Chemical Vertical Zonality in Silicate Nickel Deposit in Gllavica, Republic of Kosovo

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Abstract: In this paper is presented chemical vertical zonality in mineral deposit nickel silicate Gllavica that is located near to the airport of Pristina. In this study were included detailed geological research of the first phase and the second pahse in deposit. According to geological exploration is presented zonality in direction of the depth of the nickel silicate deposit. Geological exploration have appeared vertical profile by zones from the surface to the depth of the deposit. The content of nickel increases nontronite zone, according to the results shown in this prospecting zone the nickel mineralization reaches higher values in the zone nontronite - serpentinite.

Key words: Vertical zonality, exploration, Gllavica deposit, Ni-silicate, Kosovo.

1. Introduction

Kosovo is situated in the central part of the Balkan Peninsula. In the southwest, it is bordered by Albania, in the west by Montenegro, in the north and east by Serbia and in the southeast by Macedonia. The territory extends within longitudes 41°50'58" N and 43°15'42" N and within latitudes 20°01'30" E and 21°48'02" E [1].

Kosovo covers a surface area of 10,887 km². It is characterized by an average altitude of 800 m above, but shows considerable changes in relief and morphology of terrain (Fig. 1).

2. Nickel Exploration in Mineral Deposit in Gllavica

Exploration of silicate nickel ores in the territory of Kosovo date from 1958 which define the first occurrence of nickel minealization on Gllavica territory near the magnesite mine in Magura. In 1961 begin detailed research in the broad area of nickel silicate deposit. These detailed geological exploration

enabled Glavica deposit outline. [2, 3]. Exploration works in nickel deposit "Gllavica" were conducted in two phases. First phase of the research work was carried out from 1961 to 1997. The second phase of research was conducted during 2006 and 2007 [4]. Deposits ore body thickness varies from 2-32 m, the average thickness is about 11 m [3]. In the first phase of exploration, there were a total of 459 drillings and in the second phase were realized 192 exploration drillings with network 50 x 50 m (Fig. 2).

Fig. 1 Geographic map of Kosovo 1: 1,000,000.

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Fig. 2 Modelling of 2D drilling, source [4].

3. Geology of Mineral Deposit

Formations that make up this field are green shale Paleozoic, peridotites-serpentine, deposits of Pliocene and Quaternary. Deposit of Ni-silicate "Gllavica" is part massif of Golesh and lies in the south-eastern part of the massif [5]. Overall depth of the crust breaking rich in Ni reaches 60-80 m.

Deposit was formed in specific conditions during the formation of laterite crust disposition of ultramafic rocks. In mineral deposit "Gllavica" top to down direction is separated in these zones (Fig. 3):

- A-red clay zone;
- B-opal zone;
- C-nontronite clay zone;
- D-serpentine zone;

E-peridotites fresh zone.

Red clay zone (A). This zone is composed form clay yellowish to red colour containing fragments of opal.

Mineral represented in this area is goethite, and much less appear opal, quartz and halloysite. In the upper part of this zone is determined the presence of these elements (Fig. 4).

Characteristic of this part is to establish the composition of the local Co due to the appearance most of MnO, and Fe, and Ni composition is quite low. Characteristic of this profile is the beginning of increasing Ni composition of Mg. This part of the area made the transition to the higher parts of the area mineralized. The thickness of this zone varies from 5.1 m to 7.2 m; part of the area is altered.

Fig. 3 Schematic laterite profiles in the nickel silicate deposit of Gllavica.

Fig. 4 Distributions of elements in the clay zone.

Opal zone (B) is not a clear profile, it is developed in the upper parts of the deposit, but appears also in the lowest levels in the clay zone of nontronites, in-depth of deposit this zone closes [6]. This zone appears compact with fragments in composition of clay mineralized iron, iron hydroxide and manganese oxides. Chemical analysis of this zone are shown in Fig. 5.

This area is characterized by relatively high SiO₂, low composition Fe and very low MgO, Ni and Co. The thickness of this zone ranges from 1.0 m to 4.0 m. In crust of alteration hartzburgite are presented in the form of net or vein as opal and compact mass. Main component is opal; build about 80% of this area.

Nontronite zone (C) represents the largest

concentration area Ni (Fig. 6). Ni minerals are pimelite and nontronite. This area includes the central part of the deposit and represents the lower level to which has reached up to change hartzburgite and fresh peridotite in its entirety and have moved to altered crust products [7]. The area is built out of clay material nontronite with yellow colours close to that of the yellow-green in the lower parts containing impregnation and seam hydrosilicate Ni-pimelite. Percentage of goethite rises toward the surface and in the upper parts of this zone, nontronite fully assignable goethite and free silicon. In the lower secondary separated clinohryzotile along with pimelite, which affect the growth of MgO in low profile nontronite zone [8].

Serpentine zone (D) lies under the area of nontronite clay. These rocks are coloured in green, green to yellow to dark yellow. Alteration is made of the primary ingredients laundering processes surface initial stage where olivine and enstatite have become nontronite or serpentine [5]. Secondary products in this segregated area of quartz reef and opal amounts of magnesium secondary and hydration silicates of magnesium. Main minerals of this area are nontronite and serpentine. In smaller amounts are found minerals of goethite and hematite.

Fig. 5 Distributions of elements in the opal zone.

Fig. 6 Distributions of elements in the nontronite zone.

Microcrystalline quartz, partly opal and cristobalite are presented in the form of vertical veins that fill empty space of altered hartzburgite [8]. The main components of this area are magnesium legislation, sepiolite and β kerolite. Pimelite appear in the upper parts of this area and this greatly ore nickel mineralization.

This area is characterized by high values of MgO component (Fig. 7) which is associated with the appearance of magnesium transferred from the water during filtration in depth. Cobalt (Co) has decreased significantly and Ni is above the percentage of the metal taken for calculation of economic reserves ($\text{Ni} = 0.5\%$). The thickness of this zone is quite variable and ranges from 4.0 to 23.0 m.

This zone represents the footwall of the deposit where dominate dunite. In the upper part of this zone passes in the serpentinization peridotite where the process of alteration of primary components has a very low intensity and have been almost completely preserved in structure and composition [5].

In this area falls a content of SiO_2 and increasing the content of MgO components (Fig. 8), as a result of that

Fig. 7 Distributions of elements in the serpentinite zone.

Fig. 8 Distributions of elements in the peridotite zone.

presentation, fresh peridotites. Contents of Ni and Co in the area falls and appears only trace.

4. Geological Reserves in Mineral Deposit in Gllavica

The Republic of Kosovo is one of the influential states in the region in terms of Ni ore. In our country meet Ni mineral deposits but also exploitation and melting of Fe-Ni, which makes it quite easy and convenient as well as research exploitation [7, 8]. For this reason, our country would be reasonable to find reserves where cut of grade is less than 1% Ni and Fe -20%. Statistical data for Ni and other components for mineral deposit Gllavica according to data (Table 1) average distribution of Ni is very high 1.16% (Table 2).

5. Materials and Methods

To study in our paper we have used a large number of geological data of the first phase and second in exploration mineral deposit Ni silicate Gllavica. Sampling is taken by us settlement and drilling exploration of profiles. Chemical analysis and spectral-chemical are realized in experimental laboratory self mine and laboratory mines Trepça. Analyses were made in macro and micro elements. For the study of laterite areas, we have exploited elements that are typical laterite deposit (Tables 1 and 2).

6. Results and Discussion

The results presented in Table 1 and Table 2 is from the second phase deposit Gllavica show that have quantity and better quality than the first phase. This discussion is qualitatively different than the result of the second stage has a number of great and detailed geological researches in the fields. The study of this deposit according to the results (Table 2), presented shows that the average content of Ni for the entire deposit is 1.16%, for the production of today's Industries are high economic value.

Table 1 Geological reserves in Gllavica mineral deposit.

Geological reserves	Percentage (%)				Quantity	
	Ni	SiO ₂	Fe ₂ O ₃	Co	m ³	Ton
Total	1.02	51.70	22.63	0.04	7,227.15200	13, 156. 061

Table 2. Statistical parameters of the distribution of Ni metal and other components in Gllavica mineral deposit.

	Thickness (m)	Ni	SiO ₂	Fe ₂ O ₃	MgO	Co
Arithmetic average	16.54	1.16	52.07	21.52	10.66	0.04
Standard error	0.49	0.02	0.50	0.40	0.25	0.00
Median	14.80	1.12	52.01	20.21	10.07	0.03
Mode	12.50	0.95	48.56	14.25	8.00	0.02
Standard deviation	9.85	0.37	9.78	7.73	4.40	0.03
Variation coefficient	59	32	19	36	41	82
Kurtosija	-0.05	1.34	0.48	1.85	2.23	23.73
Asymmetry	0.57	0.73	-0.18	1.09	0.99	3.78
Rank	52.50	2.69	70.11	51.27	31.31	0.33
Minimum	0.50	0.02	5.69	9.48	0.00	0.00
Maximum	53.00	2.71	75.80	60.75	31.31	0.33
Amount	6,600.10	465.37	19,682.09	8,155.77	3,292.75	15.81
Number of drilling	399	400	378	379	309	380

7. Conclusion

According to the data presented in the paper for laterite profile to deposit Ni silicate shows legality according formation theoretical model of laterite deposits. In mineral deposit of Ni silicate Gllavica zonality is noticed quite clearly form lateritic profile. This zonality shows that we have a distribution of Ni, Co, Fe, MgO and SiO₂ which varies by area. Distribution of Ni, Co, Fe clay zone in the area opal have decrease and nontronite, serpentinite zone have increased content that Ni, Fe, Co and MgO. Geological profiles nontronite, serpentinite is main areas mineralized Ni silicate. In the area of fresh peridotite have high content of MgO and SiO₂ which are main components in the formation of rocks ultra basic that once also present foot wall part of the deposit.

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