Enterprises of the Kursk-Belgorod Mining Complex: Resource and Economic Potential of Sustainable Development

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Abstract: The paper presents the authors' point of view concerning resource and economic potential of the sustainable development of enterprises of the mining complex, formed on the territory Kursk Magnetic Anomaly. In the course of the research: a spatial layout diagram has been presented and a brief production characteristic of plants in the Kursk-Belgorod mining complex has been given as well; based on the assessment of the volumes of extraction of iron ore and quartzite, the production activity of the enterprises has been assessed; the resource potential of the sustainable development has been estimated through the iron ore reserves as of 2019; based on the values of the increase in the group of financial indicators for the period from 2012 to 2019, the economic results and prospects have been estimated; taking into account a number of production and economic factors, the prospects and limitations of the sustainable development of enterprises of the Kursk-Belgorod mining complex have been identified. The research has shown significant economic achievements of the mining and processing enterprises and favorable production prospects. The potential for increasing the resource base of the complex is associated with increasing reserves at existing fields, and with the development of new deposits.

1 INTRODUCTION

The relevance of the research is due to the need to identify the resource and economic potential of sustainable development of enterprises of the Kursk-Belgorod mining complex, formed on the territory of the world's largest iron ore province – the Kursk Magnetic Anomaly, whose area is 160 thousand km^2.

The sustainable development of industrial mining complexes from the standpoint of achieving economic results is considered, in particular, in Russian (Kostyukhin and Savon, 2020; Serova et al., 2020) and foreign (Barclay and Everingham, 2020; Hao et all, 2020; Sanakulov, 2018) researchers' works. Analyzing financial flows, R. Boschma et al. (Boschma et al., 2014), M. Cehlar et al. (Cehlar et all, 2020), E. Korchak and T. Skufina (Korchak and Skufina, 2020; Skufina et al., 2019), P. Papizh (Papizh, 2015) defend the opinion that the mining complex increases the investment attractiveness of the region of presence, attracting national and foreign investments. Industrial achievements, namely, volumes of mined ore and produced iron ore concentrate, pellets, sinter ore, etc., quite often underlie the assessment of sustainable development of mining complexes as well (Chen et al., 2015; Narrei and Ataee-Pour, 2020; Fonseca et al., 2014; Samarina et al., 2020; Sumit and Lodhia, 2014; Wang et al., 2018). The industrial and economic results of the activities of large industrial complexes were also studied in the authors' research (Samarina et al., 2016; Samarina et al., 2019; Samarina et al., 2020). Recognizing the significance of the results of these and other scientific research, the authors emphasize that currently in Russia there are no unified approaches to assessing the resource and economic potential of sustainable development of mining

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complexes localized in the iron ore province. All this makes the presented research actual.

The purpose of the research is to characterize the current state, as well as to assess the resource and economic potential of sustainable development of the Kursk-Belgorod mining complex.

Specific research objectives:

1. To present the spatial layout and brief production characteristics of mining and processing plants as part of the Kursk-Belgorod mining complex.
2. To assess production activities and resource potential for sustainable development of mining enterprises.
3. To compare the economic results and prospects of mining enterprises.
4. To reveal the prospects and restrictions of sustainable development of enterprises of the Kursk-Belgorod mining complex.

2 MATERIALS AND METHODS

The research is based on an integrated approach, which on the basis of territorial, resource, production and organizational factors made it possible to identify and study the prerequisites and prospects for the sustainable development of the local mining complex – an aggregative production association of enterprises specialized in functional characteristics and localized in a territory rich in iron ore deposits.

The core of the mining complex is mining and processing plants (MPPs), the divisions of which are interconnected by production processes: from the extraction of iron ore, through its enrichment, to the release of finished products such as iron ore concentrate, sinter, pellets, hot-briquetted iron, etc. (Papizh, 2015; Samarina et al., 2020; Sanakulov, 2018).

The research has been carried out on the materials of the Kursk-Belgorod mining complex, formed on the territory of the world's largest iron ore province – the Kursk Magnetic Anomaly. The products of the mining complex serve as the basis for Russian steel production. Therefore, the most complete use of the resource and economic potential depends not only on the functioning of the Kursk-Belgorod mining complex, but also on the development of many sectors of the Russian economy. In addition, the iron ore products of the enterprises of the complex as one of the leading Russian export item are actively exported abroad,

The paper analyzes the following performance indicators of the enterprises of the Kursk-Belgorod mining complex for the period from 2012 to 2019:

- the results of production activities were evaluated on the basis of indicators of the mass of iron ore mined in 2019;
- the resource potential was estimated through iron ore reserves classified as A + B + C_1 as of 2019;
- the economic results were assessed on the basis of the growth for the period from 2012 to 2019 of the following financial results of MPPs: revenue, profit from sales, EBIT and net profit;
- the immediate economic prospects were assessed on the grounds of the rating expert evaluation presented on the Internet portal Audit-Jt.ru.

The research involved some materials from the state report "On the state and use of mineral resources of the Russian Federation" (On the state, 2019); the information from Stoilensky, Lebedinsky, Mikhailovsky, Yakovlevsky MPPs and KMAruda Combine's official websites; the economic analysis according to the enterprises book-keeping data has been carried out using the Internet portal Audit-Jt.ru.

3 RESEARCH RESULTS AND THEIR DISCUSSION

3.1 Mining and Processing Enterprises on the Territory of the Kursk-Belgorod Mining Complex

As of 2019, iron ore reserves of the categories A + B + C_1 of the Kursk-Belgorod mining complex amounted to 31,457.1 mln tons and the category C_2 – 32,274.2 mln tons. The iron content in ores varies from 29.5% (Stoilenskoye deposit) to 61.7% (Gostishchevskoye deposit). There are several mining and processing plants on the territory of the complex (Figure 1).

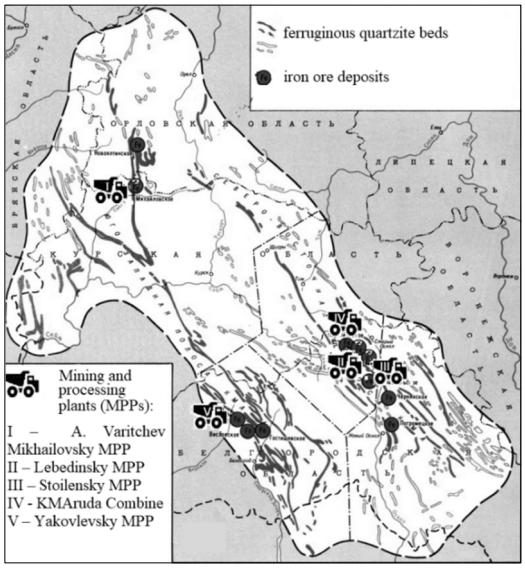

Figure 1: The location of mining and processing plants on the territory of the Kursk-Belgorod magnetic anomaly.

Most of MPPs gave the first ore in the 1950-60s by means open-pit mining. An exception was Yakovlevsky MPP (absorbed by Severstal in 2019), mass ore underground mining began only in 2005; currently an output is 1.2 mln tons. The cluster supplies iron ore concentrate, ore, pellets, sinter ore for Russian and foreign steel companies. JSC Lebedinsky MPP produces hot-briquetted iron - the most modern product of MPPs with iron content of more than 90% (Table 1).

Table 1: MPPs as part of the Kursk-Belgorod mining complex (compiled by the authors based on the information from the MPPs' websites).

Mining enterprises, Corporation	Year of opening	Personnel, pers.	Mining method *	Iron ore products **
Stoilensky MPP, NLMK Group	1961	7540	O	i/o; io /c; io / p
A. Varichev Mikhailovsky MPP, Metalloinvest	1957	9459	O	s/o; io /c; io / p
Lebedinsky MPP, Metalloinvest	1967	6413	O	i/o; io / p; hbi
KMAruda	1953	2380	U	io /c
Combine, Industrial and Metallurgical Holding				
Yakovlevsky MPP, Severstal ***	2018	1528	U	i/o; s/o

* Method of ore mining: O – open-cut mining; U – underground mining.
** Iron ore products: i/o – iron ore; s/o – sinter ore; io /c – iron ore concentrate; io / p – iron ore pellets; hbi – hot-briquetted iron.
*** The cessation of a legal entity activity from November 15, 2019

3.2 Production Activity and Resource Potential for Sustainable Development of Mining Enterprises

The authors estimate the production activity of the mining complex through the volumes of iron ore production; resource potential – through iron ore reserves of category A + B + C_1. The MPPs' rating in the Kursk-Belgorod mining complex in terms of production and resource indicators is presented in Table 2.

Table 2: Production and resource indicators of sustainable development of enterprises of the Kursk-Belgorod mining complex (compiled by the authors based on the materials State Report (On the state, 2019).

Mining enterprises	Production activities (iron ore mining)		Resource potential (reserves iron ore)	
	mln tons	share	mln tons	share
Mikhailovsky MPP	95.4	50.69	7674.0	29.7
Lebedinsky MPP	50.0	26.57	7011.4	27.1
Stoilensky MPP	36.8	19.55	6368.0	24.6
KMAruda Combine	4.8	2.55	2922.0	11.3
Yakovlevsky MPP	1.2	0.64	1872.3	7.2
Total	188.2	100	25847.7	100

The analysis shows that both from the standpoint of assessing the resource potential and in the view of production activities, Mikhailovsky MPP is in first place: 7674.0 mln tons of iron ore reserves of category A + B + C_1 (11.0% of the total Russian reserves and 29.7% of the complex reserves); the production amounted to 95.4 mln tons. The structure

of the MPP includes enrichment and pelletizing plants, as well as a crushing and screening plant. The number of personnel is about 9.5 thousand people. The products are iron ore concentrate, fluxed and non-fluxed iron ore pellets and sinter ore as well.

The second place is taken by Lebedinsky MPP: 7,011.4 mln tons of iron ore reserves of category A + B + C_1 (9.5% of all-Russian reserves and 27.1% of the complex's reserves); the production amounted to 50 mln tons. The structure of this MPP includes enrichment, re-enrichment and pelletizing plants. The number of personnel is about 6.4 thousand people. Products: iron ore concentrate (including re-enriched), fluxed and non-fluxed iron ore pellets, hot briquetted iron.

The third place is taken by Stoilensky MPP: 6368.0 mln tons of iron ore reserves of category A + B + C_1 (8.8% of all-Russian reserves and 24.6% of the complex's reserves); the production amounted to 36.8 mln tons. The structure of the MPP includes a pelletizing plant. The number of personnel is over 7.5 thousand people. The production: iron ore concentrate, iron ore pellets, sinter ore.

Then, KMARuda Combine follows by a wide margin: 2922.0 mln tons of iron ore reserves of category A + B + C1 (3.2% of all-Russian reserves and 11.3% of the complex's reserves); the production amounted to 4.8 mln tons. The structure of the combine includes a crushing and processing plant. The number of personnel is 2.4 thousand people. Products: iron ore concentrate.

Yakovlevsky MPP went out of its existence as a legal entity on November 15, 2019, having joined JSC Severstal as a structural unit. The deposit of the same name is under development: the reserves of iron ore of category A + B + C_1 are small: 1,872.3 mln tons, but the reserves of category C_2 are estimated at 7,740.5 mln tons. The output was 1.2 mln tons. More than 1.5 thousand people work at the MPP. The production: iron and sinter ore.

3.3 Economic Results and Prospects for the Activities of Mining Enterprises of the Mining Complex

The economic results of mining enterprises were assessed on the grounds of the growth values of a number of financial indicators for the period from 2012 to 2019. The nearest economic prospects were determined on the basis of the rating assessments (Table 3).

Table 3: Indicators of economic development and prospects of the Kursk-Belgorod mining complex's MPPs (compiled by the authors on the basis of the enterprises' statements of financial condition).

Mining enterprises	Growth from 2012 to 2019, %				Economic prospects
	Revenue	Sales profit	EBIT	Net profit	
Mikhailovsky MPP	103,4	127,6	113,6	116,1	AAA
Lebedinsky MPP	118,1	129,4	124,7	138,1	BB
Stoilensky MPP	107,5	121,3	111,9	111,8	AA
KMAruda Combine	41,5	25,3	46,5	32,6	BBB
Yakovlevsky MPP	n/a	n/a	n/a	n/a	n/a

* An assessment of the economic prospects of the enterprises: BB – normal; BBB – positive; AA – very good; AAA – excellent;
* n/a – no data for analysis.

From the standpoint of achieving profitability of production activities, the best indicators are shown by Lebedinsky MPP – for the period from 2012 to 2019, this enterprise provided the largest increase in indicators. This is followed by Mikhailovsky MPP and Stoilensky MPP by a small margin. The results of KMAruda Combine are much worse. At the same time, Mikhailovsky MPP and Stoilensky MPP have the best immediate economic prospects. KMAruda Combine shows the worst result here too.

3.4 Assessment of the Prospects for Sustainable Development of the Enterprises of the Kursk-Belgorod Mining Complex

Lebedinsky MPP demonstrates best economic performance among the enterprises of the complex and experts assess the nearest economic prospects as "normal". In 2018, in the process of combining deposits through revaluation and exploration of the Lebedinskoye deposit, iron ore reserves of categories A + B + C_1 increased by 3529.2 mln tons, category C_2 – by 3624.7 mln tons. At the same time, the reserves of the Stoylo-Lebedinskoye deposit were overestimated and decreased: categories A + B + C_1 by 2128.6 mln tons, category C_2 – by 1785.0 mln tons (On the state…, 2019). Thus, the positive balance of the increase in reserves of the combined field, developed by Lebedinsky MPP, in the A + B + C_1 categories amounted to 1400.6 mln tons, in the C_2 category – by 1839.7 mln tons. The enterprise is the

only producer of hot briquetted iron in Europe with a content of useful substance more than 90%.

Stoilensky MPP has been developing the Stoilensky ferruginous quartzite deposit for 60 years. The MPP firmly occupies the third position in terms of production and economic indicators among the enterprises of the Kursk-Belgorod mining complex. The bulk of the company's products are shipped to Novolipetsk Metallurgical Plant, the largest steel plant in Russia. The experts assess the immediate economic prospects of the enterprise as "very good".

KMAruda Combine is developing the Korobkovskoe ferruginous quartzite deposit, which has been in operation since 1953, using underground mining. In order to increase production, the MPP is developing all deep horizons, which increase the cost of production. All economic indicators of the plant are 2.5-5 times behind the corresponding indicators of other enterprises of the Kursk-Belgorod mining complex. Nevertheless, having closed the year 2017 with a net loss of 1.5 billion rubles, the enterprise was able to make further profits: 2.17 billion in 2018 and 2.45 billion in 2019. The experts assess the immediate economic prospects of the enterprise as "normal".

Yakovlevsky MPP ceased to exist as a legal entity on November 15, 2019, having joined Severstal as a structural unit. The eponymous deposit of rich hematite-siderite-martite ores (iron content is 61%) is in developmental stage.

In addition to the deposits being in operation, on the territory of the Kursk-Belgorod mining complex, the Vislovskoye and Gostishchevskoye deposits with rich hematite-martite ores (iron content is 60.7% and 61.7%), as well as the Prioskolkoe deposit of ferruginous quartzite (iron content is 37.1 %). The deposits are distinguished with complex mining and geological conditions of the development. Therefore, despite high potential, with existing technologies, the development of these fields is not economically expedient.

4 CONCLUSION

At the current productive rates, the reserves of iron ore of the Kursk-Belgorod mining complex's enterprises will last for several centuries. The research has shown MPPs' significant economic achievements and their favorable prospects. Despite the high degree of development of the raw material base, the expansion of existing production capacities continues on the territory of the Kursk-Belgorod mining complex. The potential for increasing the resource base of the complex is associated, firstly, with increasing reserves at existing deposits, and secondly, with the development of rich in iron new deposits.

The total production of the Kursk-Belgorod mining complex's enterprises amounted to 188.2 mln tons, which is about half of the production in Russia. At the same time, metallurgical enterprises located on the territory of the complex smelt less than a quarter of Russian steel. The lack of metallurgical capacities is compensated by the supply of iron ore products to the South Ural and West Siberian regions of Russia which meet with resource shortage and also abroad.

The large scale of the raw material base, the quality of iron ores, convenient horizons and simple operating conditions in comparison with other iron ore provinces' deposits, provide the Kursk-Belgorod mining complex with sustainable development and a prominent place not only in Russia, but also on international markets. The spread of the economic crisis caused by the coronavirus pandemic may lead to a decrease in the production activity of the country and the world's industry which will inevitably affect the demand for iron ore products. It can be expected that during the crisis, the mining of iron ore by the Kursk-Belgorod mining complex's enterprises will significantly decrease, however, rich resource and economic potential will allow a rapid increase in production capacity with the recovery of the country's economy.

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