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Coal resources of southern Kuzbass (Novokuznetsk administrative district)

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Abstract. The article summarizes data on geological structure of Novokuznetsk district of the Kemerovo region and its coal reserves. Survey is conducted consistently in regards to geological and economic areas of Kuzbass, included in the territory of Novokuznetsk district (Aralichevsky, Baidayevsky, Bunguro-Chumyshsky, Erunakovsky, Kondomsky, Mrassky, Osinovsky, Tersinsky, Tutuyas, Central, Uskatsky). Stating presence of significant coal reserves in this territory, the survey points out that in some geological and economic areas reserves are either depleted (Aralichevsky) or there are no prospects for reserves increase (Baidayevsky, Mrassky). The largest coal reserves explored are concentrated in Erunakovsky, Tersinsky and Osinovsky geological and economic areas. The main reserves of highly demanded coking coals are located in Erunakovsky and Osinovsky areas. As for the Novokuznetsk administrative district, a significant increase in coal production level is possible, although it has to be linked to demand, since the extracted coal can not be stored for a long time. Today key point is not the increase in coal production, but qualitative deep processing of coal.

1. Introduction

Traditionally, review of the mineral resource base is conducted for a large geological region (Kuznetsk coal basin, geological and economic region) or for administrative region (the Kemerovo region) [3, 5]. For smaller areas of administrative district level, such reports are not available. In this sense, provided review of resources of the Novokuznetsk administrative district of the Kemerovo region is seen as the start of analysis of the mineral resources base of the Kemerovo region by districts. Such survey can be useful for municipal administrators, for a variety of economic and administrative structures involved in extraction and processing of minerals.

In terms of coal mineralization, the Novokuznetsk district holds a special position among the rest of the Kemerovo region. The Kemerovo region is always associated with the Kuznetsk coal basin with a unique coal deposit. In any place of this basin the researcher will meet a certain number of coal seams. In this sense, the term coal deposit in the Kuzbass lost its original meaning (Kuzbass is a unique coal deposit as a whole). It is often now, that coal deposits in our region are understood as coal mining sites and areas prosperous for its development. Thus, the Sibirginskoye field in Mrassky geological and economic area smoothly passes into the Uregolskoye field, and the latter to the Kyzakskoye one. From the geological point of view, these are the same coal seams and the deposit location is determined only by mining allotment. Sometimes several mining companies work at one site of coal mining and then the names – Taldinskoye – the first, Taldinskoye – the second etc., appear. This brings a certain confusion and uncertainty in concept of the deposit (as an accumulation of mineral matter on the surface or in the depth of the Earth, feasible for industrial use in terms of quantity, quality and



conditions of occurrence) [2]. It is for this reason that there is no clear list of specific coal deposits in the Kemerovo region, and when economical assessment the region's potential takes place, researchers operate with the concept of geological and economic area. Kuzbass is divided into 22 districts by geological and economic features. Eleven of them are fully or partially located within the territory of the Novokuznetsk administrative district. They are as follows: Aralichevsky, Baidayevsky, Bunguro-Chumyshsky, Erunakovskiy, Kondomsky, Mrassky, Osinovskiy, Tersinsky, Tutuyas, Uskatsky and Central (Fig. 1). In these areas, the main coal reserves of various brands, including especially valuable grades of coking coal, are concentrated. Not all the eleven areas listed above within the Novokuznetsk district have the same value as for now. Some coal sites are operated from before the World War II, others have only been put into operation recently (Kiyzasky open pit mine). As of January 1, 2013 there are 307 extraction licenses acting in the Kemerovo region (excluding gas, groundwater and common mineral resources). Of these, coal accounts for 85% - 261 licenses [4].

2. Methods of research

The Novokuznetsk municipal district geologically is a broad terrain of the east-west trending, that includes the structures of the western slope of the Kuznetsk Alatau (in the east), Kuznetsk coal basin (the main part), the Mountain Shoria and Salair, including the Ninya-Chumysh depression (the western part) that divides them. Geological exploration status of these territories is uneven. Kuznetsk coal basin and the Mountain Shoria are of the greatest degree of exploration. Low population areas of Kuznetsk Alatau and Salair are less explored.

The materials available to date allow us to interpret geological history of the territory with sufficient confidence. Mountain-folding structures of Kuznetsk Alatau and the Mountain Shoria are considered as structures of the Caledonian stage (the Lower Paleozoic) including its early Salair phase (the Cambrian period). The geological structures of Salair and the Kuznetsk basin adjacent to them are considered to be the structures of the Hercynian orogeny (the Late Paleozoic). The Kuznetsk depression has sharply asymmetric structure, in the east thickness of the section is sharply reduced. The greatest thickness of sediments, including coal-bearing deposits, occurs in the western pre-Salair part of the depression. Salair structures encroachment on the adjoining sediments of Kuzbass is observed. Time of the Kuznetsk depression formation for a long time was subjected to discussions. The author shares the view that the beginning of sedimentation processes in this geological structure started in the Givetian age of the Middle Devonian. According to palaeobotanic and paleontological data, this is the age of the deposits lying on a dislocated foundation of the Early Paleozoic and the Early Devonian rocks of Kuznetsk Alatau. Based on that Kuznetsk depression can be attributed to piedmont depression on the border with the Tom-Kolyvan folded zone. Ninya-Chumysh basin separating Salair and the Mountain Shoria, was formed in the Lower Cretaceous. In addition to these structures two discordant basins (Central and Tutuyas), composed of sediments of the Jurassic system, have been distinguished in the Novokuznetsk district in the area of coal deposits of the Permian system. Volcanic-sedimentary deposits of the Triassic are recorded at the base of the Central basin section.

Such a complex and long history of geological development of the territory predetermined multiplicity of the region's minerals, but the main wealth of the area is made up of coal.

3. Results and discussion

The Aralichesky geological and economic area is one of the oldest in the Novokuznetsk district (part of Novokuznetsk and Prokopyevsky district) and is located in the valley of the rivers Tom (Kondoma, Aba, Sharap tributaries). The first coal mining enterprises were the Ordzhonikidze mine (1930-1994) and the Dimitrova mine (1931-1996) in Novokuznetsk. 85mln tons of coal were produced during the operation time. Until now resource potential of the Aralichevsky area has been completely exhausted taking into account increase in reserves prosperous in terms of industrial development and establishment of large, economically efficient production [7].

Baidayevsky geological and economic area orographically occupies the right bank of the river Tom and the basins of the rivers Abashevaya and Esaulka, and is partially located within the city of Novokuznetsk. The first information about findings of coal in the area belongs to the middle of the XVIII century. In regard geology and structure, area is represented by a series of brachyfolds developed along the deposits of the Ilyinskaya and the Erunakovskaya subseries of the Permian system. Coals in the area are almost all coking, low-ash. The total coal reserves of A, B and C₁ categories (as of 01.01.2001) are 1240 million tons. Inferred resources are 1720 million tons. Almost the whole area is affected by mining operations in one form or another. Until recently, Abashevskaya mine (closed in 2014), Zyryanovskaya mine (closed in 1999), Novokuznetskaya mine (closed in 2001), Nagornaya mine (closed in 1996) had been operated here. Yubileynaya mine (Topprom JSC), Esaulskaya mine (Raspadskaya United Company), Polosukhinskaya mine, Antonovskaya mine, Bolshevik mine (Sibuglemet Group) continue operation. Large reserves and inferred resources of coking coals of especially valuable brands in the area are concentrated in low-density seams and are not processed because of absence high-performance machinery. There are no prospective areas for discovery of economically profitable coal reserves in this area. The time for existing reserves extraction in operating mines is about 50 years.

The Bunguro-Chumyshsky geological and economic area occupies the extreme western part of the Novokuznetsk district, including watershed of the rivers Tom (with Kondoma and Aba tributaries) and Chumysh (in the western part of the district). Over the long history of geological exploration of the area all promising coal plots have been prospected and explored. Carboniferous deposits belong to the Balakhonskaya series (the Upper Carboniferous – the Permian) and are faulted into the system of anticlinal and synclinal folds with steep incidence angles. The reserves of coal of A, B and C₁ categories are 3300 million tons, inferred resources are 14451 million tons. Despite significant reserves and inferred resources, development of coal mining is constrained by the absence of coking and technological grades of coal of high demand. Among factors of constraint are complex geological conditions of coal seams occurrence (steep incidence angles, fault tectonics). There are no huge areas suitable for highly effective underground mining in the area, development of open pit mining is handicapped by an increase of overburden ratio with depth. Currently, open pit mining is conducted here in small sections of lean coals and anthracites used for energy production. Several sections of “Listvyansky open pit mine” OJSC of “Kuzbassrazrezugol” company “Bungursky open pit mine” LLC (Bunguro-Listvyansky 4 and Mikhailovsky sites), “Kalininsky open pit mine” OJSC operate here.

Erunakovsky geological and economic area is located within the territory of Novokuznetsky, Belovsky and Prokopyevsky districts. Novokuznetsky district includes the part of the left bank of the river Tom from the Ilyinskoe village to Ust-Naryk village. By its geological and structural features Erunakovsky area is subdivided into 11 perspective coal fields, recognized as deposits. Of these, Krasulinskoye, Tagaryshskoe, Kukshinskoye, parts of Taldinskoye, Zhernovskoye, Novokazanskoye coal fields belong to Novokuznetsk district. The carbon mineralization is associated with the deposits of the Kolchuginskaya series of the Middle-Upper Permian. Denoted coal fields, as a rule, correspond to axial parts of brachianticlines and brachinsynclines. Each of these structures has its own name, which is transformed into the name of the deposit. Steep fold wings refer to areas challenging for coal mining. The southwestern part of Erunakovsky geological and economic area belongs to the structures of pre-Salair part of Kuzbass (elongated linear folds), the northeastern part belongs to the central zone of Kuzbass (flat brachiform folds). The total reserves of coal of A, B and C₁ categories are 25545 million tons, inferred resources are 83265 million tons. Coals here, excluding non-caking long-flame, are suitable for coking, a significant part of coal is suitable for semi-coking, coal-derived gas and liquid fuel production. By their territory “Erunakovsky open pit mine”, part of “Taldinsky open pit mine” of “Kuzbassrazrezugol” company, OJSC “Ilyinskaya Mine”, “Uskovskaya Mine” OJSC (former Ulyanovskaya), OJSC “Otkrytchik open pit mine”, “Zhernovskaya Mine” OJSC belong to Novokuznetsk administrative district. Erunakovsky geological and economic area of Kuzbass and its part, included in Novokuznetsk administrative district, has not yet been sufficiently developed by coal

mining industry and has a significant reserve of explored subsoil plots for construction of new mines and open pits. Here it is possible, first, to increase significantly energy coals production in operating open pit mines, and, second, to start selective extraction of particularly valuable grades of coal at Zhernovskaya and Uskatskaya mines. Further increase in reserves is possible due to exploration of Kukshysky and Narytsky coal fields.

Kondomsky geological and economic area occupies the southwestern part of Novokuznetsk administrative district, its southern border coincides with the outer contour of Kuzbass. This is the northern edge of the Mountain Shoria, confined to the valley of the river Kondoma and its tributaries rivers Kinerka and the Malaya and the Bolshaya Tesh. Area is conditionally divided into 9 fields perspective for coal mining, which are recognized as deposits. These are as follows: Razvedchik, Targayskoye, Shushtalepskoye, Nikolaevskoye, Karachiyakskoye, Alardinskoye, Teshskoye, Chernokaltanskoye and Verkhnetneshskoye. Carbon mineralization of the area is associated with the Balakhonskaya series (C₃-P₁). Coal mining has been conducted since 1949 (Shushtalepskaya mine, 1949-1998). The reserves of coal of A, B and C₁ categories in the Kondomsky area are 3695 million tons, inferred resources are 35149 million tons. Almost half of all prospected coal is coking coal, but not particularly valuable. Energy coals are classified as lean and are used mainly at enterprises of the Kemerovo Region (Kaltanskaya TPP). Reserved areas with prepared coal reserves are absent here. At the same time, operating mines of the Kondomsky area are provided with reserves for the near and distant future. Alardinskaya mine is provided with reserves for 200 years, the rest - for 40-50 years in average. A significant increase in production of lean energy coal is possible by means of open pit mining on thick seams. Currently, the following organizations are engaged in coal mining in the area: "Alarda Mine" LLC, "Kaltansky open pit mine" JSC (currently this company includes Osinovsky open pit mine). Targaysky open pit mine is being prepared for operation. Prospects for increase in coal mining in Kondomsky area are in developing open pit mining on thick seams of lean coal ("Razvedchik", "Chernokaltansky", "Teshsky"). In addition, thick seams of lean coals are found on sites explored for underground mining: Urzizakovsky, Targaya, Krasnogorsky, Taylensky, Korchakolsky, Teshsky, Chuazasky.

Mrassky geological and economic area is located in the south of the Novokuznetsk district in the right bank of low course of the river Mrassu. The southern border of the district is conventionally accepted along the Tom-Mrassu watershed, the border with the Kondomsky area is drawn between Chuazasky and Uregolsky coal fields. Carbon mineralization is associated with sediments of the Balakhonskaya series (C₃-P₁). From the geological point of view, this territory is often referred to as the Mountain Shoria monocline (the entire section is represented by sedimentary rocks including carbonaceous rocks slightly pitching towards the central part of Kuzbass) [6]. Coal mining had started in 1963 in "Mezhdurechensky" open pit mine. Later on, Sibirginsky open pit mine had been launched. Total reserves of coal in the area amount to 3493 million tons of A, B and C₁ categories. Inferred resources are 13.504 million tons. Coals are mainly energy ones. In small quantities there are coking coals of abundant brands. Coal production in the area is mainly carried out by the open pit mining method in Sibirginsky open pit mine OJSC, partly by Krasnogorsky open pit mine of Yuzhny Kuzbass company and Mezhdurechye OJSC of Sibuglemet group. These enterprises have covered the entire range of industrial coal seams incrops of the Quaternary deposits. Uregolsky coal site was commissioned the latest (part of this plot is mined by Sibirginsky open pit mine, the other part - by recently created "Kizassky open pit mine" OJSC) and there are no areas for new coal open pit mines in Mrassky geological and economic area. Sibirginsky open pit mine has already partially switched to underground coal mining on the deep horizons of Sibirginsky coal field.

Osinovsky geological and economic area occupies watershed of the Kondoma and the Tom in the basins of the rivers Chernaya, Rychagi, Bukanai, Kalandas. Two prosperous coal fields having status of deposits are distinguished in the area by their geology and structure: Osinovskoe (the main part of the area) and Vorobienkoye (a small syncline with thin coal seams). Carbon mineralization is associated with the Upper Permian deposits of the Kolchuginskaya series. Coals of the area are of high quality. The basis of reserves here are coals of acute deficiency Zh (fat) and KZh (coking fat) grades.

Their reserves of A, B and C categories are 1350 million tons, the inferred resources are 671 million tons. Osinovsky district is the main supplier of fat coals in Kuzbass supplied for high-quality coke production. Coal mining is carried out in underground mines which are as follows: “Shakhta Vysokaya” company, Osinnikovskaya mine (Raspadskaya United Coal Company), Talgina Mine. All operating enterprises are provided with long-term reserves, but reserve fund development is handicapped by complex geological and mining conditions (thin seams, complex tectonics, abundance of coal balls in coal seams, high gas saturation and presence of a powerful overburden of the Jurassic deposits).

Tersinsky geological and economic area occupies pre-Alatau part of Novokuznetsk administrative district. The western boundary of the district is along the river Northern Tom along the river Lower Ters, the southern border coincides with the border of the Jurassic deposits of the Tutuyassky basin, the eastern border coincides with the boundary of Kuznetsk Basin. The area is relatively poorly developed, economic activity is conducted only in the south-western part of the area adjacent to Baidaevsky geological and economic area. Kusheyakovskoe and Uvalnye coal fields are explored here. In the eastern part of Tersinsky district exploration works cover Chexinskoye, Tersinskoye and Makaryevskoye coal fields. In the same area the Tersinskoye mineral water deposit is located. Carbon mineralization is associated with the deposits of the Balakhonskaya and the Kolchuginskaya series. Coals are diverse in their properties due to the difference in stages of coal metamorphism and their petrographic characteristics. Coal reserves in the region of A, B and C₁ categories are 6.598 million tons, inferred resources are of 26.347 million tons. Coal is produced by Kusheyakovskaya Mine OJSC (Raspadskaya United Coal Company), in 2016 “Mine Uvalnaya” OJSC (“Sibirskaya Coal company”) started operation. Coals of the Tersinsky geological and economic area are suitable for synthetic liquid fuels production by means of destructive hydrogenation. Based on evaluation criteria (ash content, fusinite content, vitrinite reflection index, carboxylic acid number, chemical composition of ash) of the degree of coals suitability for hydrogenation, seams of “Tersinsky-2”, “Uvalny-9-10”, “Kusheyakovskiy-I” and “Kusheyakovskiy-II” geologic plots are of certain interest [1]. The outlines of Tersinsky coal field partially lay in state park of Kuznetsk Alatau, that seriously reduces chances of its development in the coming years. In 2015, three parts of Makaryevskoye coal field were put up for mining license auction.

Tutuyassky Central and Uskatsky geological and economic areas in terms of coal mineralization have no importance for the economy of the district because of either poor quality of coals (Tutuyassky and Central areas) or limited territory within the boundaries of Novokuznetsk administrative district (Uskatsky area).

4. Conclusions

Concluding review of coal resource base in Novokuznetsk district, it can be said that it is sufficient to plan economic activities for the nearest future and long term period. A significant increase in coal production level is possible in the district, although it has to be linked to demand, since the extracted coal can not be stored for a long time. Today key point is not the increase in coal production, but qualitative deep processing of coal. Deep processing of coals of Kuzbass and Novokuznetsk district in particular is still far from desired.

It should be acknowledged that development of coal resource base of Novokuznetsk administrative district is largely due to geologists of “Zapsibgeologiya” IGE, once the largest geological exploration organization in the south of Western Siberia. Its abolition in the early 1990s had negatively affected development of mineral resource base of the entire south of Western Siberia and the district in question in particular. Revival of a state geological exploration enterprise is a matter of time. Reality shows the need for a comprehensive geological exploration enterprise in a huge mining area.

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