UDC 338.45:553.94 (470.13-17)

Assessment and strategy of coal resources development of the Komi Republic*

The article deals with the problems of little-developed and sparsely populated areas of the northern region on the example of the Komi Republic, the typology of regions based on their industrial development is made, regional differences of the state's northern policy are marked, the role of coal in the energy supply of the country is shown, the prospects of forming a new center of coal mining in the north-west Russia based on the Seydinskoyecoal deposit areevaluated.

North, little-developed and sparsely populated areas, regional development, coal resources, diversification of coal production, new centers of coal mining.

Albina A. KALININA
Ph.D. in Economics
Senior scientific associate, Honored Scientist of the Republic of Komi
kalinina@energy.komisc.ru

Vera P. LUKANICHEVA
Ph.D. in Economics
lukanicheva@energy.komisc.ru

Irina G. BURTSEVA
Ph.D. in Economics
burtseva@iespn.komisc.ru

Features of regional policy to support the development of little-developed territories of the North

Northern regions of Russia take more than half of the total area, producing 80% of oil, almost all the gas, half coal and timber, export of which gives 2/3 currency earnings of the country. North refers to the extreme area of industrial development and forced occupation with limited opportunities for agricultural development (about 5% of total Russian production) [1]. In the north the areas of industrial development are combined with traditional territories of indigenous peoples, whose tra-

* The article was prepared within the framework of the Interdisciplinary project of UB RAS "Development of a strategy for integrated socio-economic development of weakly involved and poorly studied in economic circulation areas of the North Ural".

ditional economic activity is herding, hunting, fishing, crafts. The northern territories are characterized by: geographic remoteness, extreme climatic conditions, low population and, consequently, limited manpower with high degree of concentration in the fuel and energy complex as well as uneven distribution of population over the territory and the high concentration of it in large and medium-sized industrial cities (from 70 to 92% of the total population) [2]. These conditions determine the degree of development of the North. In the Komi Republic, almost half the territory belongs to the zone of active economic development of old industrial region of the resource type classification [3]. The rest of the space of the republic is little-developed and sparsely populated with the areas of the following types:

- traditionally developed areas with poor infrastructure, lack of industrial enterprises and low dispersal, but having untapped raw materials, forestry or land potential;
- areas of "deindustrialization" with a partially curtailed industrial production, with well-developed infrastructure;
- areas of new development within the proposed new investment projects and transportation corridors.

In the typology of regions a fourth category can be identified – a territory that will remain undeveloped or abandoned at a certain time period.

The main problem of development of the northern territories is their remoteness from the markets and an underdeveloped or absent infrastructure, which requires high costs. It is because of these factors, large investment projects in the northern regions are on the verge of profitability and they require the participation of the state. Therefore, the main form of realization of northern projects can only be a public-private partnership, especially in the creation of new infrastructure or improve the efficiency of the existing ones. This model of development of new projects is typical for all northern countries such as Norway, Greenland, north-western Canada and the Yukon Territory, Alaska (USA). Their experience shows that it is impossible to solve the problems of development of new areas within a "pure business approach", focused only on commercial viability. New projects in undeveloped northern areas can be successful only with the active support of the state on behalf of local and federal authorities [4].

State participation is expressed primarily in the performance of general geological work destination, as well as environmental, social and economic assessment of future projects. Exploration and preparation of industrial supplies, construction of mining, in this case, the coal companies is implemented on a commercial basis. However, new areas of economic development in the absence of all or part of the infrastructure (transport, energy, social, etc.) require significant capital investments and state aid is needed here.

Primary documents ("On the basis of state regulation of social and economic development of the North of Russia", "The concept of state support for economic and social development of northern areas") defining the development policy of the northern territories of Russia do not fully reflect regional differences. However, the formation of the northern regional policy must take into account socio-economic specifics of individual regions and their role in the economic sphere of the country. These specific areas in Russia are primarily the Khanty-Mansiysk, Yamal-Nenets and Nenets autonomous okrugs, and the Komi Republic, having a sustainable resource base for economic growth. They account for about 80% of profits earned by enterprises of northern Russia. Economic potential of these areas is based on the high export orientation. In these primary areas the implementation of resource extraction and transportation megaprojects "Ural Industrial – Ural Polar" and "Belkomur" is planned, which should give an impetus to engage in the commercialization of natural resources of little-developed areas of the North, including the coal ones.

Northern regions require a comprehensive support, government regulation should be

manifested in all its forms: fiscal, investment, institutional, tariff, foreign trade, and others to improve efficiency and reduce the northern costs. You cannot confine compensation of investment uncompetitiveness of enterprises of the northern territories by the use of incentives and guarantees, full integration of the northern regions into a single economic space of Russia is required.

Coal of the North in power supply of Russia

Resource base of coal mining in the North and similar areas (hereinafter the North) are the reserves and probable reserves of the Pechora, Sosva-Salekhard, Ulughemskog, Taimyr, Tunguska, Lena, Zyryansk and South Yakutsk coal-bearing basins and individual districts, areas and fields of Sakhalin, Chukotka, Magadan and Kamchatka. The total coal resource potential of the North is 72.6% of the resource potential of the Russian Federation, and the balance holdings are only 12.8%. Of all the fields in the north the most assimilatedare the Pechora and South Yakutsk basins that make up respectively 24 and 21% shares and 37% favorable and 21 stocks in categories A + B + C1 of the total resources and reserves of coal, accounted state balance of all basins and fields of the Far North [2]. Only these two basins supply coking coal for export and for other regions of Russia. Stocks of Tunguska, Lena, and Ulughemsk and Zyryansk basins are being developed by industry, but the extraction of coal in these basins is carried out mainly in small sections to cover own needs of the regions in the total volume of 4 million tons. All other basins and fields in the north are of the first type of assimilation [2].

The Pechora coal basin is connected with other regions of the country by the railways and has a developed infrastructure. As a result of the coal industry two cities were formed in the basin – Vorkuta and Inta – with dominant coal specialization. All this determined the primacy of the Pechora basin, among other coal basins of the North. The area of the Pechora coal basin includes all three types of little-developed territories.

Thus, **type I** includes the territories of Halmeryusk and Korotaihinsk geological and industrial areas (GIA) of valuable coking coals of grades "K", "OS", "T", Adzvinsk and 10 fields of Inta GIA grades "A" and "B". These fields are still a glimmer of hope on the prospects for development. However, a possible increase in demand in the steel industry coking coals of the most valuable brands, as well as the construction of the railway Vorkuta – Ust-Kara (in accordance with the Transport Strategy of Russia until 2030), allowing secure access to Halmeryusk and Korotaihinsk GIA, create conditions for possible development in the long run.

Type II of little-developed areas includes Vorkuta and Inta industrial areas. "Deindustrialization" of these areas lies in the fact that as a result of restructuring of coal industry, 65% of mines in these areas were closed, the volume of coal production in the remaining mines fell by more than two times, the auxiliary organization and productions were eliminated. However, recently re-equipment of promising mines and the Pechora concentrator began, planned resettlement of the surplus population is implemented and the release of housing fund of Vorkuta and Inta. These cities preserved the basic infrastructure to use it during the development of promising new deposits.

These priorities include the two fields: Seydinskoye (steam coal) and Usinskoye (coking coal grade "G"). These fields are different from others so that their territories are located within the industrially developed Vorkuta and Inta GIAs, and the existing infrastructure can be used in field development, which undoubtedly is a positive step along with the fact that these deposits are the most large. Their stocks allow building coal mines and sections on modern technologies. Perhaps that is why Seydinskoye field, despite the pending exploration, is classified according to the energy strategy (ES) of Russia for the period up to 2030 to the number of new fields to be developed in the 2020 – 2030 along with fields in Eastern Siberia, Far East and Khanty-Mansiysk autonomous okrug.

Prospects for the development of Usinsk deposit of coking coal is mainly determined by the strategy of development in Russia. Seydinskoye field power coal in confirming the appropriateness of their production is adopted in Russia's energy strategy until 2030 to development [5]. This means that its preparation should begin today. Consider the conditions under which Seydinskoye field of the Pechora power coal (hereinafter – "Seyda") can fit in the ES-2030 and become a real prospect of the Pechora coal basin in the framework of the third type of new development area of little-developed area. To this end, we estimate the degree of readiness of the geological deposits to the development, separate the factors promoting and hindering its development. The main direction of Seyda coal's useis high-quality fuel for power outside of the country (North-West and Ural Industrial), subject to the implementation of two transport projects (West and East).

Formation of a new mining center in the Pechora coal basin

The degree of "Seyda's" geological readiness to the development [6]. Seyda coal mine is located in the southern part of the Vorkuta coal-bearing area of the Pechora basin, 60 km southwest of the city of Vorkuta. In the relative proximity to the mine (194 km) there is another coal town of Inta. Work on the geological exploration of deposits began back in 1955.

Deposit to a depth of 600 m is divided into two parts: the northern with the area of 154 km^2 (22 km to the south with a dip width of 7 km) and the southern with the of area of 380 km^2 (26 km to the south with a width of 20 km in the north to 6 km in the south). Total resources of Seyda coal deposits are now estimated at 31.3 billion tons, of which conditioning are 22.3 billion tons.

In the northern part of the deposit a preliminary exploration is made and reserves of steam coal "D" grade for eight coal-bearing strata in the amount of 3.2 billion tons, mostly of complex structure are estimated. On this area, four field mines with a capacity of up to 9 million tons of coal a year each are separated.

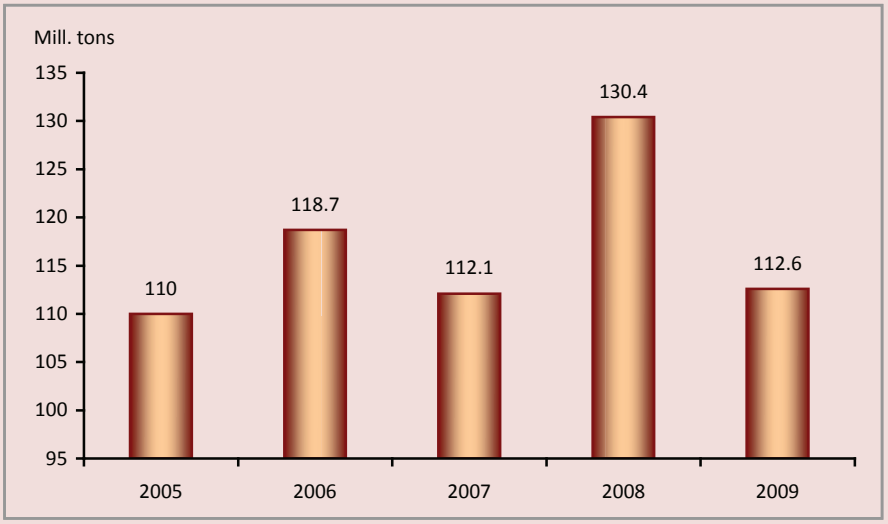
On the southern part of the deposit the exploration is held. This part of the deposit is characterized by simple geological structure, corresponding to the first group of complexity. Characteristics of coal seams are in line with indicators of northern part of the deposit. By volatile and the thickness of the plastic layer coal seams of the southern part of the field belong to the "D" grade and the transition from the "D" to "G". Within the area nine mine fields with capacity up to 9 million tons of coal a year each are allocated. As a top priority mine fields № 5, 6, 7, 8 and 9 are recommended, of which only in the mine field № 5 "Yuzhnoseydinskaya" in 2003 JSC "Polyarnouralgeologiya" completed the exploration work. The possibility of open-pit mining of two coal seams is suggested.

Results of exploration in the field of mine № 5 "Yuzhnoseydinskaya":

- approval of steam coal reserves for underground mining in categories C1 + C2 in the amount of 433 million tons by the State Reserves Committee Rosnedra in 2007;
- plots for open-pit mining within the field of mine № 5 with reserves of categories C1 + C2 92.6 million tons to a depth of 200 m submitted for approval to the SRC were not approved due to lack of mining engineering and economic feasibility;
- SRC suggested considering the open pit reserves and estimating the possibility of progressive geotechnology – a comprehensive open-underground mining development of "Seyda" in carrying out the scoping study exploration of conditions, which hitherto has not been developed.

On quality characteristics steam coal of "Seyda" take precedence over similar coals developed in the Inta field. Seyda coals are low-sulfur (Sdt = 1.3%), high-calorie (Qrj = 20 MJ/kg). After the enrichment coal concentrate output exceeds 70% with ash content 19-22%. Nearly half of stocks (42%) is concentrated in strata capacity of 5 – 8 m, mostly gentle bedding. The majority of the reserves (2/3) are at depths of 300 m, enabling both underground coal mining, and the open development.

Supply of Russian coal to power plants of the country in 2005 – 2009 [7]



Factors of "Seyda's" development. It should be noted that the development of "Seyda" is not determined by the needs of the Komi Republic, but by fuel and energy balance of Russia under the condition of the implementation of the idea laid down in of EC-2030 of increased use of coal in the Russian domestic market with increasing prices for gas in 2-2.5 times. The former expectation that by 2010 there will be a change of "gas-coal" price ratio in favor of coal and then the gap will grow to a value of 2.5:1, is not confirmed yet. On the contrary, the supply of Russian coal to power plants does not grow but decline *(figure)*.

It is necessary to create economic incentives for the expansion of the domestic coal market - for example, to introduce, according to the suggestion of ERI RAS [8], an excise tax on gas flaring in large power plants, especially those working in the "gas-coal".

The following factors contributing to the development of "Seyda" should be marked out:

I. *Geological and geographical*:

Significant resource potential of coal with a predominance of powerful banks in the southern part of the field, their flat and shallow occurrence, better quality parameters compared to the coal of Inta.

The possibility of open mining of part of the stocks.

Availability of infrastructure facilities – main-line railway Moscow – Vorkuta and intertie power transmission line of 220 kV Pechora – Vorkuta, passing directly over the southern part of the deposit;

Proximity to the field to Vorkuta allows make it the base city, while reducing infrastructure costs for development of "Seyda" and to use power concentrators of Inta to enrich Seida coal, taking into account their reconstruction of course. All these features should be taken into account in the projecting of coal enterprises of "Seyda" and infrastructure financing by the owners.

II. *Technological*:

The predominance of high-power coal banks provides the possibility of large-scale application of efficient equipment and high technology during coal mining (mine-lava, a comprehensive open-underground method, etc.).

A comprehensive open and underground mining, combining the open and underground mining, using a common infrastructure, allowing to organize the extraction of coal in a shorter time, because it will be implemented in open-cut mining at the first stage, and only after it pit mining starts.

Experience in developing of the Yunyaginsk coal mine in the Pechora basin suggests the possibility of wider use of coal mines in the

Table 1. Comparison of indicators of the Yunyaginsk coal mine with those of Southern Kuzbass and Yakutia

Indicator	Coal mines		
	Yunyaginsk	Olzherassky (SouthernKuzbass)	Kolmar (Yakutia)
Banks' thickness, m	2.28	2.0	2.4
The volume of production, tons	625.0	1139.0	600.0
Stripping ratio	22.5	10.97	6.5
Ash content of the rock mass, %	30.4	21.8	28.0
Number of staff, people	227.0	461.0	380.0
Labor productivity per 1 worker, thous. tons/person	2.75	2.47	1.58
Cost of raw coal, doll./ton	22.0	31.4	25.0

newly-developed fields, despite the harsh climatic conditions of the Arctic. Comparison of some indicators of the Yunyaginsk coal mine with the indicators of two other comparable by power figures in South Kuzbass and Yakutia shows that the Yunyaginsk mine is quite competitive with them *(tab. 1)*.

As can be seen, the Yunyaginsk coal mine, despite the high stripping ratio and a higher ash content of rock mass, but smaller number of staff (1.7-2.0 times) has a lower cost of coal extracting (1.1-1.4 times).

The effectiveness of a comprehensive open-underground mining can be judged on its broad application at the existing coal mines of Kuzbass [9].

On the qualitative composition Seida coals can be used not only as an energy fuel but also as a basis of coal chemistry when developing appropriate technologies for these coals.

The emergence of a new coal-producing center of "Seyda" creates conditions for more sustainable Pechora coal basin, and reduces its vulnerability in times of crisis due to the deepening of coal production diversification.

Among the factors constraining the development of "Seyda", in our view, should include: a sufficiently high degree of uncertainty about the production of Seida coals in the ES-2030; incomplete exploration to assess the recoverable reserves of coal; insufficient pilot tests to select the areas of non-traditional use of these coals.

Completed "Business plans for the development of Seyda field" (2003, 2004) examined the limited capacity of the mines 2.5-3 mill. tons. According to recent data (2006), the production capacity of the mine № 5 "Yuzhnoseydinskaya" in volume of 8 million tons per year is based on the same stocks of coal. While there is no clarity about the open mining using new geotechnology. At an early stage of development it is necessary to determine the first priority of mine construction or use a combined mine geotechnology.

Directions of Seida coals' using. The main direction of Seida coals is high quality fuel for power plants. One of the possible consumers of these coals in the future may become Industrial Ural[1] (hereinafter – Ural). Relationship expansion of Komi – Ural, rather limited at present, in the long run will be contributedby the implementation of two railway transportation megaprojects:

1) "Belkomur" (from the Finnish border in Karelia, Arkhangelsk oblast and the Komi Republic to Solikamsk in the Urals), which reduces the transportation of Seida coal in the western part of the Urals by 500 km, and to the ports of the White S ea by 800 km;

2) railway "Polunochnoye – Obskaya – Salekhard – Nadym" within the mega-project of "Ural Industrial – Ural Polar". Implementation of these mega projects will help create a new transport frame of Komi – Ural macroregion. Eastern road is the shortest way to the Urals for Seida coal, only 800 – 900 km. The need of the Urals in the steam coal in the long run is conservatively estimated to be 10 million tons per year [1].

[1] Industrial Urals means the region, covering the territory of the Sverdlovsk, Chelyabinsk and Orenburg oblasts, the Perm Krai and the Republic of Bashkortostan.

Using of Seyda coal makes it possible to obtain the effect of consolidation of the assets of coal miners and power engineers "to consider the overall economy" for the Ural coal generation. Another domestic market for Seyda coal can be North-West, provided that the introduction of new generating capacity in the region is dominated by coal-fired power rather than by gas.

As can be seen, North-West and the Urals are most likely to become the zones of energy consumption of Seida coal. The ES-2030 consideres the possibility of development not only of "Seyda", but the North-Sosva deposit of brown coal as an alternative to cessation of coal mining in Kizel coal basin in the Urals. Without considering all aspects of this problem, we make a comparison of some indicators of Seyda and North-Sosva deposits *(tab. 2)*.

Even the given list of indicators shows that Seida coals have a distinct advantage as an energy fuel for the Urals. Moreover, "Seida" already has approved commercial reserves to build the first powerful mine in contrast to the North-Sosva field. This suggests that the development of "Seyda" should be a priority for the Urals.

Possible direction of Seida coals using, except for energy, could be unconventional using, associated with the processing of coal and production of new products from waste coal. The essence of coal processing is in the complex use of both a carbon (organic) and mineral parts of it. In world practice, technologies, which get over five hundred products out of coal are developed: synthesis gas, fuel oil, naphtha for gasoline production, xenon and krypton, ammonia, phenol, ammonium sulphate, carbon dioxide, and various carbon fibers, mineral wax, humic fertilizers, adsorbents, isolated rare metals.

Most developments in Russia involving the processing of coal processing are more prospective experimental-industrial in nature. Processing of coal compared to the alternative oil- and gas processing, has the lower technological and economic indicators. Widespread use of coal fuel chemistry technology in Russia in accordance with the ES-2030 can be expected only by 2030.

One of the most cost-effective is the technology of semi-coking by the method of "Karbonika" in Russia today. This technology is implemented in a pilot plant with a capacity of 30 tons of coal per year. In the past five years all the technical and technological solutions are worked out, research on various coals is conducted and industrial and experimental batches of the product tested on a number of enterprises in Russia and abroad are produced [11].

The aim of this process is to obtain a liquid tar, of which light fuel oil, lubricating oils, as well as paraffin, mineral wax and other products are produced. Semi-coke is characterized by low volatile substances (less than 12%), high caloric (more than 27 MJ/kg or 6449 kcal/kg) and reactivity, low electrical conductivity. Obtained as a by-product, semi-coke is used for power generation, domestic needs, as an additive in the charge for coking, etc. Other products of semi-coking are semi-coke gas and pyroligenous liquor used to produce several chemicals, including phenols, used for plastics industry.

This technology, unlike most known, is characterized by the environmental safety and

Table 2. Comparative indicators of Seyda deposit development (underground) and North-Sosva deposit [10] (open pit), 2006

Indicator	Seyda deposit	North-Sosva deposit	
	Mine № 5	Otorinsk mines	Tolinsk mines
Production capacity of the mine (quarry), mill. t	8.0	8.0	8.5
Net calorific value, kcal/kg	4800.0	4240.0	3005.0-3786.0
Capital expenditures, bill. rub.	26.9	31.6	21.7
Number of personnel, people	1763.0	2750.0	1620.0
Cost of 1 ton of raw coal, rub./t.	400.0	1127.0	737.0

waste-free, ease of technical performance and reliability of equipment, high economic energy efficiency and high export potential of semi-coke. In 2004, the price level of carbon reducing agents in Germany, Norway and Japan amounted to 300 doll./ton with a deficit of these products. At that price for semi-coke all the costs of electricity and heat generation, as well as coal mining are covered.

Pilot studies to yield the final product of Seida coals (grades "D", "DG") were conducted only on semi-coking and receiving a molded coke. The use of molded coke permitted the use of coal in the batch grades "DG", "D" and "GJO" from 10 to 40% without compromising the quality of cokes.

Production of molded coke allows using substantial reserves of Seyda coal deposits grade "D" for metallurgical batches of layered coking. Experimental studies have confirmed the possibility of semi-coke production of Seidacoal with 80-84% yield of semi-coke and tar up to 12%, including light to 23% which are the most valuable raw material for plastics.

Accommodation of coal-chemical product production on the basis of Seida coal can be carried out outside of production, for example, in the Pechora region, where there is power and industrial areas for construction that will reduce the amount of productive investment.

Thus, Seyda coals may be raw materials for their non-traditional use, but to select a specific technology, coal processing requires more detailed study of their qualitative composition and experimental-industrial tests.

Waste products of Seida coals concentration can be used for the production of bricks, tiles, ceramic tiles, silicate concrete, lightweight concrete aggregates and insulating materials.

Unconventional use of Seida coals would increase their value compared with pure energy use and can become a source of development of the basin due to the expansion of commodity production and higher prices on coal-chemistry products (by 50-400%) compared with the energy and technology using of the Pechora coals.

Implementation of the considered and other innovative technologies in the framework of program solutions will ensure the transition of the Pechora basin in a cost-effective way of development. For the republic, it is important that "Seyda" became an effective production of high-energy fuel with a high degree of utilization of waste coal, with a focus on the Russian domestic market (most likely industrial Urals and North-West), as well as a raw materials base of coal-chemical production in prospective. To do this the following things are necessary: the completion of exploration in the southern part of the "Seyda"; assessment of the economic feasibility of opencast and complex open-underground technology; conducting pilot tests of Seida coals for the purpose of development of the most appropriate technologies with the of use coal-chemical, research and production base of Kuzbass .

Conclusion

Thus, little-developed territories of the North are diverse by their possibilities of development and have certain growth points in the future. Thus, the area of the Pechora coal basin is characterized by: priority development of new deposits (Seyda and Usinsk) in existing industrial zones of Vorkuta and Inta, in the future, subject to the construction of the railway Vorkuta – Ust-Kara, the transport prerequisites for development of Halmeryuskand Korotaikhinsk GIA of coking coal of most valuable grades are created.

Their development will depend on the nationwide demand for high-quality coal, the needs of export and further macro-economic spatial development of macro-regions of "Komi – Ural" and "Ural Industrial – Ural Polar".

References

1. Problem regions of resource types: economic integration of the European North-East, the Urals and Siberia / ed. V. Alexeyev, M.K. Bandman, V.V. Kuleshov. – Novosibirsk: IEIE SB RAS, 2002. – 356 p.

2. North as an object of integrated regional studies / ed. V.N. Lazhentsev. – Syktyvkar, 2005. – Pp. 330-350. (Scientific Council of RAS on regional development, Komi scientific center of UB RAS).

3. Spatial development paradigm of little-studied areas: experience, problems, solutions / under total ed. A.I. Tatarkin. – Vol. 1. – Ekaterinburg: Institute of Economics UB of RAS, 2009. – Pp. 282-321.

4. Shafranik, Yu.K. Investments in the Russian oil and gas industry / Yu.K. Shafranik // Energy policy. – 2007. – Vol. 1.

5. Energy Strategy of Russia until 2030 [Electronic resource]. – Access mode: http://www.energystrategy.ru/

6. State balance of mineral reserves of the Russian Federation on January 1, 2009. – Vol. 91. Coal. – Vol. III. North-West federal district. Nenets autonomous okrug, Komi Republic. – M., 2009. – 62 p.

7. Tarazanov, I. Results of the Russian coal industry for 2009 / I. Tarazanov // Coal. – 2010. – № 3. – Pp. 34-42.

8. Plakitkin, Yu.A. Opportunities to ease the impact of the global financial crises in the Russian coal industry / Yu.A. Plakitkin, L.S. Plakitkina // Mining industry. – 2009. – № 2.

9. Fedorin, V.A. Combined (open-underground) geotechnology of Kuzbass mineral resources exploitation / V.A. Fedorin [and others] // Kuzbass coal. – 2008. – Special issue.

10. Fedorov, S.V. Techno-economic assessment of the development of North-Sosva lignite deposits / S.V. Fedorov, V.V. Sharin // The region's economy. Topical application. – 2007. – № 2. – Pp. 60-64.

11. Technology "Karbonika" as a breakthrough in the integrated use of coal. [Electronic resource]. – Access mode: http://www.carbonica.ru/technologia.html