

## CRM of Ukraine Database Supplements

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|-----------------|----------------------------|
| Mineral target: | <b>Balakhivske deposit</b> |
| Commodity:      | Graphite                   |

**Version: 31 Mar 2024**

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| <b>Project</b>                   | <b>101075609 — GSEU — HORIZON-CL5-2021-D3-02</b>                                                                                      |
| <b>Supplement Data</b>           |                                                                                                                                       |
| Supplement number:               | <b>MO.400003</b>                                                                                                                      |
| Dissemination level:             | <b>Public</b>                                                                                                                         |
| Supplement type:                 | <b>Description</b>                                                                                                                    |
| Work package:                    | <b>WP2: Critical Raw Materials, the International Centre of Excellence and United Nations Framework Classification (CRM-ICE-UNFC)</b> |
| Lead WP/ Supplement beneficiary: | <b>[EGS]</b>                                                                                                                          |

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| <b>Supplement status</b>         |                                   |
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Commodity: graphite.

Location: Petrovskiy District, Kirovograd Region. The nearest settlements are the village of Balakhivka (1 km southwest of the deposit) and the village of Noviy Starodub (2.3 km northwest of the deposit). The nearest railway stations are Korolivka (10 km north of the deposit), Oleksandriya (22 km northwest of the deposit) and Zhovti Vody (25 km southeast of the deposit).

Area : 71.2 hectares.

Exploration: the deposit was discovered by Kryvorizka GRE in 1979-1981. In 1986-1992, a preliminary exploration was carried out, based on the results of which the reserves of graphite ore within the project contour of the Southern section of Balakhivske deposit were calculated and approved by the DKZ of Ukraine (protocol No. 21 dated 01.21.1993) in amount (ore, thousand tons / graphite, thousand tons): B – 2234.0 / 145.0; C 1 – 13635.0 / 705.0; C 2 – 20973.0 / 960.0.

In 1993-2000 Kryvyi Rig KGP, according to the technical task of "Olexandriyavugillya" PO, detailed exploration of the Balakhivske deposit was carried out (protocol No. 61 dated November 30, 2000). On the southern flank of the deposit (Southern section), additional ground geophysical work was carried out, detailed drilling was performed, technological samples were selected and tested in experimental and industrial conditions. The results of these works confirmed the geological structure and distribution of the Southern ore body, where the main reserves and the highest quality ore are concentrated.

In 2021, a repeated geological and economic assessment of graphite ore reserves was carried out at the deposit (protocol of the DKZ of Ukraine No. 5420 dated 12.16.2020).

Geological characteristics. Geostrurally, the work area is located in the northern part of the West Ingulets fault zone, the West Ingulets structural-facies zone, which occupies an intermediate position between the Kirovograd and Middle-Dniprean blocks of the Ukrainian Shield.

In terms of geomorphology, the site of the works is located on a steppe plain with a slight slope to the southeast.

In terms of hydrogeography, the work area is the basin of the Ingulets River, which is characterized by a large number of rivers and creeks. The largest are: Beshka, Ovyanka, Verblyuzhka, Kamyanka and Balka Vodyana.

Metamorphic, ultrametamorphic and igneous rocks of the Archaean and Proterozoic age, which are covered by a cover of Cenozoic sediments, take part in the geological structure of the area.

In the geological structure of the deposit, crystalline rocks of the Rodionivska Suite of the Ingulo-Inguletska Series of the Lower Proterozoic age (PR1rd) take part. Rodionivska Suite (PR1rd) is represented by two sub-suites: lower and upper. The lower sub-suite (PR1rd1) is composed of white, light gray quartzites and quartzite-sandstones. The upper sub-suite (PR1rd2) is an ore-bearing pile. Thin (up to 35 m) lenses and layers of calciphyres are sometimes found in the lower part of the sub-suite. The rest of the body is a layer of graphite-bearing gneisses: biotite, graphite-biotite, amphibole-biotite, and sillimanite-biotite. Biotite and graphite-biotite gneisses make up 80% of all total reserves. Gneisses are dark gray in color, sometimes with a greenish tint, the rocks have a striped structure, fine- and medium-grained. The texture of gneisses is lepidoblastic or lepidogranoblastic, sometimes granoblastic, hypidiomorphous grains.

Two types of weathering crusts are widely developed on crystalline rocks - planar and linear. The thickness of the planar weathering crust varies from 0-3 m to 15-20 m. The zone of kaolins and disintegration (linear weathering crust) is developed to a depth of up to 200 m.

The granitization process is widely developed within the section of the Rodionivska Suite, the most characteristic manifestation of which is the formation of veins of pegmatoid and aplitoid plagioclase-microcline granites. At the same time, part of the graphite has a rheomorphic appearance: the scales of their accumulation increase and accumulate in the salbands of pegmatoid veins.

The genesis of the graphite ores of the Balakhivske deposit is metamorphic.

The Balakhivske graphite deposit is confined to the eastern limb of the East-Starodubaska brachyanticline, the core of which is composed of quartzites of the lower sub-suite, and the limbs of gneisses of the upper sub-suite of the Radionivska Suite. The deposit is a thick layer of monoclinaly lying rocks and consists of three parts: Northern, Central and Southern, which are separated from each other by sublatitudinal faults.

Within the deposit, a single body of graphite ore is divided into five ore bodies according to the conditions of occurrence and spatial location: eastern, western, southern, central and eastern parallel. According to the morphological type, the deposits of graphite ore belong to sheet-like. The southern ore body is adjacent to the western one, has a sublatitudinal strike and a southeast to south dip (40-50°). The thickness of this body ranges from 196 to 246 m.

Loose and semi-loose ores are distinguished by their physical and mechanical properties.

According to the mineralogical composition, the deposit is represented by three types of graphite ores:

- graphite-biotite gneisses (graphitic carbon content up to 20%);
- cataclased rocks with graphite, feldspar and quartz composition (graphite prevails with the size of scales from 0.05 mm to 0.1 mm, rarely more than 0.2 mm);
- quartz-clay rocks with graphite (graphite is found only in clay and quartz cement, the carbon content in the ore ranges from 3.2% to 11.9%).

As a result of the tests, it was established that all three types of ores belong to the same technological type. All grades of commercial graphite can be obtained from graphite ore: crucible graphite HT 1,2,3 GOST 4596-75 (concentrate with a carbon content of 93.34-94.60% with an ash content of 5.4-6.66%, yield of crucible graphite 7.45-8.18% with an ash content of 4.0-5.0%); fine elemental graphite GE-3, GE-4 GOST 7478-75 (concentrate with a carbon content of 24.84-28.20% with an ash content of 5.56-6.97%); elemental graphite large GE-20 and foundry GL GOST 5279-74 (concentrate with a carbon content of 63.62-67.71% with an ash content of 5.51-6.72%). After chemical enrichment of the float concentrate, it is possible to obtain all grades of low-ash graphite (ash content 0.2%).

The loose rocks are represented by the soil-vegetable layer, Quaternary loams and Neogene sands, with an average thickness of 40 m. Within the project pit, the reserves of the soil-vegetable layer that are suitable for reclamation in the amount of 256 thousand m<sup>3</sup> have been estimated (protocol No. 21, clause 3.7 dated 01.21.1993).

The hard rocks underlying the ore deposit – quartzite – can be used for the production of crushed stone products.

Hydrogeological conditions at the deposit are favorable for open-pit development. Within the Southern section of the Balakhivske deposit, two aquifers have been identified, which are the main source of water inflows to the quarry: non-pressurized in the Neogene sands and pressure in the fractured zone of crystalline rocks (head pressure - up to 20 m). Water inflows to the quarry are possible due to precipitation (up to 22.5 m<sup>3</sup>/h) and static reserves of underground water (up to 280 m<sup>3</sup>/h).

During the radiation-hygienic assessment of the mineral and host rocks, it was established that abnormal power intervals of 0.3-5.0 m with a radiation intensity of up to 20 PA/kg (sometimes up to 60 Pa/kg) make up 2.5% of the total length of ore sections, and have a schlieric character, mainly thorium-type activity and associated with radioactive minerals of pegmatites: zircon and monocyte. Their uneven distribution in the volume of the mineral can lead to high concentrations in the mined ore. It is recommended to carry out regular radiation control during operational work.

The deposit is assigned to the 2nd group according to the complexity of the geological structure of the deposits in accordance with the Classification of deposit reserves and forecast resources of solid minerals and is prepared for industrial development.

As of January 1, 2023, the deposit is being developed by Rozvitok Pobuzhya LLC.

The total amount of reserves: as of 01.01.2023, reserves of graphite ores are divided by categories, thousand tons: ore B+C 1 – 22297.0; C 2 – 20356.0.