The geological structure of coal formations of the Sukharysh syncline, which is located in the Kopeysk-Bredy subzone of the Alapaevsk-Adamovka structural-formational zone, was studied. The focus was specifically on the deposits of the Fedorovskaya sequence (C$_{2}$fd) with outcrops in the sections along the Uvelka River and in few roadside pits. The width of the sequence is about 1000 m. The Middle Carboniferous (Bashkirian) age of the deposits was reliably dated based on the fossil faunal finds. It was shown that shales and aleurolites, which are widespread in the limestones of the Fedorovskaya sequence, belong to the low-carbon type and fall into the field of the siliceous-carbonate unit. The carbonaceous matter is developed in the form of scattered impurities, concentrated in the ultrafine veinlets and laminas, and corresponds to higher kerites subjected to catagenesis and the early stage of green shales facies. The organic carbon content is up to 20%, and, thus, the rock appears to be opaque. Sedimentation process took place in the isolated local shallow-water depressions under the geodynamic conditions of collision. The terrigenous material was formed as a result of the destruction of the underlying rocks of the major and average element composition of the Berezinskaya sequence. The maturity of the deposits consistently increases from the Tugundinskaya to Fedorovskaya sequences.

**Keywords:** South Urals, Sykharysh syncline, Fedorovskaya sequence, stratigraphy, paleogeography, carbonaceous shales, black shales, TOC, Carboniferous
Figure Captions

Fig. 1. Geological map of the Sukharysh syncline (according to B.A. Puzhakov [6], simplified by the author). Legend: 1 – Fedorovskaya sequence (organogenic-detrital pelitomorphic gray and dark-gray limestones, interbeds of carbonaceous-clayey shales), 2 – Birgil'dinskaya sequence (sandstones, gravelstones, carbonaceous-clayey shales, limestones), 3 – Tugundinskaya sequence (limestones, sandstones, aleurolites, often carbonaceous), 4 – Berezinovskaya sequence (lavas, lava breccias, trachybasalt tuffs interbedded with siliceous tuffites, clayey-carbonaceous-siliceous shales), 5 – faults, 6 – finds of foraminifers, 7 – finds of brachiopods, 8 – location of the studied section.

Fig. 2. Photos showing the sections of carbonaceous shales of the Fedorovskaya sequence. Note: 1 – flagged sample positions for silicate and thermal analyses, 2 – sampling points where gold specks were registered.

Fig. 3. Photos of the microsections of carbonaceous shales from the Fedorovskaya sequence. Note:  a – organogenic structure of carbonaceous aleurolite (microsection T-24-10);  b – interbed with the high content of carbonaceous matter in the detritus of radiolarians (microsection T-24-10);  c, d – various concentrations of the carbonaceous matter in the aleurolite and radiolarite interbeds (microsection T-24-3);  e – fragment of phosphorized ichthyodetritus (?) (microsection T-24-3);  f – cavities in organogenic detritus filled with dark-brown bitumen greases (microsection T-24-9). All photos in parallel nicols.

Fig. 4. Characteristic thermograms (a) and positions of the analysis points on the thermal resistance diagram (b) for the carbonaceous deposits of the Sukharysh syncline. Note: burn-off stages according to V.I. Silaev et al. [10]: I – recent plants, organic matter in unmetamorphosed sedimentary rocks, coprolites; II – asphalts, lower kerites; III – asphaltites, kerites; IV – higher kerites, anthraxolites, shungites; V – graphite, carbonado.

Fig. 5. Positions of the composition points of carbonaceous shales of the Sukharysh syncline on the standard classification diagrams. Sequences: 1 – Birgil’dinskaya, 2 – Tugundinskaya, 3 – Fedorovskaya. a – A–S–C classification diagram [11]. Fields of formations: I – carbonate-carbonaceous, II – terrigenous-carbonaceous, III – silty-siliceous-carbonaceous. Parameters: A = (Al/2O3 – (CaO + K2O + Na2O))/1000 and S = (SiO2 – (Al2O3 + Fe2O3 + FeO + CaO + MgO))/1000 expressed in molecular amounts, parameter C = CaO + MgO expressed in weight percent of oxides. b – DF1–DF2 [12], where: DF1 = –0.263 ln (TiO2/SiO2)adj + 0.604 ln (Al2O3/SiO2)adj – 1.725 ln (Fe2O3MgO/SiO2)adj + 0.66 ln (MnO/SiO2)adj + 0.144 ln (CaO/SiO2)adj + 0.545 ln (K2O/SiO2)adj – 0.33 ln (P2O5/SiO2)adj + 1.588; DF2 = –1.196 ln (TiO2/SiO2)adj + [1.064 ln (Al2O3/SiO2)adj + 0.303 ln (Fe2O3MgO/SiO2)adj + 0.436 ln (MnO/SiO2)adj + 0.838 ln (MgO/SiO2)adj – 0.407 ln (CaO/SiO2)adj + 1.021 ln (Na2O/SiO2)adj – 1.706 ln (K2O/SiO2)adj] – 0.126 ln (P2O5/SiO2)adj + 1.068. The subscript “adj” indicates that the calculation is based on the oxide contents normalized to 100% dry matter. Fields of the sedimentation environments: I – island-arc, II – collision, III – rift-driven. c – F1–F2 [13], where: F1 = 30.638(TiO2/Al2O3) – 12.541(Fe2O3total/Al2O3) + 7.329(MgO/Al2O3) + 12.031(Na2O/Al2O3) + 35.402(K2O/Al2O3) – 6.382, F2 = 56.5(TiO2/Al2O3) – 10.879(Fe2O3total/Al2O3) + 30.875(MgO/Al2O3) – 5.404(Na2O/Al2O3) + 11.112(K2O/Al2O3) – 3.89. Fields of clastic material sources: I – sedimentary rocks rich in quartz, II – magmatic rocks of major element composition, III – magmatic rocks of average element composition, IV – magmatic rocks of acidic composition. d – log (SiO2/Al2O3) – log (Fe2O3total/K2O) [14].

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Keywords: Snachev, Uchenye Zapiski