al., 1997; Bots et al., 2011; Balthasar, Cusack, 2015), thus the real situation of the early Carboniferous "switching" could be more complex.

Recently, we hypothesized that a shift in the predominant sediment from calcite to aragonite took place in the mid-Tournaisian (Dub et al., 2019). This is evidenced by the abundance of calcareous green algae, presumably mainly aragonitic (Ries, 2006; Stanley et al., 2010; Granier, 2012; Ivanova, 2013), deposits with very high $\delta^{13}C_{carb}$ values (Romanek et al., 1992; Buggisch et al., 2008; Saltzman, 2005; Swart et al., 2009; Yao et al., 2015), and lowering of Sr concentrations in biological low-Mg calcite together with increasing of its values in bulk samples of carbonates (Steuber, Veizer, 2002; Mizens et al., 2014) in the lower part of Upper Tournaisian. Apparently, by the beginning of the Visean, the seas became "calcitic", as indicated, in particular, by the appearance of *Koninckopora* composed of calcite (Wright, 1981; Granier, 2012).

Most likely, organisms with a calcite skeleton (e.g. colonial corals) found it harder to maintain their physiological processes in the "aragonite seas" than the aragonite ones in the "calcite seas" (Porter, 2010; Kiessling, 2015). Hence, the rapid re-emergence of metazoan reefs could be hindered by significant changes in the chemical composition of seawater in the Tournaisian and Visean.

The use of Raman spectroscopy in research of Paleoproterozoic ministromatolites of Karelia

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There are numerous microbialites in carbonate rocks of paleoproterozoic complexes of Karelian province on Fennoscandian shield. In 2005 V.V. Makarihin and P.V. Medvedev show the unified classification of microbialites based on Botanical Nomenclature distinguished with the use of formal morphology features. In this classification phytogenic buildings are classified as division *Lytophyta* that subdivided to *Oncolytophytina* (floating structures) and *Stromatolitophytina* (sessile structures). The subdivision *Stromatolitophytina* consists of five classes. The class *Ministromatophyceae* (ministromatolites) is chosen for detailed research. This class was classified because of diameter and height of structures that usually less than 1 cm.

The detailed analysis of column non-branched small domed ministromatolites *Klimetia torosa* confirmed its biogenic nature. Individual petrographic thin sections for this study was chosen from the collection of the laboratory. High-resolution Raman spectrometry Nicolet Almega XR with the use of confocal lens 50x magnification and solid type screw in laser DPSS with the spectral range of 785 nm and with capacity of 150 MW was used for the research. First, the dolomite composition of rock and ministromatolites was confirmed, the accessory minerals as quartz, rutile, fluoro-apatite, hematite were found. Second, two components that usually form the lamination were distinguished while the analysis of columns: light mineral aggregares and dark pelitic clotted material of different forms and shapes. Third, the diverse morphological structures were found in dark pelitic clotted component: round, elongated and twin spherical shapes covered on the surface. The colonies of spherical and thread forms are in size ranging from first up to tens microns. There are numerous frequency of these forms and their irregular distribution through the entire area in the layer as well as on the surface of researched part of the specimen. Due to the comparative analysis it was found that these forms have similar sizes and shapes with morden cyanobacteria suggesting the structures are biogenic. Last, the spectra of carbonaceous material in thier composition support this point of view.

Another most common column paleoproterozoic ministromatolites of Karelia were recently analyzed in the same way with Raman spectroscopy. The results show the rock composition, the morphology details of ministromatolites, the carbonaceous material in pelitic clotted component. Also the morphology and Raman spectrum of fixed iron bacteria are demonstrated in this research. This processed material wil be represented at the meeting.

The lithogenesis peculiarities of the Vereyian horizon sandy reservoirs in territory of the Tatarstan

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In recent years, oil producing companies of Tatarstan have been actively involved in development of oil deposits of the Vereyian horizon of the Moscovian stage of the Middle Carboniferous system. At the same time, the lower carbonate parts of the section of the Vereyian horizon do not cause problems at choosing technologies for their development. The development of upper terrigenous-clayed sediments is present certain difficulties. The main reasons are high degree heterogeneity of reservoir rocks and their poor lithological and mineralogical knowledge. A detailed study of oil-bearing sandy reservoirs was carried out for features of reservoir properties formation of in the process of post-sedimentation lithogenesis. The objects of study were core material of wells that penetrate the layers of the Vereyian horizon in the eastern side of the Melekess Depression. Considering the tasks, the main research methods were optical-microscopic and X-ray analyzes.

It was found that the main reservoir rocks of the Vereyian horizon upper member are fine-grained sandstones and silty sandstones that formed during regressive cycle of shallow paleosea of that time. In the process of terrigenous reservoirs formation, they were under the influence two stages of lithogenesis. The first stage included sedimentogenesis and early diagenesis. At this time, there was an accumulation of terrigenous material, its compaction, dehydration. The rock also acquired an indistinctly laminated texture due to predominant subhorizontal orientation of the mineral fragments in it. As sediment subsidence and lithostatic pressure increased, the grains of mineral fragments acquired a dense structural packing close to rhombohedral. Large muscovite flakes and orthoclase grains bear traces of mechanical deformation in form of splitting. In the early diagenesis, cementation of clastic component with pelitomorphic calcite occurred.

The second stage of lithogenesis was associated with water-gas and water-oil fluids migration. The incoming acidulous solutions contributed to dissolution of calcite from terrigenous rocks cement, the partial removal of dissolved substance outside the forming reservoir layers and formation of authigenic sparitic calcite. Framboidal pyrite was formed on relatively large calcite grains due to the vital activity of sulfate-reducing microorganisms. During periods of pore solutions increasing alkalinity, the process of dissolution of very fine-grained quartz and larger quartz fragments regeneration took place. Subsequently, the formed pore space was filled with oil, which suspended all subsequent processes of mineral matter transformation, preserving them to this day. The indicated stages and processes of transformation formed the terrigenous reservoirs of the Vereyian horizon upper member.

Late Paleozoic Odonata assemblages of the East European Platform

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Fossils of Odonata are quite rare and account for about 1–4% of total insects in most Late Paleozoic (Carboniferous and Permian) localities. This is due to both the peculiarities of the setting of the burial and the habitat of odonates. Odonata are usually buried in sediments of small stagnant, or weak-flowing and marginal water bodies, geologically interpreted as lacustrine or more rarely lagoonal and marginal-marine facies. In the Late Paleozoic, odonates are represented by four main ecological types: 1) large-sized unspecialized meganeurids; 2) medium-sized broad-winged ditaxineuroids; 3) medium-sized petiolate-winged permagrionids; 4) small petiolate-winged kennedyids (Vasilenko, 2013).

Nine Late Paleozoic localities of fossil Odonata are known from the East European platform. There are Kamensk-Shakhtinsky (Bashkirian; Rostov Region), Chekarda (Kungurian, Perm Region), Tyulkino (Ufimian, Perm Region), Soyana (Kazanian, Arkhangelsk Region), Tikhie Gory (Kazanian, Tatarstan), Kityak (Kazanian, Kirov Region), Isady (Severodvinian, Vologda Region), Kargala and Vyazovka (Severodvinian, Orenburg Region) (Martynov, 1930; 1937; 1938; Nel et al., 2012; Vasilenko, 2013; Felker, 2020).

Among the above localities, we distinguished several varieties, showing the relationship between the ecological types of Odonata found in them (Vasilenko, 2013) and the assumed conditions of their formation. Thus, in the Late Paleozoic of the East European Platform, there are three main groups of odonate assemblages. (1) The assemblages of Soyana and Tyulkino preserved in lagoonal deposits show a marked predominance of Meganeuridae. (2) The assemblage of Chekarda, formed in the zone transitional between the river delta and brackish lagoon, shows dominance of relatively small and medium-sized odonates of families Ditaxineuridae and Kennedyidae. (3) The assemblages of Isady and Kityak deposited in fluvial facies contain only petiolate-winged protozygopterans Kennedyidae and Permagrionidae. Odonata are known from very few specimens in the Tikhie Gory (3 specimens), Kargala (5 specimens), Vyazovka (1 specimen), and Kamensk-Shakhtinsky (2 specimens) localities, so it is difficult to link their ecology and the paleoenvironment.

Magnetostratigraphy of the Permian-Triassic continental sediments: Voskresenskoe section, central part of the Russian Platform

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Magnetostratigraphy of the Permian-Triassic boundary of the East European platform is actively discussing, and new paleomagnetic data on the P-Tr sedimentary sections may significantly improve the regional magnetic polarity scale. One of them – Voskresenskoe section – is located in the central part of the Russian Platform (N56.83°, E45.43°) in the Nizhniy Novgorod Region, on the eastern part of the Moscow Basin (syneclise), and represented by the red-colored terrigenous rocks. Detailed paleomagnetic studies of the Voskresenskoe section were carried out by our team for the first time in 2019: 80 oriented block-samples were taken from of overlapping trenches on the right bank of Vetluga River. In total 132 specimens were cut from them. Total thickness of sampled stratigraphic interval is about 18 m.

Detailed temperature demagnetization revealed the presence of characteristic component of magnetization (ChRM) both normal and reversed polarity. The lower part of the section (lower part of Vyatka Formation, Upper Permian) are magnetized during the normal polarity time. The samples from the upper part of Vyatka Formation contain reversed polarity ChRM; in the upper part of the section, corresponding to the lower Triassic, the reversed polarity zone replaces by the normal polarity zone.

The most interesting result of this study is that ChRM of 24 samples from two layers (~1.5 m in thickness) in the Upper Permian interval has an enigmatic direction and does not correspond with expected paleofield direction for the East European platform in Permian or Triassic: this ChRM is characterized by shallow inclination and WSW declination. Similar anomalous interval of magnetic record was recently found in Nedubrovo and Balebikha sections (Vologda Region, Russian Platform). The presence of the same anomalous interval in the Voskresenskoe section can be considered as an indication on its regional (global?) distribution, and gives the opportunity to use this paleomagnetic zone as a regional magnetostratigraphic marker.

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New NMR Relaxometry method for assessing the content of organic matter in rock on the example of the Boca de Jaruco oilfield

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The new NMR relaxometry method, including the simultaneous registration of the decay of free induction (FID) and the decay of the transverse magnetization of the Carr-Purcell-Mayboom-Gill (KPMG) sequence, followed by the determination of their amplitude-relaxation characteristics (deconvaluation), has demonstrated high efficiency for determining the group and phase composition of heavy oils. In this work, this FID + KPMG method was used for the first time to assess the content of organic matter (OM) and type OM in rock samples taken along the section of the productive formation of the Boka de Jaruco oilfield. In parallel, the same samples were examined by thermogravimetry (TGA).

The NMR relaxometry method is based on the fact that the initial amplitude of relaxation decays is strictly proportional to the number of protons in the sample and, consequently, to the OM content in the sample. The total initial NMR decay amplitude (A_0) is determined as the sum of the amplitudes of the liquid-phase (A_{0L}) and solid-phase (A_{0S}) decay components, which in turn is calculated from the fitting using the Voight and Abraham model functions, respectively.

For each of 10 rock samples taken from the depth interval 601-708 m, the OM content was determined by the formula OB (NMR) = (A_{0S} + A_{0L}) * k / m, where k is the conversion factor, m is the mass of the rock sample.

In this work, the thermal parameters of the rock were used to determine the OM (TGA) content as the sum of the rock mass loss (% wt.) In the temperature range Δ 200-400 °C and Δ 400-600 °C: OM (TGA) = $\Delta m_1 + \Delta m_2$.

The distribution of OM (TGA) along the section showed that in the upper part of the section at a depth of 601 m and 606 m, their lowest value is noted, and the maximum at the maximum sampling depth. The distribution of OM (NMR) over the depth of the section shows a similar pattern, which allowed us to assume that there is a linear correlation between these two methods. A quantitative assessment of the correlation relationship for all 10 samples showed that the correlation coefficient has a value of 0.97. Moreover, the linearity coefficient is very close to unity (0.9743).

To characterize the OM in the TGA method, the parameter F = Δm_1 / Δm_2 is used. It turned out that there is a connection between the parameter F and the ratio of the amplitudes of the liquid and solid components of the NMR signal A_{0L} / A_{0S}, confirmed by a high correlation coefficient of 0.9.

Outcrop of Mechetlino II as a new object of the Yangan-Tau Geopark

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The Mechetlino II outcrop is located on the right bank of the Yuryuzan River (Republic of Bashkortostan), 200 m downstream of the Mechetlino section, which claims the role of the Global Stratotype Point (GSSP) or "golden nail" of the Kungurian stage of the Permian system and is the main object of international importance Yangan Tau Geopark. In September 2019, Yangan Tau was included in the global network of UNESCO Geoparks, becoming the first Geopark in Russia to receive such a high status. At the initiative of the Geopark management, work was carried out to study the outcrops along the Mechetlino outcrop to create a geological trail for tourists. Therefore, the work devoted to the study of the outcrop, which in the future may become part of the Geopark, is relevant. Also, the relevance of the study is due to the fact that a detailed study of brachiopods, one of the important for the stratigraphy of Permian deposits of fauna groups, was carried out for the first time.

The aim of the work is to study the Mechetlino II outcrop as one of the objects of the geological trail of the Yangan-Tau Geopark. Tasks: sampling and dissection of brachiopods, establishing the taxonomic composition of brachiopods and describing the species encountered, determining the age and conditions of formation of the studied sediments, assessing the prospects of outcropping as one of the objects of the Geological Trail of the Yangan Tau Geopark, compiling a guide to brachiopods for the museum complex Mechetlino. Material for research was collected during field work in the summer of 2018.

In the Mechetlino II outcrop, outcrops of organogenic limestones with numerous brachiopods are observed, together with which segments of crinoids and bryozoans occur as separate interlayers. Studied 19 specimens of brachiopods of different preservation. The systematic composition of the complex includes seven species: Dictyoclostus uralicus (Tschernyshew), Martinia incerta Tschernyschew, Productus aagardi Tonla, P. artiensis Tschetpuschew, P. septentrionalis Tschernyschew, P. transversalis Tschernyschew, Terebratuloidea triplicata (Kutorga) . The age of the deposits is determined as the Artinskian stage of the Permian system. Correlation of the Mechetlino II section with other regions has been carried out. The presence of brachiopods, bryozoans, and crinoids indicates that a warm shallow-water basin with a normal salinity level existed in the studied area in the Artinskian Age. A detailed study of brachiopods from the Mechetlino II outcrop was carried out, the result of which was the decision to include it in the geological trail as a separate observation point, equipping the stop point with an information board. A description of all discovered species was carried out, the results of which were included in the Keys to Permian fossils of the Mechetlino section and transferred to the Yangan-Tau geopark.

Possibilities for correlation of Permian evaporites based on cosmic microspherules

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Biostratigraphic, lithological, mineral-geochemical methods, as well as a determination of the absolute age of sedimentary rocks, often do not allow correlating the productive strata within individual deposits. We have shown previously that cosmic magnetic microspheres (less than 1 mm in diameter) can become an additional tool for dissection and correlation of the same-age sedimentary rocks. Microspherules are well preserved for a long (hundreds of millions of years) geological time in marine and continental environments, so they can also help in the correlation of polyfacies strata.

The purpose of this study is to compare the gypsum layers of the Kamsko-Ustyinskoye and Baymatskoye deposits (Roadian deposits of the Guadalupian series of the Permian system) Kamsko-Ustyinskoye and Baymatskoye gypsum fields is located 66-84 km southern from Kazan city intheright bank of the Volga River in the European part of Russia. The research tasks included detection of microspheres from the rocks (gypsum, anhydrite, dolomite) of the mentioned deposits, analysis of the morphology, the mineralogical and chemical composition of microsperules. Previously, we studied single samples of gypsum from both deposits.

We selected 12 and 10 core samples from the lower and upper layers of gypsum respectively in the Baymatskoye field and 16 and 10 samples from the same layers in the Kamsko-Ustinskoye field. All samples were powdered in an agate mortar. Then magnetic minerals were extracted from each sample (the average weight of one sample is ~80 grams) using a neodymium magnet, among which microspheres were selected under a binocular microscope. In total, we detected more than 70 microspherules and 5 drop-shaped particles.

We found that microspherules have a size distribution of 5-150 microns and different surface textures: A - wrinkled, B - lattice-like, C - feathery, D - scaly, E – fractured. The EDS results (tab. 1) showed that all microspherules consist of iron oxides and contain impurities Si, Al, Ca, Ni, Cu, Mg, Mn, etc. , both on the surface and in the inner part. The results of Raman spectroscopy showed that the microspherules are composed of magnetite.

Microspherules are quite common and evenly were found in the upper and lower layers of the Baymatskoye field, and in the Kamsko-Ustinskoye field. In the lower layer of the Baymatskoye field the number of microspherules is greater than in the upper layer. Often their number in one sample is more than 5.

The similarities in the structure and composition of magnetic microspherules from the upper and lower gypsum layers of 2 deposits indicate their common genesis. The spherical and drop-shape forms, size of microspherules, surface dendrite textures, and magnetite composition indicates high-temperature origin. All of these suggests ablation origin of findings from the large meteoroids and cosmic dust.

According to the results, the studied microspherules are common and recognizable objects of good preservation. This makes it possible to use the findings of magnetic microspherules as an additional tool for correlating sedimentary strata and to obtain information about the intensity of cosmic events in the geological past.

Ore minerals in the Upper Riphean deposits of the Subpolar Urals

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Establishing the genesis of ore minerals is of great interest for determining the patterns of ore formation and identifying industrially significant objects in the north of the Urals.

Samples for research were taken from the rocks of the Puyva and Khobeya suite of the Subpolar Urals. The Puyva suite occurs with erosion on the rocks of the Mankhobeya and Shchokurya suite. The suite is composed of mica-albite quartz schists with interlayers of amphibole and calcareous schists and quartzites. The total thickness of the Puyva suite is 1400–1600 m. The Khobeya suite occurs with erosion on the shale of the Puyva suite. It is represented by chlorite-muscovite-albite-quartz and muscovite-albite-quartz schists, quartzites and calcareous quartzite sandstones. The thickness is 700–1000 m. The rocks of the Puyva suite underwent at least two stages of metamorphism in the Precambrian, the early stage reached the amphibolite facies, and the later, greenschist. In the rocks of the Khobeya suite, greenschist metamorphism of moderate pressure.

The study of ore minerals in polished sections was carried out at the Center for Collective Use "Geonauka" IG Komi Scientific Center Ural Branch of the Russian Academy of Sciences The chemical compositions and fotos of ore minerals were obtained using a Tescan Vega 3 LMH scanning electron microscope with an Instruments X-Max energy dispersive attachment (analysts S. Shevchuk, E. Tropnikov).

Samples for research were taken in the summer of 2019 on the left bank of the river Pelengichey at the mouth of the river Erkusey in the Subpolar Urals from the rocks of the upper part of the Puyva and lower part of the Khobeya suite of the Subpolar Urals.

Sulfides in the Puyva suite are represented by pyrrhotite and chalcopyrite. Pyrrhotite is noted as inclusions in apatite, and individual grains are present. Pyrrhotite is often oxidized (dark gray inclusions against the background of bright, light pyrrhotite). Chalcopyrite is represented by oxidized fractured grains, apparently it was formed after pyrrhotite. Chalcopyrite formation is most likely associated with late oxidative processes.

Khobeya suite pyrite, galena. Pyrite is presented in the form of clearly defined characteristic cubic crystals and broken aggregates of grains. Most often confined to cracks, inclusions of galena are noted.

In the deposits of the Puyva suite, the formation of pyrrhotite is associated with the replacement of pyrite by it under metamorphic conditions, chalcopyrite arose later and its formation is associated with late oxidative processes. Pyrite in the rocks of the Khobeya suite is represented by two generations, the first is cubic, having clear outlines and cubic shape, without admixtures, most likely, formed at the stages of metamorphism. The second type was found in the form of scattered grains, mainly confined to cracks, probably, it was formed already in near-surface conditions.

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Hydrothermal mineralization in Abin-Gunaj zone of Greater Caucasus

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The formation of the orogen of the Greater Caucasus continues from the end of the Cretaceous to the present. As a result of the collision of the Arabian and East European megaplates, a complex tectonic pattern of the mountain-folding structure under consideration arose. According to structural-facies zoning, several zones are distinguished within it, each of which contains minerals of different genesis. The Abino-Gunai zone is characterized by mercury mineralization. The description of mercury-containing sediments was the aim of this report.

The Abino-Gunai zone is composed of terrigenous rocks of predominantly Early Cretaceous age, complicated by miscellaneous tectonic faults. Its formation is associated with the intense upliftment of the central part of the Greater Caucasus at the Late Paleogene-Early Neogene (Eocene-Miocene). The territory under consideration as a result of colliding pressure of the megaplates which "squeezed out" and was torn by tectonic disturbances, which led to its scaly-thrust structure. The development of faults (Bezepsky, Tkhamakhinsky, Planchesky) caused the entry of mantle material into the upper horizons of the earth's crust and hydrothermal activity.

In 2019, we investigated an abandoned gallery on the southern outskirts of the village of Derbentskaya (Krasnodar Kraj). The rocks in it are represented by mudstones, clays, sandstones, contain plant detritus and thin layers of coal. There are also layers of siderite and thin crusts of limonite. The rocks are strongly located in morphologically heterogeneous folds. Disparate inclusions of small cinnabar crystals (up to 3 mm along the long axis) were found here, together with dikkit and quartz, which indicates a telethermal type of hydrothermal mineralization.

The gallery is located approximately 5 km northeast of the Sakhalin mercury deposit, developed until the 90s years of the XX century. According to the State Geological Map of the Russian Federation (sheet L-37-XXVII), the deposit belongs to the Kuban mercury-ore district of the Bolshekavkaz mineralogical province. In the 70-80s of the last century, as a result of geological mapping in the Kuban region, a number of mercury deposits and ore occurrences were revealed: Sakhalinskoye, Dalnee, Belokamennoye, Zaporozhskoe and others. None of them are currently in operation.

Thus, the features of the geological development of the Abino-Gunai zone in the Late Alpine era led to the formation of industrially significant accumulations of mercury of the quartz-dikkit-cinnabar type.

Changes in the Cladocera community of the small tundra lake bottom sediments (The Yamal Peninsula, Erkuta River Basin)

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Studies of lakes bottom sediments are of particular importance for reconstructing the ecological and climatic conditions of the past, whilst also assessing the current state of lakes. The aim of this study is to explore the Cladocera community from the bottom sediments of lake K1 (an unnamed lake on the basin of the Erkuta lake) whilst attempt to reconstruct ecological and climatic conditions for the Yamal Peninsula. The Yamal Peninsula is located in the north of the world's largest West Siberian plain in the tundra zone, beyond the Arctic Circle. The object of the research is the thermokarst lake K1 (68°09'12.0"N, 69°04'36.0"E), located in the Erkuta River Basin. In 2014 during an expedition to the Yamal Peninsula the 30-cm column of the bottom sediments was sampled from a depth of 6.1 m. For Cladocera analysis 15 samples of the bottom sediments were selected using a method of sample preparation improved by Korhola and Rautio. Identification of the Cladocera remains was carried out using specialized keys for identification subfossil and modern Cladocera. The Cladocera communities are characterized by low taxonomic diversity, consisting of typical northern species. In total 13 taxa of Cladocera belonging to 3 families were identified in the column of bottom sediments of K1. Cladocera community of the K1 was dominated by *Chydorus* cf. *sphaericus* (71.34%) with *Bosmina* (*Eubosmina*) cf. *longispina* being subdominant (24.43%). The stratigraphic diagram was divided into 2 faunal zones. The remains of 11 Cladocera taxa were identified in Zone I. Both *B.* (*E.*) cf. *longispina* and *C*. cf. *sphaericus* were dominant in the lowest layers of the bottom sediments at a depth of 25-26 cm. Moving up the column of bottom sediments (depth <25cm) a significant increase in the proportion of *C.* cf. *sphaericus* (80-99.12%) and the decrease in the proportion of B. (E.) cf. longispina (0.84 – 11%) was revealed. *Acroperus harpae and Alonella exigua* remains were identified in small quantities in Zone I, with complete absence in Zone II. In Zone II an increase in the proportion of *B.* (*E.*) cf*. longispina* (15.84-43 %) and the decrease of *C*. cf. *sphaericus* (51.49 -83.17%) was observed. An increase in the proportion of pelagic species in Arctic regions is often associated with climate warming. The values of the Shannon index ranged from 0.07–1.3. While the Pielou index values ranged from 0.07–0.66. In accordance with the obtained index values K1 indicates initial signs of eutrophication with the community structure of Cladocera not sufficiently aligned with these conditions. The part of this study concerning paleolimnological work was supported by the grant of Russian Scientific Foundation (project 20-17-00135). Ibragimova A. research was supported by the subsidy allocated to Kazan Federal University for the state assignment #671-2020-0049 in the sphere of scientific activities.

Devonian phoebodontid-based zonation

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The phoebodontid-based zonation was suggested for the Middle – Upper Devonian based on the distribution of *Phoebodus* species (Ginter and Ivanov, 1995). The six phoebodontid zones (PZ) were corresponded to the Middle varcus – Middle praesulcata interval of conodont zones (CZ). The *sophiae* phoebodontid zone is correlated with the Middle *varcus* - Lower *hassi* CZ, the *latus* zone was coincide the Upper *hassi* - *jamieae* CZ, the *bifurcatus* zone - the *rhenana* – *linguiformis* CZ (Ginter and Ivanov, 1995). The Famennian *typicus* phoebodontid zone was corresponded to the Upper *triangularis* - Upper rhomboidea CZ, the gothicus zone – to the interval of Lower *marginifera* — Upper *postera* CZ, and the *limpidus* zone - the Lower *expansa* — Middle *praesulcata* (Ginter and Ivanov, 1995). There were a records of *Phoebodus* species in the Lower — Middle *triangularis* CZ.

A new information on the findining of zonal *Phoebodus* species has appeared last time. *Phoebodus latus* Ginter et Ivanov occurs recently in the Lower *falsiovalis* CZ in the section of Middle Urals. *Ph. typicus* Ginter et Ivanov was recorded in the Lower и Middle *triangularis* CZ of Kuznetsk Basin (Ivanov and Rodina, 2001). *Ph. gothicus* Ginter in Iran and Morocco is known from the Lower *crepida* (Ginter et al., 2002; Hairapetian and Ginter, 2009; Derycke, 2017). *Ph. limpidus* Ginter was found in the Uppermost *marginifera* - Lower *praesulcata* CZ in the Carnic Alps (Randon et al., 2007).

Thus, the refined boundaries of phoebodontid zones are defined as following: the *sophiae* PZ is correcponded to the Lower *varcus* - *disparilis* CZ, the *latus* PZ - the Lower *falsiovalis* - *jamieae* CZ, the typicus PZ - the Lower - Upper *triangularis* CZ, the *gothicus* PZ - the Lower *crepida* - Upper *marginifera* CZ, and the *limpidus* PZ – the Uppermost *marginifera* – Middle *praesulcata* CZ.

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A new chondrichthyan assemblage from the Middle Permian of Kinderka River (Tatarstan, Russia)

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The staff of the Kazan University in 1910 collected the sample with fragment of shark spine from the outcrop on the Kinderka River, left tributary of Kazanka River (Volga river basin). The outcrop is located at the Kazan machine plumbing building, between Panovka and Aki villages, suburbs of Kazan city. The deposits in the outcrop belong to the Upper Kazanian, and were described by Tikhvinskaya (1939). This sample later was passed to the Borissiak Palaeontological Institute of Russia Academy of Sciences where the enclosing matrix of the sample was dissoluted in 10% acetic acid and several shark microremains were extracted.

The chondrichthyan remains from the sample include the distal part of sphenacanthid fin spine; teeth of sphenacanthid, polyacrodontids, lonchidiid; and hybodontid type scales. The spine is similar to the spines of *Wodnika* occurring in the lower Permian of Alaska, USA; the middle - late Permian of Germany, England and European Russia. The sphenacanthid teeth belong to Sphenacanthidae gen. et sp. nov. earlier defined as *Xenosynechodus egloni* Glikman (Minikh and Minikh, 2009). This new sphenacanthid has been found in the Kazanian - Severodvinian interval of the East European Platform. The teeth of polyacrodontids are represented by two taxa: "*Polyacrodus*" and taxon resembling *Omanoselache* described from the Guadalupian and Lower Triassic of Oman (Koot et al., 2014). The teeth of lonchidiid were attributed to a new species of "*Lissodus*" similar to *Lissodus sardiniensis* Fischer, Schneider et Ronchi known from the Gzhelian–Asselian of Italy (Fischer et al., 2010).

Previously noted that the chondrichthyan assemblage from the Kazanian of European Russia contains ctenacanthids *Glikmanius occidentalis* (Leidy) and *Cladodus kurgaensis* (A Minikh); sphenacanthid *Sphenacanthus* sp. and new genus; lonchidiid *«Lissodus»* sp.; polyacrodontid *«Polyacrodus»* sp.; neoselachii *Cooleyella amazonensis* Duffin, Richter et Neis (Ivanov, 2012). The shark assemblage of Kinderka River includes two taxa of sphenacanthids, two polyacrodontids and new species of lonchidiid.

Structural differences between sedimentation-diagenetic and infiltration-metasomatic anhydrites

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Anhydrite is widely used both in the study of geological processes and in thermoluminescence dosimeter. The relatively simple structure of the mineral and the wide possibilities of variations in oxygen-vacancy defects in the spectral range convenient for EPR (electron paramagnetic resonance) studies make it anhydrite as one of the widely studied alkali metal sulfates. The reliability of EPR studies in single crystals of anhydrite, both natural and specially grown without and with impurity ions, provides the identification of electron-hole centers and the choice of charge stabilization associated with vacancies of the nearest calcium ions and various impurity ions such as Y, B, Na, K, as well as rare earth elements Dy, Eu, Tm.

The formation and stabilization of defect centers depends on the conditions of crystal growth and, therefore, the correlation between the thermal – photo- radiation and EPR properties of anhydrite will allow monitoring the sulfate rock.

This paper presents the results of EPR studies of two different genetic types of anhydrite that are common in the Republic of Tatarstan – sedimentation-diagenetic and infiltration-metasomatic.

Different conditions of the crystallization medium could be the cause of the features of the development of defects in the crystal structure of the anhydrites under consideration. With this in mind, an EPR study was carried out for the most representative samples of anhydrite and host rock from each genetic group. The studies were carried out on a PS-100X spectrometer (Minsk, BSU) at a frequency of 9.139 GHz at room temperature on rock samples previously ground in an agate mortar to a size of ~ 0.1 mm. To determine the electron-hole centers, scanning was carried out with a magnetic field sweep of 100 G. X-ray irradiation of rocks was carried out on the URS-55A installation.

An analysis of the results obtained showed that the studied natural anhydrites, regardless of the formation conditions, are characterized by the presence of paramagnetic centers - pronounced SO_3^-, O_3^-, O_2^- and weak O^-.

Structural differences between sedimentation-diagenetic and infiltration-metasomatic anhydrites are revealed by difference in the relative ratio of paramagnetic centers concentrations, in the dynamics of annealing of paramagnetic centers, in the dynamics X-ray irradiation.

The investigation of the scale effect in Bashkirian limestones using core porosity data

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The relevance of the topic is that changes of core sizes have a great influence on laboratory porosity values. This dependence is explained by the scale effect occurring in heterogeneous rocks such as limestones and dolimites.

In the research work the whole core segment 1 m long by 10 cm in diameter of limestones drilled-in in the depth interval of 962.0-963.0 m (Ivinskoye field**)** was investigated to evaluate the representative elementary volume using laboratory porosity data. The goal of these experiments is to define connected porosity values of core samples varying from core plugs 3 cm long by 3 cm in diameter to core samples 6 cm long by 7.3 cm in diameter extracted from the whole core fragment with the use of the buoyancy method.

In the first step lithologic and mineralogical researches were done to identify lithotypes of limestones. It has been concluded that the 1 m long interval consists of grainstones.

In the second step core samples drilled out of the 1 m long interval were cleaned using the Soxhlet distillation extractor and then saturated with distilled water to compare dry weight, suspended weight and saturated weight in air for connected porosity determination.

The interpretation of graphs demonstrating connected porosity values in function of core volumes allows to calculate the representative elementary volume of the whole core fragment that is equal to 3455 cm^3. Consequently, the investigation of the core sample 44 cm long by 10 cm in diameter permits to estimate the accurate connected porosity value consisting of both intergranular and fracture porosity for the 1 m long interval.

The analysis of the neutron gamma porosity log and results of laboratory porosity measurements shows that porosity values of core samples 5.3 cm long by 7.3 cm in diameter are comparable to porosity log data in the best way.

The whole core segment connected porosity evaluated using core samples 6 cm long by 3 cm long is lower than the whole core fragment connected porosity calculated using 7.3 cm diameter core samples by 19 %.

Potential of geophysical methods for studying the cryogenic state of the upper part of the permafrost section during mine development on the territory of the Central Kolyma region

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The paper presents the results of the cryogenic state study for a rock mass of a placer gold deposit located in the middle reaches of river Debin in the Central Kolyma area of the Magadan region Russian Federation

Based on the comparative analysis of geophysical studies in plan and section, the following geoelectric elements of the cryogenic structure of the geological terrain in the depth range of 1-20 meters were established.

The search objects – thawed zones - are registered due to specific electrical resistance (resistivity) of less than 500 Ohm×m and values of the induced polarization parameter (IP) of 9 to 12 %.

Seasonally thawed rocks have a distribution in the near-surface layer up to a depth of 3-4 meters and have a resistance of 500-1000 Ohm×m and an induced polarization of 7-9%.

Locally frozen rocks or focal (insular) permafrost, which is an alternation in the section of thawed and frozen rocks. The complex nature of the interaction of unfrozen water with the mineral skeleton and ice causes a wide range of changes in the resistance from 3000 to 10000 Ohm×m and the IP of 5-8% for frozen soils.

Permafrost rocks have the specific electrical resistance of more than 10,000 Ohm×m and the IP of less than 5%.

As a result of the works, subjacent and subpermafrost thawed zones have been identified and tests sites for dragging operations are planned for them. Within the boundaries of the dragging site, several verification trenches with a depth of 3 to 6 meters were passed, which fully confirmed the results of geophysical research on the absence of frozen rocks. Along the trench bed and across the entire area, measurements of the soil temperature were made in the natural occurrence. Their results are also consistent with the geophysical diagnostics on the presence of thawed and frozen rocks.

Thus, within the research area, pronounced regularities of the cryohydrogeological state of rocks with different values of specific electric resistance and IP have been established, i.e. thawed, seasonally thawed, locally frozen and permafrost states.

On the basis of the obtained geophysical materials, thawed zones areas and zones suitable for dredging and mining of commercial blocks, as well as areas of permafrost distribution have been identified.

Carbonaceous matter in black-shale deposits of the Bredy Formation (Southern Urals)

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Black-shale deposits are widely distributed globally. They form a very favorable geochemical environment for the sorption of noble and rare metals. They can also be a source of such metals while undergoing metamorphic transformations. In the Southern Urals, black shales can be found in the Bredy Formation (C1bd) along with gold and quartz ore bodies (Kumak, Kumak-Yuzhny, Zabaikalskoye, Tsentralnoye), all located within the Anikhovsky Graben.

The Bredinskaya Suite is composed of carbonaceous terrigenous and sedimentary rocks: siltstones, carbonaceous-argillaceous shales and sandstones, as well as rare layers of limestone and coal. The black shales of this region can be subdivided into several groups depending on their composition: (1) sericitic-quartz-carbonaceous; (2) quartz-carbonaceous-tourmaline; (3) ottrelite-carbonaceous; and (4) quartz-carbonaceous-ottrelite. The first ones are the most widespread. They are grayish-black (sometimes black) fine-grained rocks with poor schistosity, easily splitting along cleavage planes. The average mineral composition of black shale rocks is: quartz (up to 40%), sericite (5-10%), carbonaceous matter (up to 50%), carbonates (5-10%), sulfides (up to 5%).

The carbonaceous matter is in a finely dispersed state or in the form of a mass that cements the rest of the minerals. It is dominated by sapropel in the form of irregularly shaped fragments; however, in metamorphic parts, it is represented by large flaky graphite veins. The shales under the study have C_{org} content of 6.4%, in the average (with the maximum of 11.1%), and this allocates them to the carbonaceous group. $\delta^{13}C$ (vs. PDB) values fall within the range of (-19.07) – (-22.80), which indicates the biogenic nature of carbon. The minor variations are most probably associated with varying intensity of metamorphism

Black shales are convenient for determining the degree of metamorphism. Thermal and gravimetric analysis of the samples taken from the Bredinskaya Suite showed that organic carbon underwent high-grade metamorphism, comparable to that of high kerite, anthraxolite and shungite. The maximum temperature of the exothermic effect falls within the range of 630-770 °C (during metamorphism, temperature was around 560-700 °C), which corresponds to the epidote-amphibolite subfacies of the greenschist facies

Reconstruction of the depositional environment of Paleoproterozoic stromatolitic dolostones based on geochemical data

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Stromatolitic dolostones of Paleoproterozoic age were studied using precise Geochemistry methods to determine differences in the composition of stromatolitic buildups and host rock, as well as patterns of distribution of trace elements within stromatolites and geochemical differences between biogenic and chemogenic stromatolite laminae. The analysis of geochemical features of sedimentary formations of the Paleoproterozoic in the Onego and Paano-Kuolajarvi structures, which differ in their lithology, is carried out. It was concluded that there is a weak supply of exhalative material to the Onego sedimentary paleobasin. The recorded input of hydrothermal material in the flanks of the basin is associated with late superimposed processes rather than sedimentation.

During the evolution of the Karelian craton in the Paleoproterozoic (from Jatulian to Ludikovian), the area of basins in the Northern part of the craton was reduced. At the same time, the flow of hydrothermal material to the sedimentation area decreased, but the flow of endogenous material, possibly tufogenic, increased, indicating an increase in magmatic activity. At the same time, the supply of hydrothermal material to the sedimentation area decreased, but the supply of endogenous material, possibly tuffaceous, increased, which indicates an increase in magmatic activity.

Carbonate sediments of the Onegian formation (Upper Jatulian) were formed under shallow water conditions, often with a dissected topography of the seabed and the existence of evaporate environments. An indication of the high evaporation rate in the Onego paleobasin are the finds of pseudomorphs after salt and gypsum, the finds of anhydrite and halite in the Jatulian sedimentary rocks.

Isotopic data on carbon and oxygen of the Onego carbonate rocks do not contradict the conclusions based on lithological data: sedimentation in the Late Jatulian took place in shallow-water evaporate basins. Isotopic signals in the Jatulian formations are not completely inherited from the stage of sedimentation, but arose during epigenetic processes in the later - Ludikovian time, when a significant amount of H_2 entered the basin. The reason for this input of hydrogen was global. It leads to the conclusion that the duration of Jatulian in the modern chronostratigraphic scheme is greatly overestimated.

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Carbon and oxygen isotope composition of Paleozoic stromatolites of the Timan-North Ural region

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The carbon and oxygen isotope composition of carbonate rocks is widely used in the reconstruction of paleoecological conditions of sedimentation. In the same time stromatolites are sensitive signs of facies. The first results of studying the carbon and oxygen isotope composition of the stromatolites of the Gorstian and Ludfordian of the Upper Silurian on the Padimeytivis River of Chernov Swell, the Frasnian (Upper Devonian) from the section on the Sedyu River of South Timan, and the Famennian from the section of borehole 19 of the Oshkotyn area Khoreyver Depression are present in this paper.

The material for analysis was represented by powdered samples (up to 1 mg), that were obtained sequentially over layers of stromatolitic buildups. The research results include 26 analyzes of the carbon and oxygen isotope composition for the Silurian stromatolitic buildups, and 29 analyzes for the Devonian stromatolitic buildups, which were carried out at the Geoscience Center of Geology named after Acad. N.P. Yushkina, FIC Komi Scientific Center, Ural Branch of the Russian Academy of Sciences on a DELTA V Avantage mass spectrometer (analyst I.V. Smoleva). The error in determining both coefficients did not exceed ± 0.1 ‰.

The results of the isotope study showed that the isotope ratios in the stromatolitic buildup (sample № 1k/6s/2) of the Gorstian range from 0.89 to –3.77 ‰ for $\delta^{13}C$ and from 21.85 to 27.29 ‰ for $\delta^{18}O$. The heavier $\delta^{13}C$ values –0.45 ... –0.89 ‰ were established at the base of the buildup, compared with the values of $\delta^{13}C$ –1.61 ... –3.77 ‰ in its upper part. In the distribution of $\delta^{18}O$ values there is a tendency to increase them up the buildup, where they reach 27.09 ‰.

The carbon and oxygen isotope composition of the Ludfordian stromatolitic buildup (sample 427) is characterized by lower values. The isotopic values are of –6.03 ...– 7.54 ‰ for $\delta^{13}C$ and of 22.87 ... 25.07 ‰ for $\delta^{18}O$. In the middle part of the buildup, the values slightly increase to –7.54 ‰ for $\delta^{13}C$ and to 25.07 ‰ for $\delta^{18}O$. Patterns in the distribution of the values across the layers have not been established.

The $\delta^{13}C$ values of the Frasnian stromatolite from the section of the South Timan (sample C12/18) range from 0.06 to 0.57 ‰, $\delta^{18}O$ - from 22.5 to 23.67 ‰. At the base of the buildup, the dark puffs have slightly heavier $\delta^{18}O$ values (23.37–23.67 ‰), compared to light ones (22.21–22.5 ‰). Moreover, $\delta^{18}O$ values tend to decrease upwards in the buildup.

According to the results of the isotope analysis of the Famennian stromatolite (sample OSH 19/14), the $\delta^{13}C$ values range from 0.8 to 1.5‰, and $\delta^{18}O$ values - 23.3–24.4 ‰. The lowest $\delta^{13}C$ values and $\delta^{18}O$ values are observed in the lower part of the buildup (0.8–1.2 ‰; 23.3–23.6‰, respectively). In its middle part, an increase of $\delta^{13}C$ values to 1.5‰ and oxygen to 24.4‰ is observed. In the upper part of the buildup, the values decrease in comparison with the middle part to 1.2 ‰ in $\delta^{13}C$, to 23.8 ‰ in $\delta^{18}O$.

As a result of the isotopic analysis of Silurian and Devonian stromatolites was revealed a pattern in the change in the isotopic values both up the buildup and in their distribution over dark and light layers. The carbon and oxygen isotope composition in the Ludlowian stromatolites differs from the Devonian ones by lower values, which may indicate the desalination of waters in the marine basin.

Thus, the study of the carbon and oxygen isotope composition of ancient biogenic formations is an important tool for interpreting the ecological conditions of the marine basin of the past.

TEPHRA Database for the Eastern European Plain

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Tephra is fragmental material produced by a volcanic eruption (Thorarinsson, 1950). During the eruption, tephra particles settle from an eruptive cloud mantling the landscape and forming an isochron, which directly links various sedimentary successions and permits their synchronization. In distal areas, low-concentration tephra particles may not form visible layers and are referred to as cryptotephra (Lowe and Hunt, 2001). Extensive data on the composition and ages of different tephras were compiled into regional and global databases (RESET tephra database, Tephrabase). The territory of Central and Western Europe, for example, is covered with hundreds of well-studied tephra and cryptotephra sites. However, tephra sites in Russia are poorly represented in these databases although ~100 sites exhibiting visible tephra layers have been identified within the European Russia by the late 1900s (e.g., Karlov, 1957; Tsekhovsky et al., 1998). These Russian-language works are scattered throughout old journals and abstract volumes and thus are virtually not available to the international tephrochronological community.

To fill this gap, we started a database of tephra sites in the East European Plain, the Caucasus, and Transcaucasia based on published works and our own data. We verified some of the earlier described tephras and analyzed them with the help of spot analyses including electron microprobe and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Our database currently includes 184 tephra sites mostly located in the southern part of the East European Plain, the Caucasus, and Transcaucasia: Azerbaijan (30 sites), Kharkiv, Sumy, Donetsk, and Lugansk regions of Ukraine (in total 23 sites), Voronezh and Belgorod regions (22), Kerch and the Taman Peninsula (18), Stavropol Territory (12), the Kabardino-Balkarian and Karachay-Cherkess Republics (11). Single sites are noted in the NW and NE European plain.

According to the published data, tephras are dominated by silicic varieties (trachytic – 33 sites, rhyolite - 26, rhyodacite – 7, and andesite-dacite – 25). Most of the trachytic tephra likely belong to the Campanian Ignimbrite (CI) eruption from the Phlegraean Fields Caldera, Italy, dated at 39,280±110 yr BP (Melekestsev et al., 1984; Pyle et al., 2006). Single-shard geochemical analyses are available only for Kostenki (Voronezh region) (Pyle et al., 2006), Roksolany (Odesa region, Ukraine) (Wulf et a., 2016), Lake Bolshoye Shchuchye (Yamalo-Nenets Autonomous District) and Lake Yamozero (Republic of Komi) (Haflidason et al., 2018), Medvedevskoe and Pastorskoe lakes (Leningrad Region) (Wastegard et al., 2000), Lake Vodoprovodnoe (Karelia) (Vahrameeva et al., 2020). Further research will make it possible to add and refine the history of volcanic eruptions in the adjacent territories, as well as to carry out correlations between the sites. This work will significantly refine the chronological framework of individual paleogeographic events and synchronize them with global paleoclimatic archives.

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Reflection of global events in the history of the Paleoproterozoic Earth in the stratigraphic successions of Eastern Fennoscandia

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The Paleoproterozoic interval from 2.5 to 2.0 billion years was a time of significant changes in the history of the Earth. The expansion of the Kenorland supercontinent, which began about 2.48 billion years ago, coincided with the accumulation of ferruginous formations and bimodal magmatism on the continental margins, which was recorded by the first thick sedimentary successions on cratons. After the accumulation of ferruginous formations, rifting gives way to a compression process, which also manifested itself on other Archean cratons. Soon the climate changed dramatically, ice sheets began, reaching low latitudes and consisting of three glacial epochs. The increase in oxygen content in the atmosphere coincided with this glaciation. Mature sandstones, red beds, and aluminum-rich clay rocks indicate significant chemical weathering on continents following inter-and post-glacial greenhouse conditions. Sedimentary strata with an age of 2.22 – 2.10 Ga include carbonate rocks with abnormally high positive $\delta^{13}C$ values, indicating a significant deviation in the isotopic composition of seawater. The end of the carbon isotope anomaly in the interval of 2.11 – 2.06 Ga coincides with the accumulation of manganese, phosphorites, ferruginous formations and carbonaceous shales, probably associated with the development of oceanic basins. This time interval coincides with the final split of Kenorland.

The listed events can be considered a starting point for using the event-stratigraphic method in the subdivision and correlation of the Paleoproterozoic sequences in the eastern part of the Fennoscandian Shield. Successful application of this method requires accurate dating of the identified events, together with a comprehensive understanding of the nature of sedimentary environments and the geochemical characteristics of sedimentary and volcanic rocks on a global scale.

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The *Phycosiphon*-like and *Diplocraterion* trace fossils from the Permian and Triassic of the South Verkhoyanie Mountain System (Republic of Sakha – Yakutia, Russian Federation)

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The collection of trace fossils has been obtained from the Tiryakh-Kobyume section (N 63.374284, E 140.945873) in South Verkhoyanie Mountain System.

The section consists of the Permian (Kungurian–Changsingian; about 4000 m) and Triassic (Induan, about 500 m) marine sediments which represented by interbedding sandstones, siltstones, and mudstones. Rocks contain subordinate interbeds of rare bentonites, intervals of siderite and carbonate concretions, diamictites, and glendonites. All strata contain numerous trace fossils, and usually are characterized by a high bioturbation index.

The most common traces found in siltstone beds of the whole section are flat, elongated blades (spreite), subhorizontal, or slightly inclined to the bedding planes, conventionally assigned to *Phycosiphon* Fischer-Ooster, 1858. In the Permian part of the section, these traces are characterized by relatively large size (2-4 mm) and are often found with *Zoophycos* Massalongo, 1855.

In the transitional Permian–Triassic interval, only *Phycosiphon*-like forms occur. The size of these forms decreases to the millimeter scale, but the bioturbation index of the rocks remains high.

In the Triassic sandstones, we identify vertical *U*-shaped spreite traces belonging to the ichnogenus *Diplocraterion* Torell, 1870. *Diplocraterion* is known to be a trace fossils appeared after Permo-Triassic extinction in several sections worldwide.

The trace fossils *Phycosiphon* and *Zoophycos*, which are abundant in the Permian interval of the section, can be attributed to the Zoophycos Ichnofacies, characterized by low wave energy, oxygen-poor settings, and located below the basis of storm waves. The early Triassic *Diplocraterion* icnocenosis indicate an increased oxygenation and a highly dynamic coastal-marine environment with repeated erosion and deposition. The *Diplocraterion* icnocenosis can be attributed to the Skolithos Ichnofacies.

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Electrophysical properties of shungite rocks from different stratigraphic levels

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The shungite rocks of Karelia form a large, diverse group of Precambrian carbon-bearing rocks with poorly-crystallized carbon (shungite). The fundamental problem of searching for the relationship between the structure, properties and genesis of carbonaceous matter has been developed for a long time. Interest in this problem is connected not only with the study of the evolution of the lithosphere, but also with the industrial use of carbon-bearing rocks. To date, more than 20 directions of those using have been developed, many of which are related to the electrophysical properties of shungite rocks. The electrical conducting properties of shungite rocks are largely due to the carbon content in their composition. The existing classification of shungite rocks is based on their division into groups related to the carbon content in the rock. However, at the moment this classification does not meet industrial requirements, since the properties of shungite rocks with the same carbon content may differ significantly.

The research objective is to study the electrophysical properties of shungite rocks of various stratigraphic levels of the Zaonega formation. Samples were specially selected with a close percentage of carbon to assess the effect of other controlled factors on electrophysical properties. The most important factor determining the electrophysical properties in addition to the carbon content is the ordering of carbonaceous matter. The peak metamorphism temperature was used as a criterion for ordering carbonaceous matter associated with its transformation. Electrical conductivity and shielding effectiveness were used as the estimated electrophysical parameters. The shielding effectiveness of shungite rocks was determined on powder samples by the coaxial transmission line method in the frequency range from 100 kHz to 1 GHz (selective microvoltmeters SMV11 and SMV8.5). The electrical conductivity was determined in the coaxial line using a meter L, C, R E7-8 at a frequency of 1 kHz. Raman spectroscopy was used to evaluate structural characteristics of carbon in shungite rocks. Raman spectra of shungites were obtained using the Nicolet Almega XR dispersion Raman spectrometer (wavelength 532 nm). The quantitative characteristics of the spectra are calculated in the OMNIC program. The peak metamorphism temperatures of the studied samples were estimated from carbon using the equation: $T\ (°C) = 91.4(R2)^2 – 556.3(R2) + 676.3$.

The results of the study of the electrophysical properties of shungite rocks indicate that there is a general tendency to increase the electrical conductivity and shielding effectiveness of shungite rocks with an increase in the peak temperature of metamorphism. In particular, the rocks of the sixth horizon with the lowest peak metamorphism temperature have the lowest shielding effectiveness and electrical conductivity, and for samples of the second horizon, their increase is observed. The results obtained will allow us to use the established patterns not only to determine the industrial types of shungite rocks in the directions of their most effective use, but also to pay attention to the subtle patterns of their genesis.

The work is performed in the framework of the PFNI GAN research of IG KarRC RAS.

Rhizoid limestone from the Urzhumian of the Tetyushi Volga region

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A massive limestone beds penetrated by a dense network of root voids (rhizoid limestones) are quite common in the Urzhumian red beds of the Middle Volga region. The origin of such limestones remains controversial; some researches consider them to be carbonate paleosols formed on lacustrine sediments or, in some cases, calcretes; ones another refer these limestones to palustrine.

This work focused on single bed of rhizoid limestone from the Middle Urzhumian of Dolgaya Polyana section, Tetyushi Volga region, 5 km north of the reference section of the Monastery Ravine. The study methods included field description, optical microscopy, scanning electron microscopy (SEM), bulk geochemistry, C and O stable isotope geochemistry.

The limestone bed under study of light gray, it has the thickness of 0.7-1.0 m, sharp lower and upper contacts and the massive structure. The thin root voids (1-2 mm) penetrate this limestone over all the thickness. The uppermost part of the bed is the laminar limestone fractured by desiccation cracks filled with black microbial limestone. The rhizoid limestone is represented by highly bioturbated calcimicrite with ostracod shells and root voids, the rock also contains fragments of bivalves and fish scales. The laminar limestone consists of thin laminae of light micrite (0.5-1.0 mm) with ostracods alternating with dark micrite laminae enriched with organic matter. The black microbial limestone filling desiccation cracks is represented by micritic clots (pellets?) of 0.1-0.5 mm, enriched in organic matter, ostracod shells and calcisparite in voids between the clots; bivalve shells, fish scales and intraclasts of rhizoid limestone as well as brecciated structures occur in clotted matrix. The geochemical data of this limestone indicate an increased values of biogenic elements (P_2O_5, SO_3) and lighter isotopic composition of $\delta^{13}C$ (-4.8‰ PDB) and $\delta^{18}O$ (18.7‰ SMOW) compared with host rhizoid and laminar limestones. The SEM study of black limestone revealed the presence of microbial films represented by filaments and coccoid forms coating the micrite mass.

Thus, rhizoid limestone was formed as lacustrine lime mud, which was altered by plant roots after the shallowing of lake basin. The laminar limestone interpreted as littoral microbially induced (palustrine) carbonate sediment. Short-term drying of this sediment led to its cracking and, after flooding, to the formation of black microbial limestone (stromatolite) in the desiccation cracks. The lack of typical calcrete features (gradual contacts, nodular structures, silty-clayey inclusions etc.) and the presence of lacustrine fossils do not allow this rhizoid limestone to be considered a calcrete.

Genesis and structure of natural bitumen deposits in sandstones of the Sheshmian horizon (South Tatar arch)

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Natural bitumens are one of the additional sources of hydrocarbons. Deposits of natural bitumen are common in the East of the European part of Russia (Republic of Tatarstan). Bituminous sandy rocks belong to the Permian sediments of the upper part of the Cisuralian series (Ufimian stage, Sheshmian horizon). They occur at shallow depths, not exceeding the first hundred meters. The bodies of bituminous sandstone reservoirs have a heterogeneous internal structure, which is expressed in the variability of their composition, physical and mechanical properties, and the degree of bitumen saturation and cementation. The Sheshmian horizon consists of two layers- the upper sandy and the lower sandy-clayey. Such lithological division may be associated with the special conditions of sedimentation, which consist of a complex combination of coastal-marine, fluvial and aeolian processes. Initially, the formation of sandy- clayey deposits took place in the conditions of coastal deltas, beaches, etc. The clastic material was represented by the products of destruction of igneous rocks transported from the ancient Ural Mountains by water flows. As a result of a short-term marine regression, the upper part of the sandy stratum appeared on the surface and, after the wind impact, lost its clay component. Also, a sign of aeolian activity is the sub-parallel arrangement of sandy ridge-like structures on the surface of the Sheshmian horizon, reminiscent of chains of longitudinal or transverse dunes in modern coastal deserts (e.g. Namibia). The area of distribution of sandy deposits is limited by the western slope of the South Tatar arch and the Sheshma river basin. As paleotectonic reconstructions show, the formation of bitumen- containing structures also occurred under the influence of deep tectonic processes within the South Tatar arch. These processes were superimposed on the already existing positive forms of the Sheshmian relief, leading to their additional transformation. The resulting cracks and faults in the earth's crust served as pathways for the vertical migration of hydrocarbons from deeper oil deposits of the Devonian and Carboniferous. The field of distribution of bitumen deposits is actually divided in half by a sub-latitudinal deep fault, which can be traced on the surface along the channel of the Sheshma River. The presence of a large river system and shallow occurrence of bituminous rocks is an additional factor in the transformation of reservoir rocks and hydrocarbons. Thus, the Sheshmian stratum of bituminous rocks is a product of a complex combination of sedimentological, endogenous, and exogenous processes. The peculiarities of its internal structure should be taken into account during the development of bitumen deposits.

The analysis of the annular pressure buildup for SAP investigations

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Well integrity investigation of sustained annulus pressure (SAP) sources is usually performed in the shut-in condition of wells using conventional well logging methods such as thermometry, noise logging or pulsed neutron evaluation. The application of all listed methods is limited by the SAP intensity which could be understood by analysing annular pressure buildup measured at the wellhead. Since most of the pressure data from pressure gauge attached to evaluated annuli are available on flowing well condition it is valuable to extrapolate annulus pressure behavior to the shut-in condition as most of the integrity survey performed in shut-in mode.

The semisteady-state approach was used to calculate the annular pressure buildup occurring as a result of annular thermal fluid expansion and then estimate annular pressure buildup curves in shut-in phase of wells using pressure data of flowing wells.

There are three main components contributing to annular pressure increase, i.e. thermal liquid expansion, annular-volume change and annular leakoff. The liquid expansion could have the most influence on the annular pressure.

In the research work real annular pressure data in flowing wells have been used while fluctuations of temperature fields of wells with time have been calculated using temperature modelling of transient condition. These temperature values are essential to define annular pressure buildup using coefficients of isobaric thermal expansion and isothermal compressibility (for water-based mud in annulus).

Four production wells have been chosen for pressure investigations:

- Well No. A of the Kuyumbinskoe field. The rate of the well is 55 m^3/d (oil), perforation depths are from 2600 to 2615 m. Diameter of casings are 178 and 245 mm respectively
- Well No. B of the Korchagina field. The rate of the well is 500 m^3/d (oil), perforation depths are from 1912 to 1980 m. Diameter of casings are 273 and 406 mm respectively
- Well No. C of a gas storage filed. The rate of the well is 500 m^3/d (gas), perforation depths are from 362 to 377 m. Diameter of casings are 168 and 245 mm
- Well No. D of the Korchagina field. The rate of the well is 700 m^3/d (oil), perforation depths are from 4860 to 4890 m. Diameter of casings are 273 and 406 mm

The results of investigations estimate the variations between pressure values in shut-in and flowing conditions within 30%. Consequently, the thermal liquid expansion has a significant influence on annular pressure buildup if pressure build-up rate exceeds 5 bars a day and the production rate is over 100 m^3/d of liquid at standard conditions.

Permian and Triassic Vetlugospermaceae (gymnosperms): how were the female cones organized?

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The peltasperms (order Peltaspermales) were a very peculiar group of gymnosperms, which completely vanished and having no direct relatives in the modern plant world. The peltasperms had been flourishing during the Permian and Triassic time around the world; in Permian mostly in the regions of Northern hemisphere. This group was represented by three families: Peltaspermaceae s.s., Vetlugospermaceae, and Angaropeltaceae. All of them were closely related to each other, but nonetheless are different in details of morphology of the female reproductive organs.

The family Vetlugospermaceae was established by the present author for the peltasperms with the peltate megasporangiate shields of rhombic shape having quite uncommon feature, namely the protective ridge, which was concentrically disposed on the adaxial surface of the megasporangiate shield surrounding the ovules/seeds before they became adult. The ridge was aiming for protection of the ovules/seeds against trophic action of the herbivorous/phytophagous arthtopods, mostly insects.

Morphology of the megasporangiate shields of Vetlugospermaceae was studied in details, with the exception of exact character of the abaxial surface of the *Navipelta* Karasev shields. Hence, there was no direct evidence on the principal architecture of the female reproductive organs of these plants. It was assumed that they were organized as a kind of lax cones, but this assumption was expressed only hypothetically.

A new find of closely aggregated megasporophylls of *Vetlugospermum rombicum* Naug. provided to the present author by Mr. M.P. Arefiev (Geological Institute of RAS, Moscow) gives a good opportunity for the reconstruction of principal architecture of the Vetlugospermaceae female reproductive organs. The specimen originated from the famous Spasskoe locality (Lower Triassic) disposed in the middle part of the Vetluga River Basin, on the left (east) bank of the Vetluga river near Spasskoe village

One megasporophyll shield on the studied specimen is orientated across the cone axis and is observed in front, perhaps somewhat being moved aside during pre-diagenetic transformation of the reproductive organ. Other three megasporophyll shields are orientated sub-parallel to each other under an average angle about 45˚ (40˚ to 50˚) to the fertile axis. There are well-visible seed scars of round to ovoid shape on upper and lower (in relation to the position on the fertile axis) megasporophyll shields on the left side of the cone. The middle shield is not well-observed, but it has in general the same shape and size as the shields below and above. There is one more megasporophyll shield on the right side of the reproductive organ. Despite its insufficient preservation, it can be suggested that the shield has the same shape, size and structure as other shields on this specimen. The cone axis is relatively thin, perhaps slender, with clearly seen conductive strand disposed in the medial part of the axis. The maximal observed width of the axis is about 2 mm.

Thus, architecture of the female reproductive organ of *Vetlugospermum rombicum* was cone-like, racemose when the plant was alive and the organ was functional.

Microborings in Upper Permian ostracod shells, East European Platform

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Microborings are traces of microorganisms on carbonate substrates, the size of which does not exceed 100 μm. Such microborings were found for the first time on shells of freshwater Permian ostracods of the East European Platform (EEP).

They were found on 114 specimens of ostracods of different species, originating from 7 sections and one well in the central regions of the East European Platform (VEP): Sundyr (Chuvash Republic), Shchekino, Staroe Slukino (Vladimir region), Aristovo, Eleanora, Yaikovo (Vologda region), Chizhi (Kirov region) and well 1 Lyubim (Yaroslavl region). The sections together cover the stratigraphic interval from the Upper Severodvinian to the top of the Upper Vyatkian (Permian system, Tatarian series).

The microborings are represented by thin (up to 4 μm) dichotomically branching channels covering the surface of the shells. All microborings were divided into three types according to the character of branching and mutual position of channels. Type A is very sinuous, meandering and disordered channels, which rarely bifurcate. Diameter of the channels is uniform, 1-1.5 μm. The channels are located on the surfaces of valves and sometimes penetrate into the valves. Type B is a radial network of regularly bifurcated channels. Channel diameter decreases from center to periphery from 4 to 0.2 μm. The network is only located on the shell surface. Type C is a dense radial network of sinuous, frequently branching channels. Channel diameter ranges from 0.1 to 2 μm. The network is only located on the surface.

Traces similar to Type B have previously been found on the shells of recent ostracods (Danielopol et al., 1986; Namiotko et al., 2015). The authors of the findings suggested that they belong to Actinomycetes. Types A and C have a unique morphology, which could not be found in the studied literature. Microborings of fungi and cyanobacteria are known in this size class. However, they have different morphology. Perhaps we are dealing with new, previously not described microboring taxa.

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Pollen records from Lake Lebedinoe (the northern part of The West Siberian Plain)

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Arctic regions are considered as highly ecologically sensitive. Climatic changes impact on Arctic ecosystems and potentially induce the dramatic shifts of community composition. High-latitude lakes, being features of most Arctic landscapes, are extremely sensitive to environmental changes. Palynological analysis of lakes sediments provides valuable information on the dynamics of the vegetation cover, allowing to link a geomorphology, soils, vegetation, air streams and climate.

The West Siberian plain is one of the largest accumulative lowland plains. It is characterized by a monotonous relief without the large fluctuations in elevation and is clearly defined by zonal landscapes — from tundra in the North to steppe in the South. The geographical position of the West Siberian plain determines the transitional nature of its climate between the moderate continental Russian plain and the sharply continental climate of Central Siberia. The study waterbody – the Lebedinoe Lake - is located in the catchment area of the Pur River in the northern part of the West Siberian plain (the Yamalo-Nenets Autonomous Okrug (Russia). In August 2017, a 36 cm long sediment core (17-Ya-02A) has been extracted from 1.3 m depth in the central part of the Lebedinoe lake (64◦17.135‘, 78◦07.449‘).

Pollen records from the core are the evidence of the environmental and vegetation history. The predominance of Betula sect. Nana pollen indicates the proximity of tundra-like vegetation. The stable content of Sphagnum spore throughout the core indicates the presence of swamps and the process of peat accumulation. The presence of Alnaster and Salix pollen with Betula pollen reflect limited presence of shrub communities. The presence of pollen of Pinus, Picea, Larix, and Abies indicates taiga-like vegetation. The climate is characterized as relatively cold and humid according the laying of bottom sediments. An increase in climate humidity is observed at depths of 30-29, 24-23, 12-11, 2-1 cm of the core, evidenced by an increase in the percentage and concentration of pollen of Betula, Cyperaceae, and Sphagnum spore. However, generally the pollen records show that severe environmental conditions prevailed on the northern part of the West Siberian plain.

Subfossil cladoceran remains from the bottom sediments of Lake Lebedinoe (Yamalo-Nenets Autonomous Okrug, Arctic Russia)

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The bottom sediments are natural archives that contain information on the development and changes of environmental and climatic conditions. In our study, we used cladocerans as an indicator group during paleoecological analysis. The study of Lake Lebedinoe (64°17.135′ N, 078°07.449′ E) in the Yamalo-Nenets Autonomous Okrug was carried out for reconstruction of the past climatic and ecological conditions of the territory. This area is characterized by a sharply continental climate, as well as by the presence of permafrost, numerous lakes, wetlands, and rivers.

For paleoecological study, sediment core (17-Ya-02 A) was used. As a result of the cladoceran analysis, 4027 subfossil cladoceran remains were found in the sediment core of Lake Lebedinoe. All individuals were identified to genus and species. A total of 28 cladoceran taxa belonging to 6 families – Dapniidae, Bosminidae, Chydorydae, Cercopagidae, Macrothricidae, and Sididae – were recorded in the lake sediments. The subfossil remains of Bosminidae (51.7%) and Chydoridae (47.6%) occured most frequently throughout the core. The pelagic *Bosmina (Eubosmina) longispina* (51.7%) was highly abundant in the sediment core, which is most likely due to the well-developed open part of the lake. Secondary species were *Alonella nana* (12.0%), *Chydorus* cf. *sphaericus* (11.4%), *Alona affinis* (5.1%), and *Eurycercus* sp. (4.2%).

In the studied lake, littoral organisms are abundant based on the number of taxa encountered, and littoral and pelagic species are represented in approximately equal proportions. Species typical of the Palearctic (48%) and Holarctic (35%) zones prevail, while cosmopolitans account for only 17% of the cladoceran assemblage. According to the Shannon index and the Pantle–Buck index, the lake is characterized as β-mesotrophic and oligosaprobic.

The analysis of the structure of sediment core 17-Ya-02 A taken from Lake Lebedinoe enabled a reconstruction of stages of the lake formation, as well as changes in the species composition of subfossil cladocerans. The results of the analysis of the stratigraphic distribution of the main cladoceran taxa demonstrate that the trophic status of the lake changed throughout the core of bottom sediments. *B. (E.) longispina*, the cold-water taxon characteristic of oligotrophic water bodies, was absolutely dominant in all stratigraphic zones.

The field work was performed according to the Russian Government Program of Competitive Growth of Kazan Federal University and funded by the subsidy allocated to Kazan Federal University for the state assignment #671-2020-0049. The part of this work concerning the laboratory research and the microscopy of cladocerans was supported by the Russian Science Foundation (project no. 20-17-00135).

Perspectives for increasing Republic of Karelia's sand resources

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As the Arctic and peri-Arctic regions of the Russian Federation continue to develop, the delivery of common building materials to these areas and the renewal of their raw material reserves become an acute problem. Sand-gravel, boulder-gravel, boulder-pebble and pebble deposits, as well as building sand, are used for construction. Sand and sand-gravel-pebble deposits in the southeastern Fennoscandian Shield, Republic of Karelia, are associated with glacial deposits proper and the fluvioglacial sediments of widespread esker ridges and kames. Fractionated lacustrine-, marine- and alluvial-facies deposits are also promising for sand.

The aim of the present study is to describe Quaternary glacial lacustrine-, marine- and alluvial-facies strata, promising for building sand and boulder-pebble-sand mixtures, were revealed from the data obtained by the author while compiling a map of Karelia's geological engineering division.

The results obtained show that moraines occur to the north and north-west of Neva (Syamozero) glacier degradation stage deposits. The diamicton of the moraines can be used for the production of class-2 fine sand (here and onwards sands are classified in accordance with GOST 8736-2014) only after dressing. The moraine contains lenses of fluvioglacial genesis corresponding in composition with class-1 coarse sand. A similar but less abundant material with greater quantities of fine particles has also been reported for older Luga- and Vepsovian-Krestets-stage moraines. Salpausselkä I and II deglaciation stage end morainic ridges and eskers in West Karelia may consist of well-sorted material consistent with class-1 sand and sand-pebble mixtures. Occurring in old periglacial basins and modern lakes are layered glacial-lacustrine strata, whose particle-size composition is homogeneous and corresponds with class-1 and 2 sands. The evolution of Karelia's Quaternary deposits on the Precambrian rock substrate is responsible for the minimum sulfides and carbonate content of the sands and the complete absence of oil shales, water-soluble compounds and other harmful impurities.

Research points are focused on existing roads and infrastructure facilities that allow you to use the results of research to expand the resource base of construction materials.

On the genesis of Kem clays from the White Sea shore, Republic of Karelia, Russia

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As the infrastructure of Karelia's Arctic regions continues to develop and various objects in the Kem River valley are being built, the genesis of Kem clays is becoming increasingly acute. Studies conducted in the 20th century have shown that these are continental–facies clays. However, on geological engineering maps and in the special literature they are still indicated as marine deposits. This information is used as a basis for scientific research, and their physico-mechanical and deformational characteristics are described using regional tables for marine deposits. The highest absolute values of variations in the White Sea level in the Postglacial Period and the Holocene on the Karelian and Pomor shores have been obtained. However, the presence of a peri-White Sea freshwater periglacial basin in this area (the lower reaches of the Kem and Vyg rivers) is also known. Its traces are observed along the entire sea shore.

The aim of the present study is to determine the facies of clays developed from the surface in the Kem area at low absolute altitudes (0-5 m) and to analyze their physical characteristics. Boring in the study area was done and core samples were taken. Holes, spaced 10-15 m apart, were drilled in and at some distance from the Pueta River channel along a continuous profile. The clay cores are developed from the surface, have a thickness of up to 3 m, vary in consistency and contain up to 6% organic matter. Within the river channel they are underlain by alluvial gravel and coarse sand with up to 10% pebble and have a thickness of up to 8 m. The base of the sequence consists of Precambrian biotite gneiss.

Lithological analysis of the clays has indicated they originally formed in a stream as organic-mineral matter and were then compacted. Paleontological analysis has shown no marine microorganisms in the organic matter of the clays, suggesting that they belong to a continental facies. The clays contain an abundance of quartz and albite combined with muscovite, the only clayey mineral, which is characteristic of the redeposited weathering products of metamorphic complexes in the Belomorian Province. There are two clay varieties alternating in the sequence and distinguished on the basis of their chemical composition: high-silica and low-silica. The geological sequence shows that these deposits occur over large areas, resting, for example, on a crystalline basement outside river channels.

Structural forms definition on the basis of structural surface and gross mapgross maps analysis of Devonian and Lower Carboniferous deposits

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The formation of the Paleozoic age sedimentary cover of the East European (Russian) platform (EEP) is associated with the Hercynian Orogeny during the period from the Middle Devonian to the Early Triassic. The formation of sedimentary rocks is greatly influenced by tectonic processes, the physiographic and physico-chemical conditions of the sedimentation, and many other factors.

The purpose of the work is research the causes and conditions of troughs' basining and flattening and their influence on the formation of oil deposits. The study area is 1 block of 8 deposit of the Romashkinskoye oilfield. The object of investigation is located in the eastern part of the EEP, within the Volga-Kama anticlise, and belongs to the South Tatar Arch (STA), which is a large structural element of the first order. Devonian and Carboniferous sediments are studied.

Geological information about the structure of the territory was obtained from well logging data and seismic surveys. Structural maps and gross maps of the studied layers were constructed. The evolution of the surfaces of the area has studied by structural analysis. The analysis included a comparison of modern structural plans and the gross thicknesses.

Facial analysis was carried out based on the constructed maps: structural forms and thicknesses were compared for each of the stratigraphic units. Vertical direction of surface movement in different periods, the intensity of uplifts of some parts of the territory (erosion) or settling (deposits accumulation) were established. The method of perturbations and unconformities was applied, because at the boundary between Frasnian and Famennian stages change of sedimentary conditions occur, which led to an irregular deposition.

As a result of research, the time of the Minibaevsky trough occurence was revealed, the presence of multidirectional tectonic movements in the area of the Minibaevsky trough and negative movements in the region of the Altunino-Shunaksky trough were established. The tectonic processes had practically no effect on the central part of the study area. Thus, it can be noted that in study area, sedimentary rocks have an inherited nature and flatten up along the section. Structural plans of the Devonian, Carboniferous deposits are similar. The structural forms' shape difference has local nature and associated with the influence of neighboring blocks' tectonic forces in the east of the territory.

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Mineralogy of layered silicates suspended in the water column and in bottom sediment of Lake Onega, Russia

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Studies of layered silicates in suspension in the water column (on water filters and in sedimentation traps) and bottom sediments collected from various parts of Lake Onega were carried out using a combination of geochemical and mineral-crystal-chemical methods: X-ray diffractometry (XRD), infrared (IR) spectroscopy, and scanning electron microscopy (SEM). Analytical work was performed at the Analytical Center for multi-elemental and isotope research of the Siberian Branch of the Russian Academy of Sciences, (Novosibirsk).

According to the results, layered silicates in suspended material collected from sedimentation traps and bottom sediments in Lake Onega are muscovite, biotite, illite, and chlorite. Sedimentary material from the traps is a colloidal gelatinous silt of pelitic fraction. Scaly aggregates of grains and individual lamellar crystals of layered silicates were divided into two groups according to size. Large particles (pelitic fraction) ranged in size from 100 μm up to 5 mm in all samples, and the content of iron and magnesium was similar in both chlorites and illites. Fine-scaled aggregates and needle-like grains (≤5 μm) had significantly more iron than magnesium (and in some cases, pure ferruginous varieties) and were found only in traps and bottom sediment. The composition of Mg-Fe chlorites and illites in individual samples of suspended material from sedimentation traps and filters were the same for large grains and fine-scaled aggregates in different parts of Lake Onega.

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Diatoms from modern lake sediments of the Lake Lebedinoe (Yamalo-Nenets Autonomous District, West Siberian Arctic, Russia)

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Arctic reservoirs are excellent indicators of the ongoing increase in air temperature on the planet. Diatoms, which inhabit all surface waters of the Earth, can be used as biological indicators of changes in the environment (temperature, hydrochemical). The aim of this work was to study the taxonomic composition and ecological characteristics of diatoms in modern sediments of the Lake Lebedinoe (Yamalo-Nenets Autonomous District – YNAD, West Siberian Arctic).

In summer 2017, a modern bottom sediments was taken in the subarctic Lake Lebedinoe (YNAD, West Siberian Arctic) (64°17.135´N, 78°07.449´ E) from the depth of 1,3 m using a UWITEC sampler. Modern bottom sediments were represented by sandy material with plant detritus. Hydrochemical studies, recorded a low value of conductivity - 7.7 ms / cm-1, good saturation of water with oxygen 101.7% (9.91 mg / l), pH-6.3, characterized the water medium as weakly acidic. Processing of sediment samples for diatom analysis was performed using the water bath method. In sample from modern bottom sediments Lake Lebedinoe identified 26 diatom taxa belonging to 2 classes, 14 families and 17 genera. Diatoms from Centrophyceae were represented only by two species of the genus *Aulacoseira*, the other 24 species belonged to the Pennatophyceae. The species composition is better represented by species belonged to the genera *Eunotia and Pinnularia*. In relation to habitat, benthic species were the most frequent (69.2 % of the taxonomic richness), 26,9% of the taxonomic richness were planktonic-benthic and only 3,8% were planktonic species. In relation to salinity all found species of diatoms are oligohalobes, the majority of which constituted indifferent species (69 %), less - halophobes (23,1%) and halophiles (7,7%). In relation to pH, the majority of species were alkaliphiles (34,6 % of the taxonomic richness), a little less were found acidophilic species (30,7 %), even less were indifferent and alkalibiontic species (19,2% and 7,7% respectively). By geographical distribution, most of the species could be attributed to cosmopolitan species (69 % of the taxonomic richness), 15,4 % have arctic-alpine and 11,5% - boreal distribution. In relation to water temperature, information is available only for 9 species: 5 of them prefer moderate conditions, 3 are eurythermic and 1 species is cold water - *Aulacoseira distans var. distans* (Ehrenberg) Simonsen 1979. As for the water flow factor, information is available about 23 species, of which indifferent species predominated (10). Species of flowing water were 7, flora of stagnant water was represented by 5 species, one aerophilic species, *Pinnularia borealis* Ehrenberg 1843, was also found. Studies have shown that the diatoms of modern bottom sediments of Lake Lebedinoe (YNAO, Western Siberian Arctic) are quite diverse, the found species of the genera *Eunotia, Pinnularia* prefer low values of electrical conductivity and a neutral - slightly acidic environment. This work was supported by the Russian Science Foundation (project N 20-17-00135). We thank all colleagues who helped us during the fieldwork. O. P. is supported by subsidy allocated to Kazan Federal University for the state assignment N 671-2020-0049 in the sphere of scientific activities.

The effect of volcanic processes on the lithogenesis of saprobitumolites in the Onega Structure, Karelia

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During the detailed study of the Zazhogino deposit (Karelia) in the 1980s assessment of the effect of subvolcanic complexes on the formation of the deposit was not considered an important issue. It was assumed that changes in the properties of carbon-rich pelitomorphic rocks (saprobitumolites) at the contact with mafic sub-intrusive sheets do not affect the technological properties of raw materials. It was also assumed that the free carbon content and structural condition of hydrocarbons in the deposit are persistent.

The Southeast (Maksovo) Deposit of the Zazhogino Proterozoic carbonaceous rock deposit is confined to the sixth productive horizon of the Zaonega Formation: of the Ludicovian superhorizon (2100-1920 Ga) of the Onega volcanotectonic depression located on the Karelian Craton in the eastern Fennoscandian Shield. The presence of subhorizontally occurring variably thick gabbro-dolerite bodies in the rock sequence is characteristic of the geological structure of the Maksovo Deposit. The gabbro-dolerites were highly metasomatized to fine-grained glimmerites with variable percentages of quartz, chlorite and albite. The rock structure is amygdaloidal to porphyritic with relics of intersertal structure of the matrix. The saprobitumolites were subjected to the most considerable alteration. Their OM content decreases to 10%, and mica (mainly biotite) content increases to 25%. These are fine-grained fractured and foliated rocks with small cavities and amygdales (up to 0.5 m in size) filled with migratory OM, as well as quartz and biotite. A coking zone, up to 1.5 m in thickness, persistent throughout the entire sill top, was revealed at the exocontact. Cokes after Maksovo saprobitumolites are similar lithologically to natural cokes evolving in coal sheets at the contact with compositionally different intrusions.

Prior to sill intrusion, Maksovo rocks were poorly lithified, and primary OM did not pass a major phase in oil formation. The heat emanated by the intrusions imparted extra ability for viscous flow and plastic deformation to the rocks. The presence of water-bearing minerals and the high heat capacity and the low thermal conductivity of organo-mineral compounds contributed to the large-scale manifestation of hydrothermal and metasomatic processes. The mechanical effect and thermal conditions provoked by the emplacement of intrusions gave rise to mobile hydrocarbons (anthraxolites) liable to rapid polymerization and capable of migrating within the deposit. In the presence of conservative cap rocks, migration to higher horizons resulted in the formation of secondary bodies similar to those in the Cenozoic-Mesozoic oil-and-gas-bearing complexes of the Siberian Platform.

Thus, stepwise OM formation in saprobitumolites was provoked by a thermal effect on a large part of the deposit produced by the one-act intrusion of gabbro-dolerites. The formation of the Maksovo saprobitumolite deposit, understood as a deformation type associated with intrusive activity is a subject that needs further study.

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Chemical composition of groundwater in Kazan

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The city of Kazan is a large (1.25 million inhabitants) industrial and cultural center of Russia, for which the issues of changing the quality of groundwater are an important element of strategic development. Today, about 20% of the city's drinking water supply is connected with underground water intake facilities, and almost all large enterprises have their own underground water source for industrial supply.

The territory of Kazan includes the following underground aquifers (from top to bottom): Neogene-Quaternary alluvial complex (aN-Q); Lower Kazanian carbonate-terrigenous complex (P2kz1); Sakmarian sulfate-carbonate complex (P1s). Aquifers in Kazan are exploited by a large number of wells and are widely used for industrial water supply of industrial enterprises and household and drinking needs. Regular observations are carried out in the wells. We have collected the results of 2267 chemical analyzes of water carried out according to standard methods in certified laboratories.

The processing of the analysis results of the water samples of the Lower Kazanian complex using cluster analysis revealed the «natural» and «technogenic» groups of components. The most technogenic components are chlorides and nitrates; less pronounced confinement to this group of mineralization, are iron, sulfates and general hardness. The natural components of the water samples of the Nizhnekazan complex are hydrocarbonates, oxidizability, pH, and possibly cations.

When comparing the data on cluster analysis by observation periods, some differences are revealed, which in our opinion, may be associated with a different degree of technogenic load on the water of the Lower Kazanian complex of Kazan in the XX and XXI centuries. Factor analysis showed that technogenic factors for 2 observation periods differ contrastingly, while the most significant «natural» factor is rather well distinguished by a set of common components. By the weight of technogenic factors, it is possible to calculate the quantitative contribution of technogenesis to the composition of groundwater. Thus, the technogenic load on the groundwater of the Lower Kazanian complex at the beginning of the 21st century is higher (33%) than in the 20th century (22%), which is confirmed by the contents of the main components.

For the first time, a systematic retrospective analysis of hydrochemical data for a 60 years-observation period was carried out for groundwater in Kazan.

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Formation series of Triassic sedimentary basins in the West of the Scythian platform

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The formation analysis of the Triassic deposits of the West of the Scythian plate is performed, the results of which differ significantly from the previous representations. The most ancient deposits are represented by red-colored and variegated continental deposits of the Indus tier (the leushkov formation), which we distinguish as a rough-edged red-colored continental formation. They were preserved from erosion in local depressions of the surface relief of the Paleozoic Foundation.

The marine gray-colored terrigenous formation of the lower and middle Triassic is common at the junction of the East European platform and the Scythian plate. Accumulation of the formation occurred from the second half of the Indus and up to the middle of the Ladin ages in the conditions of a deepening sea basin. Dikes of quartz diabases have been found in the Olenek deposits, which are possible channels of spilled basalts confined to the upper anisian-lower Aladin deposits. In the upper part of the section there are layers of basalts with a thickness of 6 to 20 m. In the North-Eastern framing of the Kanev-Berezan zone of the fold, including northwestern anticlinal East Kuban troughs developed carbonate formation - age analogue of the terrigenous formations.

The volcanogenic-terrigenous deposits located above the formation of the same name (verkhneladinsky podjarus-karniysky tier) are interesting in terms of formation. A characteristic feature of the formation is the presence of dacites, rhyodacites and rhyolites in the section. Within the Timashev stage, deposits become more deep-water with the appearance of Jasper-like rocks, radiolarites, and radiolarian mudstones. The overlying marine terrigenous (mudstone-siltstone) formation of the upper Triassic lies with erosion on the underlying sediments. The pre-Jurassic section is completed by the upper Triassic carbonate formation (the upper Norian stage), developed in the Irklievo-Ladovskaya and Kanevo-Berezanskaya zones, as well as on the Adygeian salient.

The territory was zoned with the allocation of structural and formation zones: Arlievsky-Ledovskoy, Alexis, Azov-Caucasian and Timashevskaya. It is shown that the Triassic sedimentation cycle began with the accumulation of red-colored terrigenous formation of the lower Triassic. In the Indian, Olenek and anisian ages, sedimentation in the Irkliev-Ladovskaya and Azov-Caucasian zones occurred in different facies conditions: in coastal-marine and shallow-water areas in the first and relatively deep-water areas in the second. From the Ladin age to the Norian age, sedimentation in both zones occurred in the same shallow water conditions, and within the Timashev zone – in deep water. Sedimentation was accompanied by an outpouring of magmas of various compositions. The Triassic sedimentation cycle ends with the accumulation of upper Triassic carbonate formation.

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Evolution and prospects of oil and gas content of Paleozoic sedimentary basins of the Scythian-Turan platform

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Most of the territory of the Scythian-Turan plate is formed on the folded area arising from Paleolithic, history of education which in its initial periods is not clear and is interpreted in different ways. Some researchers associate the formation of Paleotethys with the destruction of normal continental crust, others-with rifting in the sub-continental crust that separates the ancient platforms, or with increased spreading within the oceanic Prototethys and its margins. In the latter case, Paleolithic is seen primarily as an inherited structure of the Northern part Protatitis. The time of its occurrence is not definitively established and is estimated from the late Riphean to the beginning of the Ordovician.

The expansion and deepening of Paleolithic lasted until the Silurian and Devonian periods, but in mid-Silurian time marked the first fold movement, which formed arrays of granite-metamorphic layer. Further differentiation of tectonic conditions in Palettize happening in Devon. Structures such as island arcs of the middle Paleozoic are found in the Alps, the Balkan Peninsula, and the Caucasus.

In the middle Paleozoic, terrigenous-shale and carbonate formations accumulated in the marginal and inland seas, which were opened by wells in many areas, which suggests the existence of a zone with a transitional type of crust in the middle of the Paleozoic. More intensive process of compression and crowding of rocks in Palettize occur in the Carboniferous. This period is marked granitization anticlinorium zones. Growing Islands of newly formed crust supply clastic material that accumulates in the Carboniferous-early Permian in marine reservoirs (the lower molasses complex).

By the beginning of the late Permian, the formation of a new continental crust was mostly complete.

The degree of lithogenesis of the rocks composing the Foundation varies from deep stages of catagenesis to metagenesis and green-shale facies of regional metamorphism, so the primary filtration and reservoir properties of the rocks are almost completely lost. The degree of catagenesis of dispersed organic matter reaches the anthracite stage. Consequently, hydrocarbon deposits in Paleozoic strata are epigenetic and are associated with zones of development of secondary reservoirs. Their formation is determined in most cases by secondary processes: the latest fracturing, leaching, weathering, and dissolution, and the intensity of their manifestation, other things being equal, largely depends on the initial lithological composition of the deposits included in the Foundation.

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Mineralogy of the Bazilevo copper occurrence in Upper Kazanian sandstones from the southwest part of the Republic of Bashkortostan

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The Bazilevo copper occurrence was revealed during the excavation of a quarry for sand and gravel material. The quarry is located on small hill 1.3 km north-east of the village of Bazilevo (53° 05' 20'' N, 55° 03' 04'' E) and is 70 × 40 m in size and the excavation depth is currently up to 9 m. The section exposed by the quarry operation is composed of brownish-gray polymictic sandstones with interbeds of sandy gravelstones of the Belebey Formation.

Ore bodies are mineralized trunks of fossil trees. Their diameter reaches 0.6 m, the longest of them has a length of at least 40 m. In total, five ore bodies have been identified, four of which strike WSW ~ 265°. They have a zonal structure: the central part is composed of friable wood remains and black coalified matter (~ 10 cm in diameter) surrounded by a crust of massive sulfides (0.n – 10 cm), and the marginal part is composed of clastic material with copper bicarbonate cement (5–35 cm). The boundaries of ore bodies are marked by a reddish oxidation zone (1–25 cm).

According to X-ray fluorescence analysis, the Cu content in ores varies from 1.4 to 30.4 wt. % (maximum in the central part of the ore body and minimum – in the peripheral). Some samples are characterized by high concentration of Ag (93 ppm), Ba (0.18 wt.%), and Pb (236 ppm). XRD analysis of ores showed that most of the copper is contained in azurite (~ 30 wt%), brochantite (~ 20%), chalcocite (~ 16%), bornite (~ 13%) and malachite (~ 8%). Also, using this analysis, the presence of the following minerals was diagnosed in the ores: marcasite, pyrite, cuprite, native copper, chalcopyrite, cubanite.

Various mineral phases are presented in cellular texture, and zoning is observed in the structure of individual cells: the nuclei correspond to pyrite (or marcasite), and the outer layers are composed of chalcocite, which form a network of thin veins when it grows together. Pyrite often replaced by chalcedony, Fe hydroxides, or Cu bicarbonates; chalcocite is also replaced by them. Bornite, cubanite, cuprite, and covellite forms veinlets, the outer rims of which are chalcocite. Brochantite forms continuous fine inclusions or complex intergrowths in thin veins together with azurite after bornite. The main mass of azurite and malachite is a finely dispersed mixture, as the cement of a detrital mass of ore bodies surrounding the sulfidized parts of wood trunks.

The genesis of Bazilevo copper mineralization consistent with polygenic model. Primary precipitation of Fe sulfides (especially pyrite) during syngenetic or diagenetic processes on an organic reductant (plant residues) is common for such ore deposits, as a result of the activity of sulfate-reducing bacteria. Subsequently, iron sulfides are replaced by copper sulfides – chalcocite, bornite, cubanite, chalcopyrite – due to the influence of Cu-bearing fluids that divided from the underlying red layers. Subsequently, the migration of oxidized water in the pore space led to partial dissolution of sulfides and based on that formation of late sulfates and hydrogen carbonates of copper, as well as iron hydroxides.

Facies and cyclicity of the Kumakh-Ulakh Formation`s cap-dolomite

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The time scales and conditions associated with the formation of Neoproterozoic cap dolostones provide data needed to test the Snowball Earth hypothesis, and reconstruct the Neoproterozoic palaeoclimate. We studied the lithological characteristics and variations in magnetic susceptibility of the cap dolostone of the Kumakh-Ulakh Formation (the Berezovskaya Depression, south of the Siberian Platform). These rocks are comparable with the globally distributed cap dolostones [3] due to the following common features: 1) they overlay conformably the Neoproterozoic glacial sediments of Nichatka Formation; 2) they are composed mainly of dolomite; 3) they have tepee-like structures; 4) they have typical carbon isotope composition (δ13C = -2 - -3 ‰ VPDB)

The studied sediments of the Kumakh-ulakh Formation, in contrast to the majority of cap dolostones, lack obvious signs of biogenic origin. Traces of shallow active hydrodynamics were also not found. Cap dolostones of the Kumakh ulakh Formation have signs of pelagic evaporites of meromictic basins, however, red coloration of sediments indicates oxidative bottom conditions unusual for long-term meromictic hydrology.

The cap dolostones of the Kumakh-ulakh Formation record magnetic susceptibility fluctuations of different order. It has been suggested that long-period variations of magnetic susceptibility may reflect Milankovich precession cycles. The precipitation rate calculated on the basis of this assumption is consistent with the estimates of the Holocene accumulation rate of postglacial meromictic basins and is 3 - 4.5 cm/ 1000 years. The orbital nature of the detected cycles can be further justified by studying other cap dolostones successions.

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Intercalation with basic amino acids of smectite bentonite of the deposit Tenth Khutor

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Smectite, the main component of bentonites, thanks to the labile crystal lattice has high sorption properties. Smectite is capable of both surface and interlayer sorption of inorganic and organic compounds. Minerals of smectite group are widely used in creation of materials with certain properties by means of chemical transformation, including creation of organomineral composites.

Bentonitic clay is a relatively inexpensive and environmentally friendly raw material for use. Therefore, scientists who study smectite-containing rocks and their modifications considers clay minerals as materials of the 21st century. However, at the same time, organomineral interactions and their role in mineral formation are among the most important problems of the 21st century in mineralogy.

Therefore, the study of the properties of smectite and their interaction with organic compounds is an urgent issue in science today.

The process of intercalation of basic amino acids is considered on the example of interaction of bentonite clay of the Tenth Khutor deposit with lysine. The comparative analysis of amino acid saturation methods and bentonite activation methods has been carried out.

Natural samples of bentonite and samples resulting from saturation with lysine were analyzed by X-ray diffraction on Bruker D8-Advance powder diffractometer (angle range 2θ=3-60°, CuKα-radiation). Thermal analysis of the STA 409 PC Luxx thermoanalyzer manufactured by Netzsch was also performed.

The comparative analysis of diffractograms of initial and samples saturated with lysine revealed a shift of the reflex characterizing the basal distance between the silica layers in the saturated bentonite sample towards the low-angle region. Also as a result of thermal analysis of saturated amino acid bentonite, exothermic peaks in the temperature range of 300-550 ° C were found, confirming the presence of organic compounds in the sample. The results of the studies indicate positive sorption of the basic amino acid in the interlayer space of smectite.

The study also revealed that in comparison with the initial form, bentonitic clay modified with 1M NaCl solution is subject to higher intercalation. It was found that sorption of amino acids into the interlayer space of smectite bentonites depends on the specific structure of smectite and acid-base properties of amino acids.

Evolution of the superfamily Palaeotextularioidea Galloway, 1933 (Foraminifera) in the Lower Carboniferous

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Foraminifers of the superfamily Palaeotextularioidea are occurred in Eurasia, North America and North-West Africa and existed from the Late Visean age of the Early Carboniferous to the Permian inclusive. Interest in this group is due to its biostratigraphic and correlation potential for the Lower Carboniferous deposits. Palaeotextularioidea are used as zonal taxa for Visean in Western Europe. The superfamily Palaeotextularioidea includes the family Palaeotextulariidae and the family Koskinobigeneriidae (Vachard, 2016). The main families feature is a wall structure. Koskinobigeneriidae is characterized by a single-layered microgranular wall, Palaeotextulariidae has a double-layered wall with an outer microgranular layer and an inner radial fibrous layer. Genus features are the tendency to uniseriality and the aperture characteristic. In the Lower Carboniferous, the family Palaeotextulariidae is represented by the genera Palaeotextularia, Climacammina, Cribrostomum, and Koskinobigeneriidae includes the genera Consobrinellopsis, Koskinobigenerina and Koskinotextularia.

Palaeotextularioidea originated from members of the family Palaeospiroplectamminidae by reduction of the spiral initial part (Lipina, 1979; BouDagher-Fadel, 2018). The earliest representative is *Consobrinelopsis lipinae* (Conil et Lys), that is known from the beginning of the Late Visean (Tulian) of the East European Platform (EEP) and the V2b and V3a zones of Belgium (Conil et Lys, 1964). This species has a thick, single-layered, coarse-grained wall and is morphologically similar to *Eotextularia diversa* (Chernysheva) of the Palaeospiroplectamminidae family, differing in the absence of an initial spiral part. *C. lipinae* is probably the descendants of *E. diversa*. Several stages can be traced in palaeotextularioids evolution in the Early Carboniferous. In the Early Visean (Tulian of the EEP and the Urals, the V2b and V3a zones of Belgium, the Cf5 Zone of England), forms with both a single-layered and a double-layered wall are known, so they originated almost at the same time. This stage is characterized mainly by biserial forms with a simple aperture (genera Consobrinellopsis and Palaeotextularia). In parallel, a complication of aperture structure is observed, there is the conversion from a simple to a cribrate aperture in the last chambers. The first representatives of such forms (*Koskinotextularia bradyi* (Moeller), *Cribrostomum eximiformis* (Lipina), *C. stalinogorski* Lipina) are also recorded in the Tulian of the EEP, the Urals, Tian Shan and from the Cf5 Zone (Livian) of Western Europe. These forms are more widespread in Aleksinian. The next stage in palaeotextularioids development is the tendency to uniseriality and bimorph forms with cribrate complication aperture in the uniserial last part appearance. Single forms with the single-layered wall and the uniserial last part (genus Koskinobigenerina) have been recorded since the end of the Aleksinian on the EEP and the Urals, and from the Cf6γ Zone (Warnantian) in Western Europe, that is comparable with the upper part of the Aleksinian. Bimorph forms with a double-layered wall (genus Climacammina) were found from the Mikhailovian and from the Cf6δ Zone of Western Europe, corresponding to the Mikhailovian and Venevian regional substages. Thus, in the Early Carboniferous, the evolution of palaeotextularioids proceeded in the direction of the aperture complication and bimorph forms appearance.

Example of studying reservoir properties of the Bazhenov formation Kogalym region

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The Bazhenov formation is distributed almost throughout the entire territory of the West Siberian oil and gas basin. The formation is a natural reservoir that is an oil reservoir and a regional fluid reservoir in the West Siberian basin (Kontorovich, Gurari).

This article discusses the reservoir properties of rocks of the Bazhenov formation on the example of the Kogalym region, in order to further predict promising areas for development. The paper systematizes data laboratory of the Center for the study of core and reservoir fluids "Kogalymnipineft". The complex of laboratory studies includes: camera description of the core, photography in daylight and ultraviolet light, lithological and geochemical studies (gas chromatography and pyrolytic method).

In the course of the work, special attention was paid to the core material, which is characterized by fracturing, highlighted by the glow of hydrocarbons under ultraviolet light. Fracturing of rocks is considered as a possible path of primary migration of hydrocarbons.

A unique example is the core of an anomalous section of the Bazhenov formation (ABF) of well 431P of the Imilorskoye field, where areas of maximum fracturing are identified in the macroscopic description. Samples were selected from the selected zones of maximum fracturing for petrographic and geochemical studies on direct contacts of bituminous rocks of the Bazhenov formation with sand-siltstone rocks. Geochemical studies of the selected samples were carried out to assess the generation potential and the oil-generating properties of the organic matter contained in them.

The complex of laboratory studies includes optical-petrographic study of samples (in passing and reflected light) at the boundary "oil – producing rock-reservoir rock". The selected samples show a network of subvertical, rarely subhorizontal microcracks, areas made of secondary minerals (carbonates), rarely organic matter of red-brown color (microoil?). The results obtained confirm the hypothesis of natural hydraulic fracturing of rocks and characterize the properties of the oil-producing rock not only as generating, but also accumulating.

As a result of complex laboratory studies conducted on core material for SLE. 431R of the Imilorskoye field, it was possible to expand the understanding of petrographic and geochemical characteristics of samples, which will allow further detailed and comprehensive study of reservoir and oil-bearing properties of rocks of the Bazhenov formation in the ABF zones.

Features of the lithological composition and reservoir properties of the Kuanysh productive horizon of the lower Jurassic of the Ustyurt region (Uzbekistan)

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The main productive horizons of the Ustyurt oil and gas region of the Republic of Uzbekistan are lenticularly layered continental terrigenous deposits of Jurassic age. Various authors in the studied section distinguishes up to 7 productive horizons, the most underlying and relatively powerful of which is Kuanyshsky [1].

The Kuanysh horizon (J_{1ksh}) is named for the area of the same name (currently the field), where industrial gas inflows were first obtained. The lithological composition is represented by light gray fine-grained sandstones, massive, oblique-wavy-layered, quartz-feldspar-biotite composition, with inclusions of well-rounded fine gravel (well Northern Berdakh-9, int. 2645-2648 m). The basal layers are composed of different-grained gravelites with inclusions of pebbles. Clastic material is well rounded, rocks are unsorted, not differentiated, low-carbonate (well Saule-1, int. 3062-3069 m). Coarse rocks are often interbedded with floodplain siltstones and mudstones. Siltstones are not clearly wavy-layered (well Eastern Muynak-1, int. 3345-3347 m). The rocks are often characterized by one-sided oblique oblique and diagonal layering. The genesis of the rocks is freshwater-lake (floodplain) - in the upper half and channel - in the lower.

The reservoir properties of the reservoirs of the Kuanysh horizon of the northern part of the Sudochiy depression are characterized by the average (kp = 15-20%) and reduced (kp = 5-15%) capacity characteristic of III-IV classes of reservoirs (according to the classification of Khanin reservoirs). In the south of the study area, reservoirs with a low capacity (from <5 to 10%) of V class are common. This is due to the fact that the primary structures of the clastic grains of sandstones, sand siltstones and siltstones of the northern part of the trough underwent the most profound secondary changes, which caused secondary cementation and clogging of the primary pores.

Thus, it should be noted that the Kuanysh horizon of the Lower Jurassic is characterized by a lateral extension, increased thickness (50-70 m), often represented by two thick sand-gravelite beds interbedded with clay-siltstone formations (indexation - J_{1ksh1} and J_{1ksh2}).

Non-ammonoid cephalopod assemblages of the Early Permian Shakh-Tau Reef

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The study of a unique collection of non-ammonoid cephalopod mollusks from the Early Permian Shakh-Tau Reef (Bashkortostan), allowed the recognition of the taxonomic composition and morphological structure of two successive fossil assemblages. The older Asselian-Sakmarian assemblage contains, about 20 cephalopod species belonging to two orders. This is to date the taxonomically richest assemblage of this age in the world. At present 15 species of 15 genera have been described in the orders Oncocerida(?) – *Barskoceras mirum* Leonova et Shchedukhin and Nautilida: suborder Nautilina (*Alexoceras mazaevi* Leonova et Shchedukhin, *Temnocheilus* sp., *Mosquoceras planum* Leonova et Shchedukhin, *Pararhiphaeoceras tastubense* (Kruglov, 1928), *P*. sp., *Sholakoceras formosum* Leonova et Shchedukhin) and suborder Liroceratina (*Megaglossoceras barskovi* Leonova et Shchedukhin, *Leniceras ovale* Leonova et Shchedukhin, *Liroceras shakhtauense* Leonova et Shchedukhin, *Shikhanonautilus siphonoventralis* Leonova et Shchedukhin, *Thyoceras involutum* Leonova et Shchedukhin, *Domatoceras sterlitamakense* Leonova et Shchedukhin, *D. bashkiricum* Leonova et Shchedukhin, and *Shatoceras umbilicatum* Leonova et Shchedukhin) and *Dentoceras magnum* Ruzhencev et Shimansky. Until now, it was believed that oncocerids, as well as nautilids of the genera *Temnocheilus* and *Megaglossoceras* did not continue beyond the Carboniferous, and they are now reported for the first time from the Early Permian. The exotic genus *Dentoceras*, by contrast, was previously known from younger sediments. The morphological structure of this assemblage considerable differs from other Sakmarian assemblages of the South Urals in the distinct dominance of coiled morphotypes, as has been noted by I.S. Barskov. Probably, this feature is associated with habitat conditions in reef environments. A similar morphological structure is also characteristic of the Kazanian cephalopods from reef deposits of the Volga-Ural region. The Late Artinskian cephalopod assemblage differs significantly from the older (reef-associated) assemblage, its composition is dominated by taxa known from the basinal deposits of the South Urals. In addition to the previously described Pseudorthocerida, 10 species of coiled nautiloids of the families Tainoceratidae, Gzheloceratidae, Domatoceratidae, Rhiphaeoceratidae, Thrincoceratidae, as well as one species of Dentoceratidae were first discovered in our collections. This community, in terms of taxonomic diversity, can only be compared with the very diverse coeval community of Gil-Tau.

Environmental dynamics and evolution of Lake Muannonjärvi, southwestern Karelia (based on micropaleontological data)

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The aim of the present study was to update a scheme of lake formation in Karelia and to reconstruct a paleoecological setting in SW Karelia in Holocene time by lithological, spore-and-pollen, diatom and radiocarbon analyses. Lake Muannonjärvi is located on the distal side of Sapausselkä-! (Rugozero) marginal glacial deposits. Diatom complexes and palynozones that are in good agreement between each other and show the paleoclimatic conditions of sedimentation were identified.

As the glacier retreated from the study area, a series of small periglacial water bodies, in which sandy deposits began to accumulate, formed near its margin. They began to accumulate in Lake Muannonjärvi in early Holocene a little bit earlier, 9830±150 C^{14} (LU-9244) years ago. Ice-free areas were colonized by periglacial grass communities that later gave way to thin birch forests. At that time various diatom complexes, consisting of planktonic forms and overgrowing and bottom species in approximately equal quantities, developed in the lake. More recently, however, the leading role was played by the bottom forms of *Pinnularia sp*. and the overgrowing organism *Staurosira sp.* accompanied by species of the genera *Navicula sp., Anomoeoneis sp.,Neidium sp.* and *Nitzschia sp.,* indicating a rapid decline in the water level of the lake. The decline seems to have been triggered by the isostatic uplift of the earth crust after the removal of the glacial load and by climate xerophytization in the late half of the Early Holocene. It is indicated by the rapid succession of mineralogenic deposits by organic sapropels with minor fine-grained sand impurity. The predominance of species of the genus *Staurosira sp.* in the sediments and the scarcity of planktonic *Aulacoseira sp., Cyclotella ocellata, Handmania comta, Tabellaria fenestrata,* forms of the overgrowing species *Cocconeis placentula f.linearis, Epithemia sp., Cymbella sp.* and *Gomphonema sp.* and the bottom species *Navicula sp., Pinnularia sp*., *Stauroneis sp.*indicate a warming event and a shallow water body. The decline in the water level is also supported by wood finds. It seems that as the water level of the lake decreased, sedimentation in it either slowed down or stopped.

The Middle Holocene is characterized by the most optimum climatic conditions. Coniferous forests, which comprised thermophilic species (*Ulmus, Tilia* etc.), were widespread in the study area. Spruce-pine forests prevailed in the early half of the Middle Holocene, while in the late half (C^{14} 2910±80 LU-9245) spruce became a major forest-forming species. Sapropels with plant remains accumulated in the lake. The diatom complex was dominated by planktonic forms from small northern water bodies of the genus *Aulacoseira sp*., indicating a humid climate and the inundation of the lake. Changes in Late Holocene vegetation were provoked by a cooling event. Spore-and-pollen spectra display a decline in the abundance of thermophilic species and spruce pollen. The forests in the area surrounding the lake were dominated by pine and lesser spruce-and-pine. Sapropels continued to accumulate in the lake. However, the diatom complex dominated by overgrowing species of the genus *Staurosira sp*. and showing the increasing contribution of boggy forms of the genera *Eunotia sp., Pinnularia sp.* and *Frustulia saxonica* indicates the paludification of the shores the overgrowing of the lake and the continuing decline of its water level. The study supports a maximum decline in the water level of Karelia's lakes in Boreal time, which was responsible for the fragmentary pattern or complete absence of deposits of this time in most of the sequences studied.

Late Permian and Early Triassic non-marine bivalves from the reference section of the Kuznetsk Coal Basin (Western Siberia)

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Non-marine bivalves have been collected from the Tailugan Formation (Permian) and Maltsevo Formation (Permian–Triassic) of the Babiy Kamen Section. Three distinct assemblages characterize the Tailugan Formation and the lower and upper parts of the Maltsevo Formation.

The first assemblage (Tailugan Fm) is represented by the typical Permian genera of Angaraland: *Anadontella* and *Degeniella*. Geochemical data from fine-grained siliciclastic sediments (claystones) indicate humid precipitation conditions and oxidative redox conditions (high reduction-oxidation reaction (Eh)).

The second assemblage (lower part of the Maltsevo Fm) includes the Permian East European genus *Palaeomutela* and rare *Anadontella*. Shells consist of primary aragonite (confirmed by RAMAN spectroscopy). Geochemical data from fine-grained siliciclastic and carbonate sediments indicate a semi-humid climate and a decrease of oxygen in the sediment (Eh reduced).

The third assemblage is represented by Triassic taxa, partially new, partially belonging to *Utchamiella* Ragozin (known from Korvunchan Fm, Tunguska Basin, Siberia). Primary shell aragonite is preserved. The upper layer is a prominent vertical irregular simple prismatic, the lower layer – crossed lamellar. Ligament is opistodetic. Geochemical data from fine-grained (claystone) siliciclastics indicate a semi-arid climate and anoxic conditions (low Eh).

Our findings support the radiometric dating of the lower part of the Maltsevo Formation as Late Permian (in contrast to previous biostratigraphic data, pointing to an Early Triassic (Induan) age). The Triassic bivalve assemblage needs detailed study and description. Shells with preserved aragonite suggest low partial pressure of carbon dioxide, relatively low Eh and buffer pH in the mud during sedimentation, and rapid burial of the bivalves.

Permian non-marine bivalve *Palaeomutela* Amalitzky, 1892 from the Collio Formation (Southern Alps, Italy): possible new FAD for the genus

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We made a comprehensive study of the collection of bivalves sampled by Berruti (1967, 1970) and Conti et al. (1991) from the Collio Fm (Collio Basin, Upper Trompia Valley, Southern Alps, Italy).

The Collio Fm (700-800 m thick) consists of siliciclastic and subordinate volcanic rocks and represents the most known Early Permian unit from Italy (Marchetti et al., 2015 and references therein). The radiometric ages on volcanic units underlying and overlying the Collio and Dosso dei Galli Fms constrain the age of these units between 283.1 ± 0.6 Ma and 279.8 ± 1.1 Ma (Schaltegger and Brack, 2007). This currently coincides with the early Kungurian of the International Chronostratigraphic Chart (ICC, 2020/03).

Within the Collio Fm, bivalves are represented by external and/or composite moulds. The bivalve assemblage contains three morphotypes externally differentiated by shell elongation: 1) oval-subtriangular, 2) subtrapezoidal and 3) elongate. The elongate morphotype is dominant.

We add some new features to the description of these bivalves, which indicate their similarity with the genus *Palaeomutela* Amalitzky, 1892 emend. Silantiev, 2015: 1) the cavity resembling a relatively thick hinge plate, with the poorly preserved imprints of plate-form teeth; 2) the poorly preserved imprint of the external ligament groove; 3) the concentric dichotomous sculpture.

Based on these features, we can assume that the Collio Fm bivalves belong to the genus *Palaeomutela*, possibly representing the oldest global occurrence of this genus (FAD- First Appearance Datum).

To-date it was generally accepted (e.g., Silantiev, 2018) that the first members of the genus *Palaeomutela* s.l. occurred at the beginning of the Ufimian Age (corresponding to late Kungurian of the ICC) in the nonmarine basins of the Cis-Ural Foredeep.

Such new finds of *Palaeomutela* in the early Kungurian of the continental strike-slip basins of the southwestern European sector of the Variscan collisional chain suggest a new worldwide first occurrence (FAD) and a possible new center of origin of this genus. This fact raises new questions requiring further research on biostratigraphy and palaeobiogeography.

If we assume that the genus *Palaeomutela* had only one center of origin, we need to hypothesise possible migration routes from Southern Europe to the continental basins of Eastern Europe and Angaraland.

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Geochemical types of Archean banded iron formation and the geodynamic setting of the basins, the Kostomuksha Greenstone Belt, Karelian Craton, Russia

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Banded iron formation (BIF) is a special type of sedimentary rocks that formed only in the Precambrian.

The Karelian Archean Craton is a classical structure of this type. It consists dominantly of Archean granitoids and greenstone complexes. The latter commonly occur as a combination of lowly to moderately metamorphosed volcanic and sedimentary (BIF, etc.) rocks.

The Kostomuksha Greenstone Belt (KoGB) lies in the western Karelian Craton. It is a relatively small (25 by 4.5-7 km) structure with the region's biggest iron deposit. The KoGB falls into two lithostratigraphic associations: the Kontokki and Gimoly Groups. The former is a Mesoarchean basaltic-komatitic sequence with felsic volcanic and BIF intercalations. The latter consists of metamorphosed Neoarchean flysch-type psammite-argillitic sediments with abundant BIF at the base of the sequence with metarhyolite sills and dykes. Thus, there are two types of BIF in the KoGB: type-I is associated with volcanic and the type-II - with sediments.

These two types of BIF differ considerably in chemical composition: The former contains higher average SiO_2, Al_2O_3, MnO and Sc, while the latter is substantially enriched in FeO_t, K_2O, Li, Rb, Ba, Sr, V, Zr and REE. Also, they differ markedly in normalized REE distribution pattern: type-II BIF displays a more differentiated pattern. There are HREE-depleted varieties of type-I BIF, but both types exhibit a positive Eu anomaly (Eu/Eu* - 1.11-1.89) typical of Archean sedimentary rocks.

Such significant differences in the chemical composition of the two types of BIF are undoubtedly due to differences in sedimentation conditions in the basins. The sea in which type-I BIF formed was similar to a fore-arc basin in an island-arc system. Felsic volcanics in it occur as relics of the volcanic island-arcs, while basaltic-komatiitic rocks are relics of the basement of this system. Fe, Si and other elements, including Sc, seem to have been supplied into the basin mainly by hydrothermal processes associated with island-arc magmatism.

The basin, in which type-II BIF formed, differed from type-I BIF not only in age but also a sedimentation setting: supplied into it were clasts that made up an ore-hosting psammite-argillitic greywacke sequence. Sedimentation was also accompanied by felsic magmatism of an island-arc type. BIF formed in it only in periods when lesser quantities of clasts were supplied but hydrothermal activity remained. The basin discussed seems to have been a back-arc basin in a Neoarchean island-arc system.

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Stratigraphy and Paleogeographic Formation Conditions of Black Shale Deposits in the Aramil-Sukhtelya Zone (South Urals)

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In recent decades, carbonaceous deposits have been attracting growing interest all over the world. This is associated with the significant fact that they provide highly informative material for reconstructing paleogeographic physicochemical conditions of sedimentary deposition, represent a favourable geochemical environment where noble and rare metals might accumulate and also serve as source rocks for shale-gas and oil production. In this case the estimation of the carbon potential on one or another site is based on C_{org} analysis in black shale units. In this regard, the Bulatovo Strata (S_1-D_1bl) are an ideal object within the fold area of the South Urals as they are well developed in the central and northern parts of the Aramil-Sukhtelya zone and possess considerable thickness and are reliably dated by conodonts, radiolaria and graptolites.

The strata have a homogenous composition and consist of carbonaceous-siliceous, carbonaceous-clayey-siliceous and siliceous shales. Carbonaceous substance is distributed uniformly in a pulverous-dotty manner and is often so thickly spread that it makes the rock absolutely non-transparent. The lower boundary of the Bulatovo Strata has been studied in detail. In conformity with interbedding, black shale deposits overlie the volcano-sedimentary sequence of the Shemetovo Strata (O_2sm). According to the data of recent geological mapping works its upper boundary is tectonic, and the thickness reaches 800-900 m.

Rocks of which it is formed relate to low-carbonaceous and carbonaceous types and belong to the siliceous-carbonaceous formation. Maximum C_{org} concentrations (3.0-7.8%) in the deposits are confined to the north-western flank of the structure-formational zone under investigation, and carbon they contain is of the biogenic nature ($\delta^{13}C_{PDB}$ (-22.6) – (-28.7) ‰). The paleogeographic depositional environment of the rocks in the Bulatovo Strata was generally in conformity with the actively-bent distal part of the water basin. The western portions of the central and northern areas were the deepest within its limits, where there were reducing conditions with a minimum amount of the terrigenous admixture. It is precisely this part of the Aramil-Suchtelya zone composed of black shale rocks with high C_{org} concentrations that evokes the greatest interest for shale-gas and oil production.

The authors have obtained the materials used in the paper in collaboration with staff members of the "Chelyabinskgeolsyemka" Open Joint-Stock Company during the 1:200,000 scale geological mapping works (sheets: N-41-I, Kyshtym; N-41-VII, Miass and N-41-XIII, Plast).

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Creating a character matrix could resolve synonymy problems of Mesozoic ommatid beetles from *Notocupes* generic complex (Archostemata; Ommatidae)

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Ommatidae is a relict group of beetles, in modern fauna comprising of only two genera and six species from Australia and South America. However, they were much more taxonomically diverse and abundant during Mesozoic. *Notocupes* (Ommatidae; Notocupedini) generic complex include 12 genera from 52 localities of Lower Triassic – Upper Cretaceous age. *Notocupes* itself together with *Zygadenia* and *Amblomma* being the most diverse genera of the complex. There are 30 species in *Notocupes* and about 7 species have uncertain generic placement. *Zygadenia* only known as separate elytra, with their structure similar to those of *Notocupes*, which later resulted in synonymizing of two genera with *Notocupes* becoming junior synonym of the former. Subsequent critique of inadequate comparison of isolated elytra and fully preserved body imprints leads to *Notocupes* being restored as separate genus and *Zygadenia* treated as a morphotaxon in further publications. *Amblomma* from Early Cretaceous of Yixian Formation is morphologically closest to *Notocupes.* Despite unparallel preservation quality of Yixian fossil material, one of the few used characters to distinguish it from *Notocupes* were shape and size of middle legs which results in synonymizing and erecting a new subgenus within *Notocupes*.

Currently *Notocupes* generic complex includes 77 species, but despite being such a big taxonomic unit, having dozens of species within genera and being discussed in significant number of studies, validity of most of the species and taxonomic relationships between genera are not clear and never been discussed in one comprehend study. *Notocupes* generic complex is in dire need of revision with description of the type material. For addressing this matter, a list of 138 characters was developed by the author, using both extensive published material and personal observation, covering characters of all body parts. Describing of new *Notocupes* beetles species using this approach appears to bring solid morphological basis to make reliable comparison between numerous closely related species of the complex and could help to perform a full-scale revision of the group in the future.

Primitive therocephalians in permian tetrapod assemblages of Eastern Europe

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Remains of primitive therocephalians (Pristerosauria) occur in abundance in middle-permian deposits of South Africa. They are represented by two families Scylacosauridae and Lycosuchidae and eight monotypic genera in Eodicynodon, Tapinocephalus and Pristerognathus assemblage zones (Abdala et al., 2008; 2014).

On the eastern European territories this group has been known for many years only by the species Porosteognathus efremovi, described on the basis of a very fragmentary material from Isheevo locality (Tatarstan) (Vjushkov, 1952). Recently some new primitive therocephalians have been discovered (Kammerer, Masyutin, 2018; Suchkova, Golubev, 2019a,b) and the revision of PIN (Moscow) and KPM (Kirov) collections led to establishing a new taxa of Eastern Europe pristerosaurians (Suchkova, Golubev, 2019c).

Primitive permian therocephalians are included in three successive faunal assemblages of Eastern Europe: Isheevo fauna – Porosteognathus efremovi and Biarmosuchoides romanovi, Sundyr fauna – Julognathus crudelis and Gorynychus sundyrensis, Kotelnich fauna – Gorynychus masyutinae and Koksharovia grechovi (in press).

In Isheevo assemblage Porosteognathus efremovi was a medium-sized predator with a skull length up to 20 cm, giving the role of the dominant predator to dinocephalian Titanophoneus potens. Biarmosuchoides romanovi, which is known only from the one dentary bone, was a small predator.

In the next Sundyr assemblage the role of apex predators belonged exclusively to therocephalians. Julognathus crudelis acquired the largest body size with a skull length of more than 40 cm. Gorynychus sundyrensis was somewhat inferior to it, but still could reach a significant size (35-40 cm of skull length). In this community Gorynychus also occupied the niche of a scavenger, as it can be observed from the considerable lifetime wear of it's incisors and canines (Suchkova, Golubev, 2019b). Sundyr assemblage is unique in the evolutionary history of Therocephalia because neither in South African assemblages, nor in later Eastern Europe assemblages they are considered to be solitary predators among the dominant block of tetrapod community.

In Kotelnich assemblage the skull size of Gorynychus masyutinae (20 cm) exceeded that of all other predators, but the skulls of eutherocephalian Viatkosuchus sumini (17 cm) and the abundant gorgonopian Viatkogorgon ivakhnenkoi (up to 16 cm) were only slightly smaller than that of Gorynychus masyutinae. Koksharovia, like Biarmosuhoides in Isheevo assemblage, was a small predator. These two therocephalians of a somewhat small size for the Pristerosauria, with large number of postcanine teeth, probably, formed a distinct biomorph of small terrestrial predators-generalists, not known for pristerosaurians in South Africa.

In Eastern Europe primitive therocephalians acquired the properly large body size only in Sundyr faunal assemblage, in which they were exclusive dominant predators and skavengers. In other assemblages they occupied niches of medium- and small-sized predators, less abundant than other therapsid predators of these communities.

New data on OSL dating of loess in the eastern Ciscaucasia (section Otkaznoe)

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Many Soviet researchers dealt with the problem of the stratigraphy of the Eastern Ciscaucasia and the Otkaznoe section particularly (Yu.B. Feiner and R.N. Lizogubov, 1987; V.P. Udartsev, A.A. Velichko et al., 1989; E.P. Virina, 1990; Bolikhovskaya N.S. 1995; Galay B.F. 1985, 1992). These schemes were carried out using various methods, such as paleosoil, palynological, lithological, etc. Contradictions between them are connected between B.F. Galay and V.P. Udartseva and A.A. Velichko schemes consists only in the identification by the latter of the interstadial Bryansk paleosol (MIS 3) at a depth of 13 m. Meanwhile, N.S. Bolikhovskaya, starting from the top, distinguishes warm Mikulino loess, which passes into the Don loess at a depth of 8-9 m. Unfortunately, the absence of absolute dating data did not allow solving these contradictions earlier. It should be noted that a series of 8 thermoluminescent dates from 238 ka to 22 ka. (V.N.Shelkoplyas, L.S.Kulikova and B.F. Galai, 1987) obtained in section with a similar structure located 60 km north-west of Otkazny – the Buddenovsk section. In addition, the authors of the aforementioned publication obtained the results of paleomagnetic analysis associated with excursions of the geomagnetic field. So, in the depth interval of 2.25-2.55 m, under the modern soil, a magnetic anomaly was recorded. By its stratigraphic position, the authors associate it with the excursion to Gothenburg – 10-12 ka. Using thermoluminescent dating, the authors associate the anomaly at a depth of 14.75-15.75 m, with the Lachamp excursion – 34-52 ka. Another anomaly was found in the 41.5-42.6 m interval just below the Mikulino soil. The authors correlate this anomaly with Blake's 120-90 ka excursion. This article will present materials obtained as a result of drilling two wells with overlap (the second well drilled to increase depth): well OT-1 (N 44.347 °, E 43.877 °, Habs = 234) – in the interfluve; well OT-2 (N 44.3464 °, E 43.8759 °, Habs = 219 m) – on the girder slope. Based on these materials, a series of 4 OSL datings were obtained for quartz and feldspar in the OSL laboratory of the FSBI "VSEGEI". In addition, dates were obtained at the LIAG Hannover for quartz and feldspar. For one of the datings, an adjustment was made for fading signal according to Kars (2008). The dates showed that the lower soils refers to MIS 5e, MIS 5c and MIS 5a. The overlying loess belongs to MIS 4-2. Also the soil and partly loess belongs to MIS 1. Also, in the course of our research, analyzes of the grain-size composition, magnetic susceptibility and the content of carbonate and organic material in the loess-soil formation of material from wells were performed. All analyzes were performed in the laboratory of Paleoarchives of the natural environment, Institute of Geography RAS.

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The Makarovo Horizon (Famennian Stage) in the stratotype section (Western slope of the Southern Urals)

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The Makarovo Horizon on the western slope of the Southern Urals is the largest regional subdivision in the Famennian (D3fm). It's known as the beds with *Cheiloceras, Zilimia polonica* and *Cyrtospirifer archiaci* [Markovsky, 1937] which corresponds to the interval of the Upper *triangularis*, *crepida*, *rhomboidea* and Lower *marginifera* conodont zones and subzones [Stratigraphic…1993;Baryshev & Abramova 1996]. In the stratotype section of Kuk-Karauk (5 km east of the Makarovo village) on the Sikaza River the light-grey, pinkish-grey fine and medium-layered organogenic-polyderitite limestones of marine origin, containing numerous remains of crinoids segments, brachiopods shells, rugoses, conodonts and fish fauna are the typical deposits of 2.4m in thickness. They have a cyclic structure and are represented by alternated greinstones-packstones and wackestones.

The Makarovo Horizon deposits in the Kuk-Karauk section include richest taxonomic composition of conodonts with 49 species belonging to seven genera: *Icriodus*, *Mehlina, Nothognathella*, *Palmatolepis*, *Pelekysgnathus*, *Polygnathus*, *Polylophodonta*. Four conodont assemblages characteristic for Lower *crepida, rhomboidea,* Lower *marginifera* and Upper *marginifera* standard zones and subzones have been established [Kononova, 1969; Kononova, Lipina, 1971; Abramova et al., 1990, 1995; Abramova, 1999; Abramova, Artyushkova 2004; Artyushkova et al., 2011; Tagarieva, 2013; 2014; Tagarieva, Mizens, 2015]. Lower *crepida* and *rhomboidea* zones conodont complexes were fixed for the first time [Tagarieva, 2013]. Intervals of the Upper *triangularis*, Middle, Upper and Uppermost *crepida* conodont subzones are absent in a stratigraphic sequence.

The selected conodont complexes consist of the genus *Palmatolepis* taxa mainly (up to 92 %). They are the representatives of deep-water palmatolepid biofacies. Species *Pa. triangularis* Sann., *Pa. subperlobata* Br. & M. and *Pa. delicatula postdelicatula* Schul. dominate in the Lower *crepida* subzone; *Pa. glabra glabra* Ul. & Bas. and *Pa. glabra acuta* Helms are common in the *rhomboidea* zone*; Pa. marginifera marginifera* Helms and *Pa. glabra pectinata* Zieg. are typical in the Lower *marginifera* subzone; *Pa. uthaensis* Zieg. & Sand., *Pa. distorta* Br. & M. and *Pa. minuta minuta* Br. & M. are characteristic of the Upper *marginifera* subzone.

In the Makarovo Horizon stratotype section of Kuk-Karauk zonal conodont sequence isn't complete there. The absence of Intervals equal to the Upper *triangularis* and Middle – Uppermost *crepida* is the illustration of hiatus phenomenon. However, in this locality there are well studied sections (Akkyr, Ryauzyak, Mendym et al.) [Abramova et al., 1990, 1995] with more full paleontological content. They may be considered as to fill the gaps in the stratotype in order to make this subdivision of full value.

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Composition, provenance area and paleomagnetism of the Bagdarin formation

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The stratigraphic sequence of the Bagdarin subzone deposits in the Vitimkan-Tsipinsk zone has currently been subject of broad and current interest. Of the greatest interest is the Bagdarin formation, whose age, volume, and stratigraphic position are still controversial. The new data that obtained in this study made it possible to clarify the composition, volume, age and to determine the provenance for the Bagdarin formation.

We consider the Bagdarin formation (with thickness of 950 m) in a new volume; it includes the terrigenous variegated rock assemblage. The Formation includes two members. Lower Bagdarin member is composed of red-colored polymictic, sandstones, conglomerates, siltstones, and mudstones. The Upper Bagdarin member is represented by the interbedding of variegated shales, sandstones and interbeds siltstones and lenses of mudstones, limestones. The formation dates back to the Late Devonian, Frasnian (properidophytes, algae, corals, stromatoporoids, heliolithids, myospores). According to the petrochemical characteristics, the rocks of the Bagdarin Formation correspond to arkoses, by their chemical composition they are assigned to sialites, and by the size of the aluminum-silicon module, to a group of clay rocks. The facies features of the Bagdarin Formation rocks indicate their accumulation in tidal plains of the terrigenous shelf with micro- and meso-tidal linear coasts, which are also confirmed by their petrochemical characteristics.

U-Pb geochronological studies of detrital zircons showed a neoproterozoic grains predominance. Most likely, the detrital zircons source could be Upper Riphean volcanics of the Usoi Formation with an age of 837.4 and 789.2 Ma and the Shaman Complex gabbro-diorites, diorites and tonalites with an age of 778 Ma and 762.6 Ma, the water discharge of which are part of the Shaman plate. These data indicate that the provenance could be the closely located uplifts of the Late Precambrian basement of the synform.

The results of a paleomagnetic study of the sandstones of these formations revealed the presence of a regular, most often characteristic, component of straight and reverse polarity in the composition of the natural remanent magnetization (NRM). The position of the virtual geomagnetic pole calculated in the middle direction of the stable component of the magnetization in the stratigraphic coordinate system corresponds to coordinates of 9.6 ° N 145.2 east longitude, which practically coincides with the position of the pole for the Siberian platform at the turn of 360 Ma and corresponds according to the International stratigraphic chart to the Devonian-Carboniferous (D-C) boundary.

Thus, we assume that the Bagdarin paleobasin was filled with sediments during Bagdarin times in Late Devonian in tectonic calm regime. The major source of terrigenous components was mostly closely located uplifts of the Late Precambrian basement of the Bagdarin synform.

Morphological changes of bryozoans from genera *Dyscritella* Girty, 1911 from Famennian (Late Devonian) to Kazanian (Middle Permian)

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The genus *Dyscritella* Girty, 1911 belongs to the order Trepostomata Ulrich, 1882. Late Paleozoic-Early Mesozoic was the final stage of development for trepostomates. An analysis of the morphological evolution of a particular taxon is interesting as a special result of the complex effect of various factors. The aim of this report is analysis of the changes in the structure of bryozoan colonies for genus *Dyscritella* in the interval of 372-265 million years. The choice of this genus is due to its long existence, wide distribution in the Upper Paleozoic deposits, and morphological features.

The genus *Dyscritella* originated in marine basins of the Earth at the Early Devonian and disappeared at the Late Triassic. Over 218 million years, more than 120 species have been replaced, most of which occur in the Permian (71% of species richness). *Dyscritella* is characterized by branched and encrusting colonies formed by budding of tubular autozooids with rare or absent diaphragms. Interzooidal spaces are filled with abundant exilazooids and acanthostyles (in some species acanthostyles are two sizes). Zooecial walls are thin in endozone and rapidly thickening in the exozone.

In the Famennian (Upper Devonian) single representatives of the genus formed encrusting thin colonies mainly with acanthostyles of the identical size. In the Tournaisian (Mississippian, Carboniferous) deposits, 12 species with branched and encrusting colonies are known. The width of the apertures, the number and differentiation of acanthostyles by size, and wall thickness in the exozone increased. The trend continued until the end of the Carboniferous. In Early Permian there were 65 species. The diameter of the branching colonies increased, however the number and size of acanthostyles, the number of exilazooids decreased. A similar trend persisted to the Middle Permian.

Thus, the morphological changes of the genus *Dyscritella* from the end of the Devonian to the middle of the Permian were probably aimed at protecting against predators (differentiation of acanthostyles), adapting to cooling of the climate (increasing the width of apertures), changing the composition of food resources, and mastering new ecological niches (variations in the growth habits and colony sizes).

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Structural features and history of Pliocene-Eopleistocene deposits of the South Caspian basin

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The Caspian region has a long history of study. However, interest in the Neogene deposits of the region is not weakening due to the discovery of oil and gas fields. Most of the fields associated with Pliocene-Eopleistocene South Caspian.

The South Caspian basin in the north is limited not by the Absheron-Balkhan system of uplifts, according to many researchers, but by a tecton-sedimentation ledge along the southeastern edge of the Peschananymsko-Samur saddle. System Apsheron-Balkhan uplift associated with the regional Caucasian-Kopetdag right-lateral strike-slip fault amplitude of about 150 km. Active movements of the fault started in the middle of the Pliocene and continuing to the present time (Patina et al., 2017).

The South Caspian basin began to form as an independent structure in the Late Miocene on the more ancient rear foothill of the Tersko-South Caspian trough, formed as a result of the orogenesis of the Caucasus, Elbours and Kopet-Dag in Sarmatian (Sedimentary basins, 2004).

Since the end of the Paleogene, under the influence of collision events associated with the closure of the Palaeotetis ocean, there has been a gradual reduction of the Paratethys marine basins covering the studied region. The last time the existence of the Caspian-Black Sea basin, who had contact with the ocean, was Pontian age - Late Miocene (Khain, 2005; Leonov et al., 2005).

Pliocene-Quaternary deposits of the South Caspian basin have a thickness of more than 10 km and have a wide distribution. They are characterized by the presence of cross-bedded progradational strata. Their accumulation occurred in the conditions of a large internal continental Caspian basin, which has no connection with the ocean.

An important structural feature of the Lower Pliocene sediments is the rejuvenation of its bottom layers when moving from the center of the depression to the side parts. The greatest thicknesses of the Lower Pliocene (up to 5 km) were established in the western regions of the South Caspian.

Based on seismic stratigraphic analysis of geological and geophysical data, the Pliocene-Quaternary history of the development of the South Caspian sedimentary basin was restored. During this time there are three major water level fluctuations of the cycle. The very first cycle was accompanied by colossal erosion processes. Intensive erosion was associated with a sharp decrease in the level of the Caspian Sea to about –700 m at the end of the Pontian age. This has led to increased denudation, the formation of river valleys and removal of huge masses of sediment in the South Caspian Basin. Intense denudation processes appeared not only in the western and southern mountainous territories, but also on the vast plains of Transcaspian and Northern Caspian.

Thus, as a result of a combination of factors (sea level fluctuations and subsidence caused by intake of large amounts of precipitation and formation Crimean-Kopetdag shift) for a short period of time accumulated thick layer Pliocene- Eopleistocene deposits.

Gneisses of the Harbey metamorphic complex (Polar Urals)

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In the North of the Urals, there are protrusions of the Foundation of ancient platforms. One of them is represented by metamorphosed formations (amphibolites and gneisses) of the Harbey complex. The age of the substrate of the complex, as well as metamorphic changes in the amphibolite facies, is considered Precambrian. According to various ideas, based primarily on the study of the geochemical features of amphibolites, protoliths of metamorphites may have formed in a trappean province, continental rift-related environment, or in an island-arc system. The study of the petrogeochemical composition of gneisses will make it possible to clarify the geodynamic setting of the formation of the substrate of metamorphic rocks.

Gneisses are represented by garnet-epidote-mica, biotite-epidote-amphibole, garnet-biotite-amphibole, garnet-biotite-amphibole, biotite-amphibole, amphibole-epidote-muscovite species. Garnet-muscovite-amphibole and amphibole-epidote-muscovite paragneisses have an affinity with the ferruginous sandstones and greywacke. The protoliths of these gneisses are most likely the same age as the amphibolite substrate and were formed due to erosion of post-Archean rocks. Garnet-biotite-amphibole and biotite-amphibole gneisses occupy the region of uncertainty between para- and orthogneisses and could be formed due to tuffites or are granitized amphibolites. Garnet-mica and biotite-epidote-amphibole rocks are orthogneis, metamorphosed analogues of igneous rocks-granodiorites. They are similar in geochemical features to granitoids of I and S types of island-arc and collision environments. Garnet-mica gneiss is characterized by zircons with resorbed forms, moderately smoothed edges and the "cauliflower" type, which may be signs of high-temperature metamorphic transformations of the rock and, consequently, its Precambrian age.

Thus, the gneisses of the Harbey metamorphic complex are represented by para- and orthorocks. Paragneisses, metamorphosed sandstones, are the same age as amphibolites. Orthogneiss – metagranodiorites, most likely, also have Precambrian age and were formed either simultaneously with the protoliths of amphibolites, or later-during collision processes.

Marine reptiles from the Jurassic deposition of Western Kazakhstan

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The formation of the sedimentary cover of the Caspian syneclise in the late Jurassic occurred under conditions of maximum surface deflection and accumulation of precipitation. By the end of the Jurassic period in the West Kazakhstan region of the Republic of Kazakhstan there is a raising of the bottom and shallowing of the basin. The ichthyosaurs and pliosaurs that lived here formed the top of the ecological pyramid, as evidenced by the numerous remains found recently in the Jura sediments. The funds of the school museums, Uralsk city and village Pogodaevo presented individual bones belonging to the ichthyosaurs of the genus Yasykovia V. Efimov, 1999 [Efimov V.M., 1999], Underosaurus V. Efimov, 1999. The article by V. S. Bazhanov [Bazhanov V. S., 1958] describes the discovery of pliosaurus from this territory and mentions two vertebrae of ichthyosaur without determining the systematic affiliation.

In 2016 near village Shchuchkino Zelenovsky district of the West Kazakhstan region were found fragments of the skeleton of the animal. During the excavations, with the participation of paleontologists of the Ulyanovsk branch of the All-Russian Paleontological Society, a significant number of bones of the skull, shoulder girdle, forelimb, and ichthyosaur axial skeleton were extracted.

Skeletal remains were delivered for processing and determination to the Ulyanovsk branch of the all-Russian Paleontological society and as a result of the study were assigned to a new genus of the ichthyosaur family Undorosauridae V. Efimov, 1999 [Efimov V.M., 2018]. Discovery has received the name Kazakhstanosaurus shchuchkinensis Efimov, et Akhmedenov Yakupova, 2019.

Based on a detailed study of the ichthyosaur skeleton and the time of its burial in the middle Volga horizon, it was found that the new form is a more primitive ancestral form of the family Undorosauridae, which gave rise to the ichthyosaur Platypterygius, which inhabited the seas of the world ocean during the Cretaceous period.

First geochemical data on lacustrine sediments, Lake Bannoe (Bannoe), Southern Urals

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The work is devoted to the study of the bottom sediments sampled from Lake Bannoe, Southern Urals. The main goal is to identify the geochemical zones in the study area and related climatic periods in the Holocene.

Four core columns, 3.8–5.14 m long, were obtained based on the acoustic data. About 1000 samples were taken in total. All core samples were cut into smaller pieces (2 cm thick) for the laboratory studies. Core column #3 was chosen as the object of this study.

Laboratory studies included: radiocarbon dating, measuring magnetic susceptibility, determining the elemental and mineralogical composition of sediments.

The radiocarbon data showed that the sediments of the Lake Bannoe are about 12,700 years old. Six geochemical zones were identified. These zones were compared with the stratigraphic scale of the Holocene and Pleistocene and the corresponding climatic stages. The lithochemical analysis showed that chemical weathering increased between 12691 and 9963 years (Late Pleistocene), 7908 and 7343 years (Atlantic), 4750 and 3998 years (Subboreal), and decreased between 9963 and 7908 years (Boreal), 7343 and 4750 years (Atlantic), 3998 and 892 years (Subboreal and Subatlantic).

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Lithological and mineralogical features of the Volga oil shale sections near the Gorodishche village

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Geological sections of the Ulyanovsk region have attracted attention for a long time. This terrigenous complex of the Tithonian stage contains increased concentrations of rare earth elements and oil shale. Taking into account the relevance of this topic, a high-carbon deposits lithological and mineralogical study was carried out, located near the Gorodishche village in north of the Ulyanovsk region.

Studies have shown that oil shale was formed under the influence of many factors. Their mineral component is determined by the peculiarities of the lithological composition and geomorphological structure of coastal part of the Central Russian paleosea. The gently sloping plain that existed in the Tithonian age on the Ulyanovsk region territory, which adjacent to marine paleobasin edge, provided a constant influx of clastic material. The source for ablation was the Middle Permian carbonate-terrigenous sediments, which compose the Ural land. That's why the composition of the Volga oil shales clay minerals is similar to composition of the Urzhumian stage clays.

The genial warm humid climate favored the development of abundant vegetation along the coastal strip. The root layer of soil and marshiness of territory prevented intensive erosion of the Urzhumian rocks. Therefore, mainly finely dispersed material and plant detritus entered the sea basin with surface rainfall. Introduced minerals and rock fragments in the basin were supplemented with biogenic components. The shallow warm sea of normal salinity, with the usual waters oxygen and gas regime, was favorable for development of marine fauna and flora. The massive distribution of planktonic algae (Coccolithophorida), belemnite, ammonite, bivalve and graptolite determined high carbonate content of the shale strata. The high productivity of phytoplankton and stagnant conditions in depressions of the Central Russian paleosea contributed to establishment of anoxic conditions in the deep parts of the basin. The low oxygen content made it possible to protect organic matter from subsequent decomposition, and the development of benthic communities of cyanobionts enriched the forming rocks with pyrite aggregates. The thin parallel lamination in strata indicates calm conditions of sedimentation, which created preconditions for slow clay minerals aggregation. At the existence stage of watered silty sediment, the centers of aggregation were fragments of mineral grains and organic remains. They were a solid substrate in a colloidal solution and collected clay particles on their surface, which, enveloping them, formed microaggregates like a "shirt". With subsequent compaction and dehydration of silty sediment, the clay microaggregates formed laminar microstructures. During this period, the aggregation of clay plates and scales occurred mainly according to the basis-basis type. In the process of clay minerals coagulation and mud compaction, the process of organic matter sorption on finely dispersed aggregates simultaneously took place. These processes contributed to gradual accumulation of oil shale with polymineral composition.

Microsculpture of the Early Triassic conchostracans from the Southern Verkhoyanie (the Tiryakh-Kobyume Section)

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The Permian-Triassic Tiryakh-Kobyume section is located in Southern Verkhoyanie (Republic of Sakha (Yakutia)). The Early Triassic shallow marine succession conformably overlies marine Changhsingian deposits (Privol'nyi Formation (Fm)) and is represented by the Nekuchan Fm. Conchostracans (about 150 specimens) are sampled from the lower part of the Nekuchan Fm (bed 35) together with ammonoids (Kutygin et al., 2019).

This conchostracan assemblage includes "*Pseudestheria sibirica*" Novojilov, "*Ps. tumaryana*" Nov., *Ps. kashirtzevi* Nov., "*Sphaerestheria aldanensis*" Nov., "*Lioestheria ignatjevi*" Nov., *Wetlugites pronus* Nov, and *Euestheria gutta* (Lutkevich).

Some conchostracan shells possess a good preserved microsculpture.

The shells of "*Ps. tumaryana*" are characterised by a smooth microsculpture on the umbonal area and small pitted microsculpture (pit size = 4.1 μm) with closely spaced pits on the anterior and central parts of the valve.

The shells of "*Ps. kashirtzevi*" have a small pitted microsculpture (pit size = 4 μm) with closely spaced pits. The surface of some specimens contains minute pyrite framboids.

Generally, it can be assumed that the pitted type of ornamentation is a characteristic feature of the genus *Pseudestheria* Raymond, 1946.

The microsculpture of "*L. ignatjevi*" is well preserved only on the anterior part of the valve, wherein a closely spaced, predominantly pitted microsculpture (pit size = 5.5 μm) is observed. The best microsculpture preservation is recorded on the last two growth bands. The surface of some specimens contains pyrite framboids.

The shells of *W. pronus* have a small reticulated microsculpture (cell size = 4.5 μm) with closely spaced ornament. The reticulation is well preserved on the last two or three growth bands. The holotype of this species has an average reticulated microsculpture (cell size = 8.1 μm) with a closely spaced ornamentation.

The species *E. gutta* has a closely spaced, fine pitted microsculpture (pit size = 4.7 μm). This species also occurs in the Early Triassic of the Kuznetsk Basin, northern and southern China, European Russia, and Germany. Siberian (Sabirova et al., 2019) and Chinese (Chu et al., 2019) specimens of *E. gutta* possess the same type of ornamentation.

We can conclude that some genera and species of conchostracans show preservations of well-defined microsculptures. The microsculptural shell features are a supporting method for revising the taxonomic diversity of conchostracans.

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Provenance and tectonic setting of the Upper Jurassic–Lower Cretaceous siliciclastic rocks from the northeastern Peri-Tethys: evidences from rare earth element geochemistry

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Regarding rare earth elements (REE) can typically originate from seawater, plants, and terrigenous substances, they are often used to explain the physical-chemical conditions of geological processes due to their similar chemical properties and low solubility. Taking into account their stability during weathering, erosion, and early diagenesis, the REEs can be used in reconstructing rock source and tectonic settings.

This abstract focuses on the evaluation of the Upper Jurassic–Lower Cretaceous mudrocks, and black shales from the Northeastern Peri-Tethys using REE geochemical approach. La/Sc ratio is proved to be controlled by the mafic or felsic composition of the source, as mafic and ultramafic rocks are enriched with Sc. Ti/Sc ratio reflects the volcanic versus mantelic compositional influence in the source. La/Th–Hf discriminant diagrams are useful in the identification of relative contribution of magmatic versus recycled sources for REEs. So, it is shown that the probable provenances of clastic sediments were mainly of the active continental margin and continental oceanic arc.

To interpret the tectonic settings of sedimentary rocks from the geochemical data, it is presumed that the nature of the source terrain is related to the tectonic processes controlling the origin and evolution of the adjacent sedimentary basin. Zr and La provide information about the degree of recycling. Additionally, La, Th, Sc, and Zr are regarded to be relative immobile elements. Thus, La–Th–Sc and Zr–Th–Sc triangular diagrams were used, in which most of the studied shales and host mudrocks are plotted between the oceanic arc and continental arc settings.

Permanent input of mixed felsic and basic pyroclastic material is proposed in the Latest Jurassic (Middle Volgian) and from the beginning of the Aptian till the Middle Albian, whereas in the Late Hauterivian-Barremian, mainly felsic pyroclastics are proposed to effect the studied basin. Among possible sources of the pyroclastics, the Transcaucasian ensialic island arc and the Senendedj-Sendjan ensimatic island arc can be regarded. The Lower Aptian OAE 1a-related black shales contain mafic-felsic pyroclastic material delivered probably from both the Transcaucasian island arc and the High Arctic large igneous province. The Middle Albian bentonite-bearing mudrocks are regarded to be formed due to strong influx of the island-arc felsic ash delivered from the Transcaucasian and Alburs island arcs located in the northwestern part of the Tethys Ocean.