



CRM of Ukraine Database Supplements

Mineral target:	Devladivske deposit
Commodity:	Nickel and cobalt ores

Version: 17 April 2024

Project	101075609 — GSEU — HORIZON-CL5-2021-D3-02
Supplement Data	
Supplement number:	MO.400009
Dissemination level:	Public
Supplement type:	Description
Work package:	WP2: Critical Raw Materials, the International Centre of Excellence and United Nations Framework Classification (CRM-ICE-UNFC)
Lead WP/ Supplement beneficiary:	[EGS]

Supplement status	
Endorsed (WP leader):	Guillaume Bertrand, BRGM
Supervised	Boris Malyuk, BRGM/GIU
Approved (Metadata Coordinator):	Oleksiy Likhosherstov, GIU
Author(s):	Affiliation:
Nataliya Kovalenko	GIU
Stella Shekhunova	IGS
Vitaliy Sukach	IGMOF
Maria Kurylo	UAG

Location: located in the Sofiivskiy district of the Dnipropetrovsk region on the northwestern outskirts of the Chervoniy Yar village in 7 km from the Devladove railway station and the Devladivske silicate-nickel deposit.

Degree of study: The deposit was explored by the Southern Ukrainian Expedition of the Ukrgeological Administration in 1954-1956. In 1956, a preliminary exploration was carried out, according to the results of which reserves at the deposit were approved by the decision of the State Committee of the USSR dated 09/20/1956 No. 1382.

Geological characteristics: Archaean and Proterozoic crystalline rocks and Neogene-Paleogene, Quaternary sediments take part in the geological structure of the deposit area. Crystalline rocks are represented by porphyry granites, plagioclase granites and migmatites of the Archean, peridotites and gabbro-peridotites of the Proterozoic. Nickel mineralization is confined to the weathering crust of peridotites and gabbro-peridotites, which form a dyke-like body with a steep dip (70-80°) cutting the Archean crystalline rocks.

The weathering crust is represented by zones of serpentized peridotites of variable strength, nontronites - with a thickness of 8.15 m, which contain nickel mineralization, and ochres - with an average thickness of 15-20 m, industrial iron ore, lightly alloyed with nickel.

Mining and geological section of the deposit:

Item No	Rock name	Depth of occurrence		Thickness, m
		from	to	
1.	loam	0.00	10.0	10.0
2.	Red-brown clays, dense, viscous, in the east in their sole - clays are green	10.0	28.0	18.0
3.	The sands are fine-grained, clayey, weakly cemented, with layers of clay in the east; watering is insignificant	28.0	48.0	20.0
4.	White, viscous clays (refractory raw materials)	48.0	56.0	8.0
5.	Gray layered clays	56.0	60.0	4.0
6.	Sandy-clay rocks with carbonaceous inclusions and layers of secondary kaolins (aquifer)	60.0	65.0	5.0
7.	Ochers are clayey rocks with deposits of brown ironstones (horizon of iron ores)	65.0	80.0	15.0
8.	Nontronites are loose clay rocks with rare siliceous inclusions (nickel ore horizon)	80.0	90.0	10.0
9.	Broken serpentized peridotites – massive fractured rocks (aquifer)	90.0	95.0	5.0
10.	Peridotites are massive coarse-grained rocks	95.0		

Nickel ores form 7 disconnected ore bodies. The latter consist of 2-4 horizontally lying ore beds, confined more to the upper zone of nontronites. The length of the most durable layers (repositories No. 1 and 4) is 1.2-1.3 km, width 200 m with an average thickness of 3.8-6.1 m. Other layers of the bodies are smaller. Their depth varies from 70 to 120 m.

Silicate ores, represented by loose clay rock of brownish-green color, the composition of which is dominated by nontronites, chlorites, vermiculites, kaolinites, hydroxides of iron, quartz, siderite, jefferisite with serpentine, containing nickel. The average nickel content in industrial layers varies from

1.06 to 1.24% and reaches 1.5-2% in individual wells. Cobalt is present as a concomitant component in the ores (the average content in the layers is 0.04-0.05%).

Nickel ores are directly, often through 4-5 meter layers of weakly mineralized rocks, covered by iron ores of the ocher zone. The latter form 4 bodies, which in plan coincide with the contours of nickel ore bodies. The largest of them (No. 1) has a length of 2.4 km and 200-250 m in width and a thickness of 1-27 m. The average thickness of the deposits varies from 2.8 to 11.5 m and they lie at a depth of 35-111 m from the surface. The average content of iron varies from 33.6 to 36.4%, nickel - 0.11-0.17%, cobalt - 0.02-0.14%.

Higher in the column, nickel and iron ores are overlain by Paleogene sand-clay sediments with a layer of refractory clays, Sarmatian sands, and Quaternary sand-clay sediments.

A layer of refractory clay with a thickness of 1-20 m lies horizontally and is exposed on an area of 32 km². Conditional clays have a thickness of 0.5-11.4 m, non-conditional layers - 0.4-7.5 m. Refractory clays lie at a depth of 50 m and are separated from the lower lying iron ores by an unproductive layer of clays and sands with a thickness of 1-15 m.

According to the results of laboratory studies, nickel ores are suitable for processing in mine furnaces into nickel matte and cast iron with extraction of 70% nickel and 93% cobalt; for reductive electrosmelting on ferronickel with a total extraction of nickel into rich ferronickel of 95% and cobalt - 93%. Iron ores are weakly doped with nickel-aluminous hydrohematite ores with a high content of alumina and silica (the ratio is close to 1:1) and can be processed without prior enrichment. Refractory clays are polymineral, with a predominant content of minerals of the kaolinite and montmorillonite group and a content of clay particles of 93-95%. Clays belong to the basic ones with Al₂O₃ content – 35-40% per calcined substance, iron oxide 1-3%, with refractoriness in the range of 1600-1730°. Clays are divided into four grades (I, II, III, PK) and are high-quality refractory raw materials suitable for the production of a wide range of refractory products.

Chemical composition of nickel ores

Components	Average content (%)				
	Body#1	Body #2	Body #3	Body No. 4	In general, by deposit
SiO ₂	36.32	44.76	46.34	43.33	42.69
Al ₂ O ₃	8.99	9.43	9.18	8.57	9.04
Fe ₂ O ₃	32.65	25.12	21.80	26.39	26.49
TiO ₂	0.68	0.65	0.72	0.67	0.68
CaO	1.47	1.29	2.22	1.45	1.36
MgO	7.21	7.75	7.78	7.65	7.59
NiO	1.59	1.47	1.36	1.33	1.48
CoO	0.06	0.05	0.05	0.05	0.05
Cr ₂ O ₃	1.32	1.17	1.11	0.95	1.14
CuO	traces	traces	traces	0.005	traces
P ₂ O ₅	0.04	0.04	0.05	0.07	0.05
SO ₃	0.24	0.15	0.34	0.06	0.19
LOI	10.91	8.58	9.24	9.97	9.67

Hydrogeological conditions are simple. Four underground water horizons have been identified in the Sarmatian and Buchach sands and in the weathering crust - the ochreous zone and weathered serpentinites; the estimated total water inflow into the future quarry will be no more than 198 m³/h.

The mining and technical conditions of the deposit are favorable for the open development of the deposit, the opening coefficient is 22.5 m³/t. The most appropriate is the combined development of nickel ores, iron ores, and refractory clays.

According to the conditions of occurrence, the nature of the distribution of useful components, and the scale, the Devladvivske deposit of silicate nickel belongs to group "b" of deposits of non-ferrous and liquid metals. It is recommended to continue the technological study of nickel ores .

As of January 1, 2023, the deposit is not being developed.

Estimation of resources/inventories. The stocks were approved by the decision of the Central Committee of the USSR (protocol dated September 20, 1956 No. 1382) in the amount of:

Category	Ore, thousand tons	Content, %			Metal, t	
		iron	nickel	cobalt	nickel	cobalt
Nickel ores						
A ₂ +B+C ₁	6,986.0	-	1.07-1.38	0.04-0.06	78,585	3,142
Iron ores						
B+C ₁	17,563	35.60-35.87	0.13-0.18	0.01-0.02	-	-
Refractory clays						
C ₁ +C ₂	252,754	-	-	-	-	-