Geological structure and coal contents of Guvilgra cavity of Gonamsk coal-bearing area of southern Yakut coal basin

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Abstract. Southern Yakut coal basin is a huge and reliable base of the high-quality coked and steam coals in the east of the country. The Southern Yakut TPC was begun in the 70-s in the south of Yakutia forming, what predetermined considerable strengthening in this region of exploration works on coal. Now the fields of Neryungri, Elga and certain sites on Denisovsk and Chulmakan fields are developed by an open method. Absence near the operating Neryungri coal mine of the coalfields suitable for open-cast mining, and also finite useful lives of the Neryungri field (till 2018-2020) caused expansion of search works on coal on flanks of the basin, directed at identification of the powerful coal layers suitable for development by an open method.

1. Introduction.

The Guvilgra basin is located in the southwestern part of the Gonam coaliferous region (Fig. 1) in the basin of the left tributary of the Gonam River - the Guvilgra River [5]. The area of coal-bearing deposits is 480 km^2. Deeply-metamorphosed Archaean deposits, Mesozoic sedimentary deposits and loose quaternary formations take part in the geological structure of the basin. Intrusive formations of various ages are established in the area, breaking through the sedimentary Mesozoic cover [6].

2. Materials and methods. Stratigraphy

Archean metamorphic formations form the lower structural floor - the crystalline basement of the Guvilgrain basin, and frames it from all sides. They are represented mainly by interbedded intensively dislocated gneisses and crystalline schist, quartzite. Archean metamorphic formations belong to the Timpton and Dzhettulino series of the metamorphic complex.

Mesozoic carbonaceous deposits lie on the deeply eroded surface of the Archaean formations. Like in other areas of the basin, the sedimentary deposits are characterized by a cyclical structure. According to the generally accepted technique in the basin, macrocycles correspond to suites. On the basis of the cyclic structure of the sedimentary stratum, paleobotanical studies in the Guvilgrain basin, deposits of the Jurassic age, have been identified as part of the Mesozoic formations. Their total open thickness is 1520 m. They are subdivided from bottom to top into the Yukhtin, Duraisk and Kabaktinsk suites (the Lower Kabaktinsky subsuite).

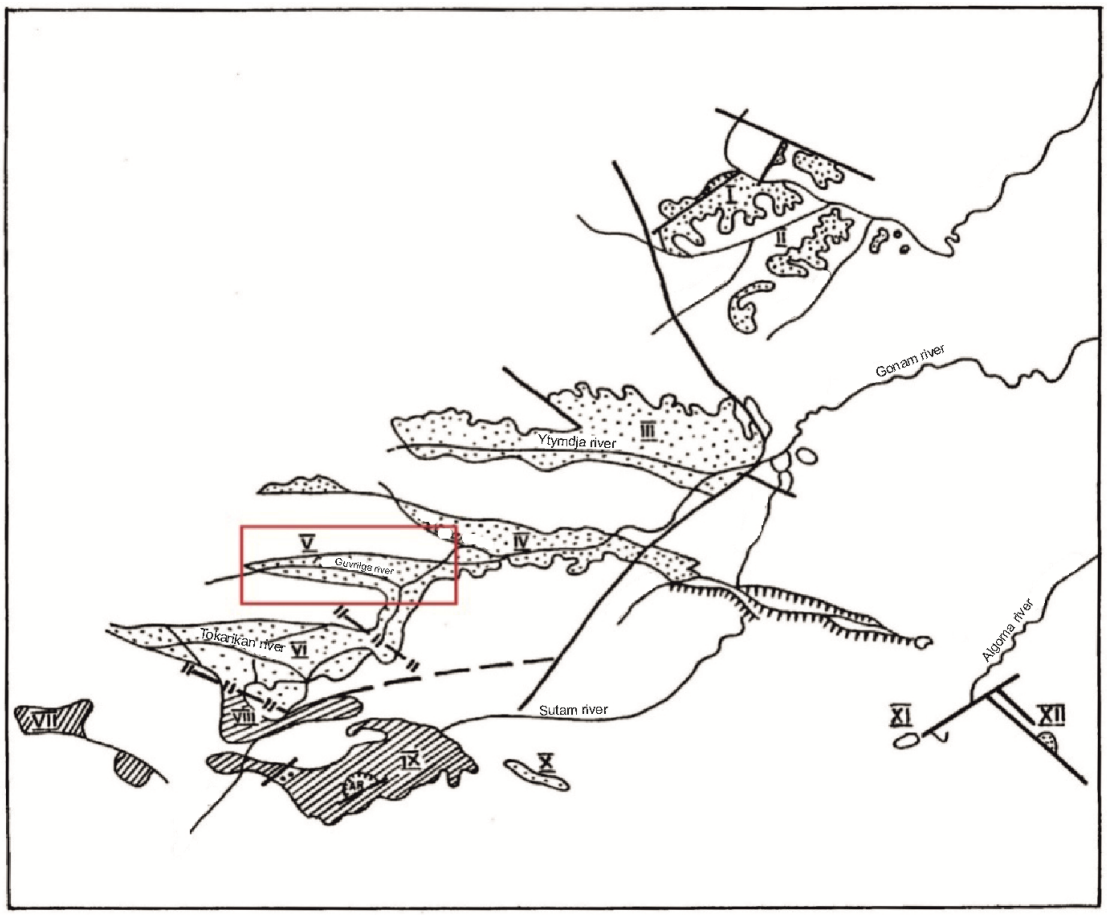

Figure 1. The arrangement of depressions in the Gonam coal-bearing region
I-Kuranakh-Gynim; II-Gynimo-Semdzhinskaya; III-Ytymdzhinskaya; IV - Gyuskangra-Narulak; V-Guivilgra; VI-Tokarikano-Konerkit; VII-Upper Timpton; VIII-Upper-Gonam; IX-Upper Sutama; X-Upper-Daurkan; XI-Chekchoy, XII-Awengur

The Yukhtin suite (J_1 *jh*). Deposits of the suite lie on the Archean granites and crystalline schists in the headwaters of the Gvilga River and on the interfluve of the Gvilga River and the Ulakhan-Melekmen stream. There are polymictic conglomerates with a thickness of 4.0-5.0 m, represented by metamorphic crystalline rocks at the base of the suite. The gravel lie above the conglomerates. The clastic material is mainly represented by quartz. The lower and middle parts of the suite are composed of medium- and coarse-grained arkose sandstones. Fine-grained and silty sandstones are presented in small amounts. There is interlacing of fine-grained sandstones of gray color with fine-grained siltstones of dark gray color in the upper part of the formation. The upper boundary between the Yukhtin and Durai suites is located along the top of the upper fine-grained bundle, which crowns the section of the Yukhtin suite and has a wide area distribution both in the Gonam and in the Aldan-Chulman District. Its power is 340 m.

The Duraisk suite (J_2 *dr*). The deposits of the suite are located on the sandstones of the Yukhtin suite. The severity of the deposits of the suite is poor; for the most part, they are filthy [4]. The opencast of the suite is composed of frequent interstratification of gray and dark gray medium- and fine-grained sandstones, siltstones, mudstones and coals. Medium-grained sandstones are used as a subordinate. The lower part of the formation is characterized by a wide development of fine-grained polymictic and quartz sandstones with thin interlayers of large-medium-grained sandstones. The middle and upper parts of the suite are represented by a thin interlayering of gray and dark gray fine-grained sandstones

with siltstones. Medium-grained sandstones are present in a subordinate amount. A distinctive feature of the sandstones is the predominance of essentially quartz differences over the polymictic ones. To the same part of the section of the formation, strata and strata of coals in quantities of more than 16 are confined, of which 9 have a power of more than 0.7 m. Sandstones of the suite are predominantly feldspar-quartz, cement is hydromica and siderite. The ratio of rocks of different granulometric composition is given in Table 1. The uncovered capacity of the Duraisk Formation is estimated at 490 m.

The Kabaktinsk Suite (J_3 *kb*) according to the deposits lies on the rocks of the underlying Duraysk suite and is exposed in the central and southern parts of the basin. A section of Upper Jurassic deposits begins from a thick stratum of coarse-grained and heterogeneous grained sandstones of light gray color, having a spotted texture due to zeolite cement. In general, the exposed part of the suite is composed of an uneven complex-cyclic alternation of sandstones and siltstones with rare intercalations of gravelites and mudstones, as well as strata and interlayers of coals. The sandstones of the suite are polymictic, with the predominance of feldspars (50-55%) and quartz (20-25%) [7]. The content of accessory minerals (sphene, zircon, leukoxen, apatite, epidote, rutile) does not exceed 1-2%. In the section of the suite, up to 30 strata and coal layers have been established, 8 of them have working power in separate cross-sections. The proportions of the rocks of the suite of different granulometric composition are given in Table 1. The uncovered capacity (incomplete) of the Kabaktinsky suite is 680-690 m. Thus, the total open thickness of the Mesozoic deposits in the Guvilgra basin is about 1520 m.

Tectonics. The Guvilgra graben is located in the west of the Gonama region and represents a large synclinal structure with a length of 60 km and a width of 5-10 km. The structure can be traced in the latitudinal direction, occupying the basin of the Guvilgra river and in part the Gonam river. Graben has a block structure, limited on all sides by sublatitudinal and submeridional faults. Like other structures of the area, the Guvilgra graben has an asymmetric transverse profile. On the northern wing of the syncline, against a background of predominantly gentle submersion of the rocks to the south, there is a subglacial stretch is fine folded with an increase in dislocation to the syncline trough. Sometimes dislocations are represented by a flexural type. On the whole, the structure of the carbonaceous stratum becomes more complicated from the northeast to the southwest. Together with it, the variability of the occurrence angles of rocks increases and their absolute value is from 50 to 10-200.

The system of faults in the hollow is distinguished from the materials of the geological survey [3], prospecting works and interpretation of the AFS [1]. Discontinuous tectonics superimposes on the folded tectonics and significantly complicates the latter. It can be assumed that the general system of discontinuous violations that has been formed to date is the cumulative result of two main types of movements:

- multidirectional and multi-amplitude movements of the foundation, divided into numerous, different in size blocks;
- dynamic effects from the approaching Stanovik and the occurrence of discontinuous violation as a method of discharging the maximum stresses of folding [9].

The frequency of manifestation of faults, as well as the intensity of folding, grows from the northeast to the southwest. Among the bursting violation, the prevailing distribution is used by faults, and more rarely by overthrusts. Bursting disturbances are accompanied, as a rule, by powerful zones of crushing. Among the existing system of faults are two main directions: sublatitudinal, parallel to the general direction of the axes of most folded structures and the northeastern, the secant strike of the coal-bearing strata almost at right angles. Of these, the first predominates. The largest violations of the northeastern strike, established by the search works, are No. 1, 2, 3 and having an amplitude of displacement of 120-140 m. There is undoubtedly that there are other bursting violations not found in the search process, not only for the reason of the one profile and a rare network of wells, but also due to the presence of a powerful quaternary cover, which makes it difficult to decipher the AFS. In

conclusion, it should be noted about the wide development in the basin of low-amplitude (first meters) and without amplitude disturbances, which are well fixed by zones of strong fracturing of the core rock in the boreholes.

3. Conclusion. The coal-bearing. In the coaliferous stratum studied, the seams and strata are distributed unequally both in the section and in the area [2]. The reasons for this are both unfavorable initial conditions of peat accumulation, as well as subsequent erosion of seams, as well as redistribution of coal matter in the seams during tectonic movements. Totally, up to 50 coal manifestations are established in the exposed coal-bearing stratum, including up to 20 seams of working capacity (0.7 m and more). The total thickness of all coal seams and interlayers is about 40 m, and the working layers - 32 m.

In the lithologic-stratigraphic section, coal strata, which are opened at least in a limited number of intersections, are assigned alphabetic and numerical indexes. The alphabetic index corresponds to the name of the suite, and the numerical sequence number of the formation in the section of each suite (from bottom to top). Indexation of strata in the formations in its reliability corresponds to the stage of work and has a preliminary (conditional) character [8].

Below, there is a description of the suites.

The Yukhtinsk suite, discovered in the northern part of the IV-1U profile, is virtually not coal-bearing.

The Duraisk suite. In the section of the formation, there are about 20 carbon blacks with thickness from 0.20 m to 3.17 m, 10 of them with working power values (0.7 m and more). Six indexed coal seams are of practical interest, the most consistent (coefficient of consistency 1.0) are the beds D15 and D11. The total thickness of the coal packs of the D15 reservoir ranges from 0.73 m to 1.37 m, with an average value of 1.20 m, while in the D11 reservoir, the power varies from 1.24 m to 3.17 m, the average values are 2.07 m. The structure of the seams is simple and complex (up to 3 rock layers).

In the section of the Kabaktinsk suite, there are about 30 carbon manifestations, 10 of them have operating power values (0.7 m and more). The carbon deposits are relatively evenly distributed throughout the section. The most sustained (coefficient of 1.0) have three layers of K15, K14 and K5. The total thickness of coal packs of the K15 reservoir is from 0.82 m to 1.34 m, an average of 1.09 m; Layer K14 - from 0.7 m to 2.72 m, on the average 1.38 m; Layer K5 - from 0.70 m to 1.80 m, an average of 1.17 m. The structure of the seams is generally complex and each intersection has from one to five to six interlayers. The characteristic of the indexed strata is given in Table 1.

Table 1. The main parameters of the indexed coal seams. The Guvilgra Basin

Suite	Index of seam	The main parameters				Limits of fluctuations of total thickness of coal beds of layers. Up-to Average power	The structure of the formation (Number of dividing interlayers)
		Total number of openings in wells	Number of openings up to 0.7m/zero values	Number of openings 0.7m and more	Coefficient of continuity		
Duraisk	D_{15}	6	-	6	1.0	0.73-1.37 1.20(6)	complicated 1-3
	D_{14}	6	0/1	5	0.83	0-2.21 1.29(6)	complicated 1-2
	D_{13}	6	0/1	5	0.83	0-2.83 1.56(6)	complicated 1-2
	D_{11}	6	-	6	1.0	1.24-3.17 2.07(6)	simple
	D_5	6	1/2	3	0.50	0-3.16 1.21(6)	Mostly simple
Kabaktinsk	K_{15}	4	-	4	1.0	0.82-1.34 1.09(4)	complicated 1-2
	K_{14}	4	-	4	1.0	0.70-2.72 1.38(4)	complicated 1-6
	K_{11}	5	1/0	4	0.8	0.64-1.12 0.87(5)	complicated 2-4
	K_6	6	2/1	3	0.5	0.0-1.22 0.71(6)	complicated 1-4
	K_5	7	0/0	7	1.0	0.70-1.80 1.17(7)	complicated 2-5
	K_4	6	3/0	3	0.5	0.20-1.38 0,88(6)	complicated 2-4
	K_1	4	0/2	2	0.50	0.0-1.74 0.84(4)	complicated 1

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