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Nickel discretization and quality review in Gllavica mine, Kosovo

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Abstract

Purpose. Professional approach to mineral deposit evaluation and estimation of Ni is done by modeling the ore body presenting the interest zone to be exploited.

Methods. With the intensive development of professional software dedicated to solving mining problems and ore reserves, Gllavica mine has implemented Surpac v.6.2 software. This software makes it possible to evaluate and estimate mineral deposit of Ni in Kosovo.

Findings. Based on geological exploration, drilling and sampling It was possible to find the quality of the ore, the footwall and hanging wall contact with ore body. The ore grade was examined and determined in the case of longitudinal geological profiles using Surpac v.6.2 Software by digitizing each drilling hole based on a database which was created considering assay, collar and survey files.

Originality. The use of appropriate software, creation of databases according to the values acquired from the field research provides the best possible assessment argued in this paper.

Practical implications. Geological research provides safety during ore exploitation that must be continuous throughout the exploitation phase. Geological research excludes blocks that differ from other blocks in terms of ore quality, so discretization of the source has enabled us to find the real quality and quantity of ore by comparing it with the profile method.

Keywords: *mine, nickel, ore grade, exploitation, modeling*

1. Introduction

This study encompasses the two research stages of "Gllavica" source, which both in the sense of the resources assessment and the exploitation plan are related to each other not only by the physical proximity and geologic connection but also because a good exploitation plan requires a primary homogenization from the exploitation stage of the source [1].

The use of modern computer software in cases requiring the primary homogenization of the source has proven to be a strong modern tool in the hands of the operating engineer. Pursuant to the presented concept in the process of ore exploitation from this source it is planned to assess the blocks from the existing field - stage one over the 574 meters quota, and the ore blocks from the new field - the so called second stage under the 574 meters quota [1], [2].

It is important that mine planning is preceded by detailed geological research by determining the depth and thickness of the nickel ore body, the other geological units surrounding deposit.

By means of geological drilling, the clay intrusions inside the source are determined. Their clay intrusions create ore depletion ending the modernization phase [1], [3]. To correctly assess the quality and nickel reserves at the deposit, we apply advanced geostatistical methods in the assessment of the deposit by dividing (discrediting) the entire size of the mineral resource into 25×25 m mini-blocks.

The SURPAC Software is highly advanced and flexible in handling and solving various problems in surface and underground mines by enabling us to create real 3D models of ore bodies that are defined through deep geologic drills. With the SURPAC software a professional 3D engineering design can be prepared based on the study data and geologic materials based on the quality of metals in deep drill cores. Through the SURPAC, mine engineers complete the geological model legends, geological maps, exploitation plans and various geostatistical information. SURPAC enables direct communication with the Civil 3D AutoCAD software thus facilitating the engineers' job in modelling and creating real terrain topographies and creating various geological profiles.

SURPAC provides powerful features and assists mine engineers in assessing the quality of metals at the source and the correct production planning at optimum cost.

Deep geological drillings dedicated to each mini-block enables the creation of three main databases (files) in Surpac

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software: Assay.csv, Collar.scv and Surve. Csv [4], [5]. The Assay.csv file contains the source quality records for each meter of drilling depth, describes the lithology of the geological contacts that meet the drilling as well as the quality of the accompanying metals extracted through the drilling rigs. The Collar.scv file contains the total depth of each drill as well as the geological drilling coordinates, while the Surve file. csv contains the name of the drill, the depth of each drill, the drill bit as well as the drill azimuth. With the help of geodetic surveys of the terrain topography we apply the professional software AutoCAD Civil 3D, creating the terrain situation with isohypses, the calculation of the exploitable reserves and the geological ones. Surpac software and AutoCAD Civil 3D exchange information about the source from the same databases, enabling us to evaluate the source correctly with the most modern geostatistical methods, knowing the quality of the ores and the volume of the ore, as well as knowing all the geological conditions surrounding the source [1].

2. Materials and methods

2.1. Source description

The "Gllavica" source of nickel silicate ore is characterized by several favorable factors in relation to the ore exploitation, the most important being the drop and extent of ore bodies located in relatively shallow depths from the surface. on the other hand, the ore, the accompanying rock and the cover are characterized by the favorable geoengineering conditions [6]-[8].

The source is researched with a 25×25 meters drilling grid, and the second stage was initially researched with a 25×25 meters drilling grid, to move on to a widened grid of 50×50 m in the lower part of the source [1], [4]. The ore rich field of Gllavica mine is physical in the sense of the separating "border" between them, however, seen from the practical sense, the ore body is an entirety that belongs to the "breaking of the crust" with a defined extent and drop [4], [5], [9]-[11].

In the geological space of this stage, the research drills were initially conducted according to the 25×25 meters grid density, in a research length of 125 m, to then move to the 50×50 meters drilling grid. The field contour-geologic border is defined based on the results from the conducted drills [1], [4], [5].

2.2. Source presentation through isohypses

From the drills conducted in the field, 579 drills in total, with the use of the appropriate software the field quota data and their sorting and interpolation within the border have been processed, and the field isohypses have been presented in (Fig. 1). The highest point of the field included within the borders of the source is 632.78 meters.

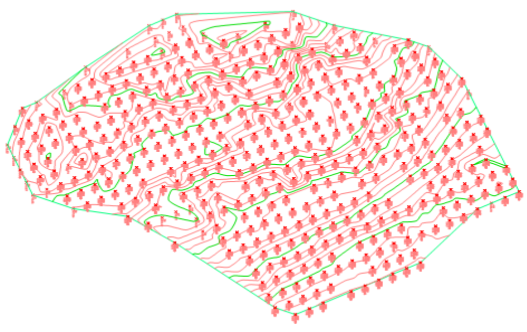

Figure 1. Isohypses of the initial configuration of the Gllavica mine area

Through the drills conducted in the field the upper contact of the ore body with the cover has been identified and this contact has been identified based on the zonal structural changes thus identifying the ore body ceiling (Fig. 2).

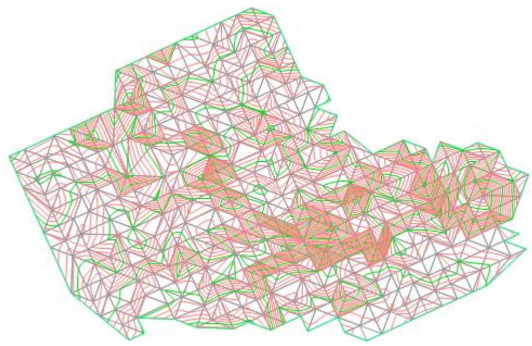

Figure 2. Isohypses of the ore body, hangingwall and footwall contact with the top soil

Similarly, from the field drills (508 drills in total), the zonal changes quota that determine the lower border of the minerals have been identified and this border presents the ore body floor (Fig. 3).

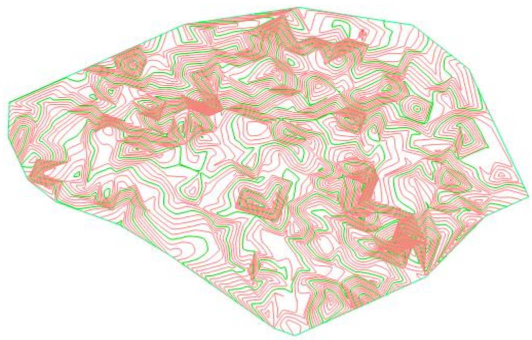

Figure 3. Ore body contact, footwall isohypses

Below, Figure 4 presents the nickel ore body, the source ceiling and floor contact.

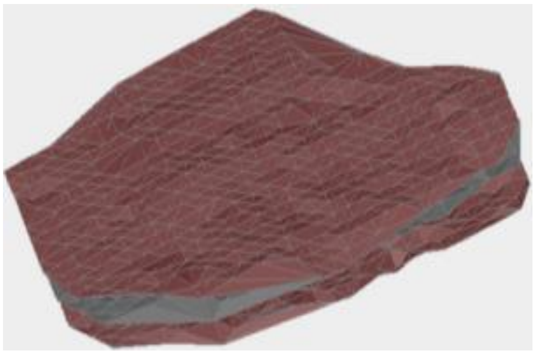

Figure 4. 3D presentation of the nickel mineral body between the geological contacts of the hangingwall and footwall

The use of modern computer software AutoCad Civil and specialized mining software SURPAC 6.2 has enabled the presentation of the condition of source position in Gllavica mine.

2.3. Nickel ore exploitation according to levels

The nickel ore exploitation in "Gllavica" mine is planned with the existing technology at the level height of 7 meters, whereas the ore will be transported with trucks to the existing deposit through the road created for ore transportation north of the mine, whereas the sterile is also transported by trucks and is deposited in the existing deposit. The ore and sterile exploitation dynamic and final condition for each level has been presented initially during the study in transverse west-east profile and the map the respective annex according to the level [11]-[13]. Each transverse profile contains the topography, drill number, ore body extent with the accompanying parameters defined by geological drills and other characteristics.

In this stage the following work stages according to block levels have been projected: first level 595 m quota, second level 588 meters quota, third level 581 meters quota and fourth level 595 meters quota (Fig. 5).

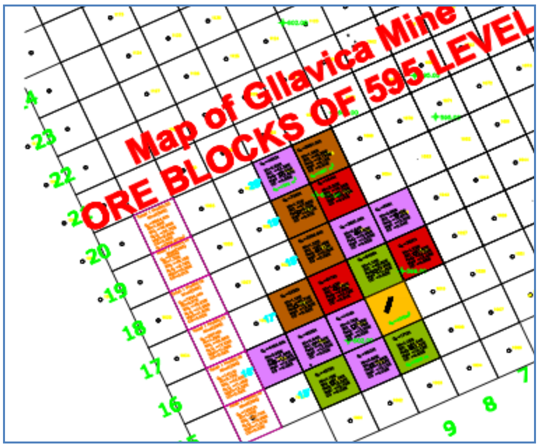

Figure 5. Blocks planned for extraction according to the nickel quality in each block

Figure 5 clearly shows the blocks and transverse profiles P-L 15-15` up to 20-20`, and (Table 1) contains the 595 meters block parameters according to the profiles.

Tables 2-4 show the blocks and transverse profiles including the ore and sterile amounts and quality in (%).

Average nickel percentage and accompanying components: Ni = 1.06%, SiO_2 = 50.25%, Fe_2O_3 = 19.00%, MgO = 15.14%, Co = 0.012%.

Average nickel percentage and accompanying components: Ni = 1.12%, SiO_2 = 46.22%, Fe_2O_3 = 14.20%, MgO = 11.40%, Co = 0.05%. Figure 6 show the entire mine zone divided in mini-blocks and the stretch of transverse profiles.

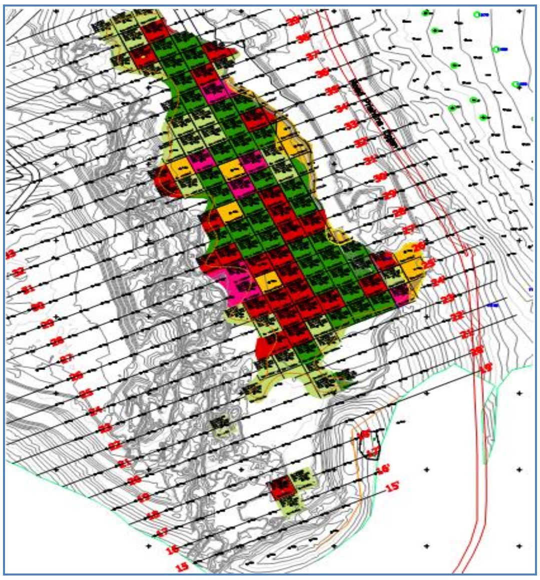

Figure 6. Transverse geological profiles throughout the research area including discrete blocks

Average nickel percentage and accompanying components: Ni = 1.36%, SiO_2 = 40.54%, Fe_2O_3 = 20.07%, MgO = 9.73%, Co = 0.037%. Average nickel percentage and accompanying components: Ni = 1.34%, SiO_2 = 46.60%, Fe_2O_3 = 23.31%, MgO = 12.06%, Co = 0.04%.

Taking into account the deep geological research and the division of the source into miniblocks, it has been possible to correctly ascertain and evaluate the shape of the nickel ore body, the thickness of the ore body and the thickness of the cover on the ore body as well as the natural intrusions of clay inside the nickel source [4].

Transverse geological profiles (profiles 16 to profiling 42) have reflected the prospective mineralization area with higher quality of nickel and other accompanying elements, also through transverse profiles it has been ascertained that the thickness of the top cover over the nickel source ranges from 4 to 18 m, while the nickel ore body is found in an irregular shape with a thickness of 4 to 40 m.

Based on the geological profiles and the size of the blocks 25×25 m, the volumes of nickel ore, the volumes of the clay cover have been calculated and the quality of nickel and other accompanying elements from profile 16 to profile 42 has been determined according to the terrain quotas 558, 581 and 574 m (Tables 1-4).

Table 1. Block parameters for the 588 meters level

Profiles	Ore amount, m³	Ore amount, t	Sterile amount, m³	Quality at source, %				
				Ni%	SiO_2	Fe_2O_3	MgO	CO
16	2843.749	5204.06	6218	0.62	43.67	9.48	27.18	0.01
17	9324.158	17063.21	0.0	1.60	48.08	28.24	25.25	0.02
18	4000.727	7321.33	0.0	1.01	42.86	12.65071	12.50	0.02
19	8709.552	15938.48	3009.0	1.02	41.61	25.14	11.47	0.01
20	19499.91	35684.83	2362	1.11	43.52	14.95	15.40	0.01
21	18867.61	34527.72	3443.0	0.99	43.52	20.13	15.67	0.01
22	15218.75	27850.32	1875	0.91	51.09	16.06	18.47	0.01
23	6950	12718.5	2187	1.24	48.54	22.63	17.59	0.00
24	6468.754	11837.82	2593	0.89	61.47	21.64	8.80	0.00
25	10718.75	19615.32	0.0	0.77	61.03	16.09	9.57	0.02
26	8031.246	14697.18	1562	0.77	61.03	16.09	9.57	0.02
27	5912.497	10819.87	4806	1.23	58.96	16.72	11.10	0.01
28	10181.25	18631.68	0.0	1.41	54.8	22.89	15.20	0.02
Total	126727	231910.3	28055	1.06	50.25	19.0	15.14	0.012

Table 2. Block parameters for the 581 meters level

Profiles	Ore amount, m³	Ore amount, t	Sterile amount, m³	Quality at source, %				
				Ni%	SiO_2	Fe_2O_3	MgO	CO
16	4375	8006.25	331.25	770.84	47.84	12.66	13.12	0
17	4375	8006.25	0	1.21	34.29	54.95	3.81	0
19	2212.5	4048.875	0	1.16	47.66	30.74	9.60	0.040
21	6000	10980	0	1.01	42.14	26.24	26.24	0.015
22	3312.5	6061.875	750	0.83	44.82	5.84	5.84	0.042
23	5312.5	9721.875	3750	0.97	45.13	22.64	19.92	0.031
24	25875.01	47351.26	21343	1.38	30.01	20.75	6.86	0.034
25	28062.5	51354.38	2287.5	1.12	33.73	18.00	14.55	0.024
26	18375	33626.25	687.5	1.40	34.42	27.10	12.25	0.040
27	13375	24476.25	5000	1.81	47.92	25.29	9.27	0.050
28	18750	34312.5	7000	1.30	46.13	19.44	12.70	0.060
29	19812.5	36256.88	12906.25	1.33	44.15	25.76	8.05	0.050
30	21125	38658.75	750	1.62	48.74	20.80	9.35	0.050
31	15312.5	28021.88	2750	1.19	30.04	21.76	6.90	0.040
32	16625	30423.75	10368.75	1.66	27.04	6.43	4.69	0.010
33	13937.5	25505.63	9312.5	1.23	58.77	19.37	6.42	0.090
34	17750	32482.5	5937.5	1.22	35.24	11.18	5.95	0.01
35	9375	17156.25	354.75	1.53	34.32	13.64	7.57	0.020
36	7937.5	14525.63	6131.125	1.75	49.18	25.86	8.07	0.05
37	5750	10522.5	3250	1.78	52.93	14.83	15.99	0.010
38	4687.503	8578.13	5000	1.57	34.64	22.56	10.66	0.040
39	7687.508	14068.14	1250	1.53	41.85	28.71	10.46	0.07
40	5470.973	10011.88	0.0	1.73	60.48	11.13	14.69	0.020
41	3262.809	5970.94	0.0	1.01	50.74	17.22	7.94	0.050
42	4943.65	9046.88	3625	0.78	56.45	14.44	14.97	0.010
Total	283702.5	519175.5	102785.1	1.36	40.54	20.07	9.73	0.037

Table 3. Block parameters for the 574 meters level

Profiles	Ore amount, m³	Ore amount, t	Sterile amount, m³	Quality at source, %				
				Ni	SiO_2	Fe_2O_3	MgO	CO
23	5438.197	9951.9	2812.5	0.92	43.74	16.52	12.5	0.01
24	5026.23	9198	0.0	1.04	45.64	13.02	13.5	0.02
25	17374.99	31796.24	1068	1.46	36.16	35.85	15.00	0.05
26	22862.28	41837.97	0.0	1.42	39.97	28.62	11.20	0.04
27	16356.25	29931.93	6142.75	1.62	38.85	34.08	9.80	0.06
28	15587.5	28525.12	29875	1.57	42.51	23.61	7.98	0.02
29	23640.62	43262.33	3625	1.20	48.8	24.08	15.6	0.05
30	18418.72	33706.26	3406.25	1.20	45.6	17.13	20.1	0.04
31	14018.71	25654.24	4025	1.60	45.4	29.81	7.50	0.05
32	20906.24	38258.42	3465.5	1.56	38.1	20.07	5.6	0.03
33	14100	25803	11106.5	1.21	56.2	22.79	13.2	0.01
34	14108.11	25817.84	11693.15	0.96	55.1	14.26	24.00	0.01
35	9249.989	16927.48	11802.7	1.24	54.2	17.93	7.80	0.01
36	9856.213	18036.87	7624.7	1.75	53.4	20.01	9.20	0.050
37	7681.831	14057.75	9924.9	1.40	48.1	21.86	10.2	0.05
38	12143.72	22223	3606.2	0.99	50.9	21.74	8.5	0.06
39	15855.03	29014.7	2487.5	1.23	50.1	21.35	15.2	0.05
40	12743.72	23321	3349.9	1.51	56.5	20.14	8.05	0.03
41	1999.945	3659.9	9005	0.76	54.7	21.46	7.09	0.01
42	5793.716	10602.5	0.0	0.92	55.8	16.80	8.5	0.02
Total	263162	481586.5	125020.60	1.23	46.60	23.31	12.06	0.04

Table 4. Exploitable reserves above the 574 meters level

Level	Sterile, m³	Ore, m³	Ore, s	Quality at source, %				
				Ni	SiO_2	Fe_2O_3	MgO	CO
595	8304	40755.98907	74583.46	1.12	46.22	14.2	11.40	0.02
588	36792	126726.9508	231910.3	1.06	50.25	19.0	15.14	0.01
581	102785.1	283702.45	519175.5	1.36	40.54	20.07	9.73	0.037
574	125020.6	263161.9945	481586.5	1.23	46.60	23.31	12.06	0.04
Total	272901.7	714347.39	1307256	1.25	44.82	20.74	11.64	0.03

Finally, during the exploitations, we have the maximal height of the level (floor) 7 meters, minimal 0 m, ore amount for the volume weight is 1.83 t/m^3 and the sterile-ore no balance/ore ratio is 0.38:1 m^3/m^3.

The exploitation duration depends on the amount of exploitable reserves and annual production plan, which is determined according to the following formula:

$$T = \frac{Q_{re}}{Q_{pv}} = \frac{1307256}{605793} = 2.15 \text{ years.} \quad (1)$$

For the annual production of 605793 t/year, this amount of exploitable reserves guarantees an exploitation period of 2.15 years.

Q_{re}, exploitable reserves, tons.

Q_{pv}, annual production, tons.

Average nickel percentage and accompanying components: Ni = 1.29%, SiO_2 = 44.82%, Fe_2O_3 = 20.74%, MgO = 11.64%, Co = 0.03%.

3. Results and discussion

In the mineral deposit of nickel silicate ore "Glavica" through Surpac software the deposit limit has been determined and reserves have been calculated according to the exploration drilling network 25×25 meters. The most important part here is to define the ore body geometry, evaluate the depth by drilling, inserting field data into the Surpac database i.e. assay, collar, and survey file as presented in Tables 5-7.

The Assay.csv database is presented in Table 5 describing the geological drilling (hole id) for each meter of depth of this drilling from the initial drilling quota (zero meters quota) to the final quota where the drilling at a depth of 33.2 m has been completed.

Table 5. Databases Assay.csv

Hole id	From	To	Lith_ general	Ni	Co	Fe	SiO_2	Mgo
10	0	1	CY	0.08	0.04	15.09	68.18	0.73
10	1	2	CY	0.04	0.03	11.87	68.44	3.59
10	2	3	CY	0.08	0.03	11.87	68.44	3.59
10	3	4	CY	0.13	0.03	11.87	68.44	3.59
10	4	5	CY	0.2	0.01	19.14	52.54	1.38
10	5	6	CY	0.31	0.01	19.14	52.54	1.38
10	6	7	CY	0.15	0.02	33.12	40.63	5.78
10	7	8.5	CY	0.2	0.04	15.09	68.18	0.73
10	8.5	10.5	CY	0.15	0.04	15.09	68.18	0.73
10	10.5	11.9	CY	0.29	0.01	19.14	52.54	1.38
10	11.9	12.9	CY	0.21	0.03	11.87	68.44	3.59
10	12.9	13.9	CY	0.27	0.02	10.53	63.01	16.89
10	13.9	14.9	CY	0.43	0.04	13.88	75.44	3.7
10	14.9	16.1	CY	0.25	0	14.66	77.6	0
10	16.1	18.1	CY	0.31	0.12	32.56	54.78	0.46
10	18.1	19.7	CY	0.08	0.01	19.14	52.54	1.38
10	19.7	20.7	CY	0.18	0.05	36.63	41.91	3.7
10	20.7	21.7	X	0.82	0.03	28.75	56.32	4.48
10	21.7	22.7	X	1.02	0.11	39.8	39.73	3.01
10	22.7	23.7	X	1.99	0.06	26.95	50.74	5.01
10	23.7	25	X	2.62	0.05	22.4	61.17	3.7
10	25	26.5	X	2	0.04	25.56	51.49	5.06
10	26.5	27.2	CY	0.18	0.05	36.63	41.91	3.7
10	27.2	31.9	X	1.74	0.08	44.09	42.52	0
10	31.9	33.2	SPN	0.35	0.05	33.44	39.42	5.24
11	0	5.9	CY	0	0.03	17.43	42.34	21.72
11	5.9	6.9	CY	0.24	0.02	12.26	40.87	16.6
11	6.9	7.9	CY	0.42	0.02	11.27	40.55	29.79
11	7.9	8.9	CY	0.6	0.02	15.42	40.16	22.32
11	8.9	10.9	CY	0.44	0.06	53.02	28.47	4.12
11	10.9	11.6	CY	0.51	0.07	57.59	21.55	2.16
11	11.6	12.3	X	1.05	0.06	45.16	33.44	4.24
11	12.3	13.3	CY	0.66	0.06	53.02	28.47	4.12
11	13.3	14.3	X	1.07	0.05	37.25	51.46	6.35

For each depth of each drill in the Assay.csv file are placed the depths of each geological layer, the depths of the location of the source as well as the quality of nickel and other metallic elements which are present in the nickel ore source (Table 5).

The Collar.scv database describes the maximum depth of each drill as well as the geodetic coordinates *x*, *y* and *z* for each geological drill (Table 6).

Table 6. Databases Collar.scv

Hole_id	Hole_path	Max_depth	X	Y	Z
10	Linear	33.2	7500948	4711746	560.21
11	Linear	35.3	7500993	4711767	553.22
13	Linear	59.2	7500878	4711659	544.41
21	Linear	74	7501084	4711808	498.59
25	Linear	28	7500791	4711729	576.83
26	Linear	29.5	7501144	4711617	588.4
29	Linear	32	7501018	4711833	545.03
30	Linear	70	7501064	4711854	498.52
31	Linear	55	7500857	4711704	547.89
37	Linear	57	7501039	4711787	526.22
68	Linear	50.5	7500938	4711467	558.78
69	Linear	43.5	7500984	4711487	554.58
77	Linear	35	7500840	4711862	568.1
83	Linear	45	7500955	4711611	554.72
107	Linear	24	7500770	4711774	580.62
108	Linear	43	7500952	4711858	541.89
1001	Linear	10.8	7500906	4711177	609.93
1002	Linear	10	7500929	4711187	606.59
1003	Linear	13.4	7500951	4711198	613.19
1004	Linear	13.3	7500974	4711208	610.17
1005	Linear	22	7500997	4711218	596.02
1007	Linear	24	7500986	4711241	600.98
1008	Linear	44	7500964	4711231	577.3
1009	Linear	50	7500941	4711220	574.49
1010	Linear	34	7500918	4711210	582.6
1011	Linear	27.4	7500895	4711200	593.84
1012	Linear	12.3	7500873	4711189	598.6
1014	Linear	7	7500839	4711201	603.55
1015	Linear	13.5	7500862	4711212	601.65
1016	Linear	32	7500885	4711222	584.5
1017	Linear	30	7500908	4711233	590.84
1018	Linear	41.3	7500930	4711243	582.36
1019	Linear	62	7500953	4711254	557.81
1020	Linear	20	7500976	4711264	596.62
1021	Linear	20	7500999	4711274	591.18
1022	Linear	23	7501021	4711285	587.84
1025	Linear	29	7501011	4711307	590.37

The Survey.scv database describes all geological drilling specifying the name of each drill (Hole ID), their depth, drilling angle and drilling azimuth (Table 7).

Using Survey.scv, Collar.scv and Assay.csv databases by applying computer software we have managed to discretize (divide into mini-blocks) the source according to the real state in which the source is located.

After creation of excel database for 3D modeling purposes the ore body of employing Surpac software as shown in (Figs. 7 and 8). In (Fig. 8) is shown the ore body and is clearly seen the contact between footwall and hanging wall surrounding the ore body. The minerals thickness at the source ranges from 2-32 meters, the average thickness is about 11 meters. The source was formed in specific conditions during the formation process of the lateritic crust of the ultrabasic rocks' alienation. The following zones are distinguished in the "Gllavica" source in the downward direction (the source stratigraphy): the red to yellow clay zone, siliceous-opal zone, nontronite clay zone, serpentinized and nontronitized harzburgite zone, and fresh peridotites zone.

Table 7. Databases Survey.scv

Ndx	Hole-Id	Depth	Dip	Azimuth
1	10	33.2	-90	0
2	11	35.3	-90	0
3	13	59.2	-90	0
4	21	74	-90	0
5	25	28	-90	0
6	26	29.5	-90	0
7	29	32	-90	0
8	30	70	-90	0
9	31	55	-90	0
10	37	57	-90	0
11	68	50.5	-90	0
12	69	43.5	-90	0
13	77	35	-90	0
14	83	45	-90	0
15	107	24	-90	0
16	108	43	-90	0
17	1001	10.8	-90	0
18	1002	10	-90	0
19	1003	13.4	-90	0
20	1004	13.3	-90	0
21	1005	22	-90	0
22	1007	24	-90	0
23	1008	44	-90	0
24	1009	50	-90	0
25	1010	34	-90	0
26	1011	27.4	-90	0
27	1012	12.3	-90	0
28	1014	7	-90	0
29	1015	13.5	-90	0
30	1016	32	-90	0
31	1017	30	-90	0
32	1018	41.3	-90	0
34	1019	62	-90	0
35	1020	20	-90	0
36	1021	20	-90	0
37	1022	23	-90	0
38	1025	29	-90	0
39	1026	33	-90	0

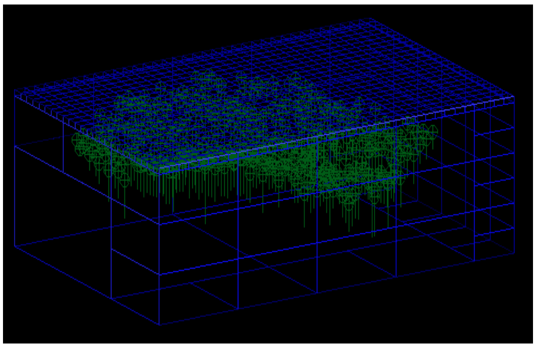

Figure 7. Geological drilling with different depths in each descreted block meeting the ore shale and geological contacts

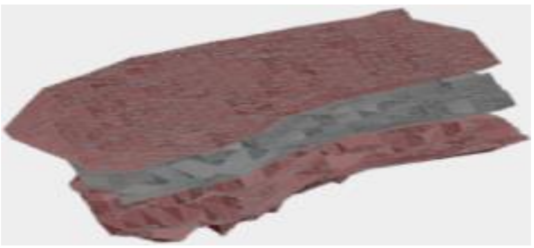

Figure 8. The definition of the nickel ore body layer is presented in gray and is located between the two clay layers – the ceiling contact and the floor contact

The databases were organized in Microsoft Excel by constructing tables with such structures so that they would be more useful for easier processing by the appropriate software. With the appropriate software first the data was processed, the isohypses of the field surface, isohypses of the ore ceiling and isohypses of the floor, profile construction, blocks and calculation of reserves.

After managing to divide the Gllavica source in mini blocks we can mix the blocks and at the same time we have tracked their exploitation and compliance of the data with the situation in the field. From the practical sense of the presentations of reserves and resources of polymetallic ore, it is of interest to have a table presentation of the ore amount (tonnage) on one side, and the quality on the other side.

4. Conclusions

The discretization of nickel source in 25×25 m and 50×50 m mini blocks, through deep geological drills has professionally enabled the correct assessment of the silicate ore quality in the entire source. Geological drills of each block have defined the ceiling and floor contacts of the ore body and have also defined the phenomena of the interposition of clay layers within the ore body.

Through transverse geological profiles the surface nickel exploitation intensity according to 595, 588, 581 and 574 m block levels has been addressed with special scientific dedication.

During the projection (study) phase the average nickel and accompanying components percentage was defined (assessed) in each level starting from 595 m: Ni = 1.12%, SiO_2 = 46.22%, Fe_2O_3 = 14.20%, MgO = 11.40%, Co = 0.05%; 588 m level: Ni = 1.06%, SiO_2 = 50.25%, Fe_2O_3 = 19.00%, MgO = 15.14%, Co = 0.012%; 581 m level: Ni = 1.36%, SiO_2 = 40.54%, Fe_2O_3 = 20.07%, MgO = 9.73%, Co = 0.037%, and 574 m level with the following accompanying components: Ni = 1.34%, SiO_2 = 46.60%, Fe_2O_3 = 23.31%, MgO = 12.06%, Co = 0.04%.

Based on the ore reserves of 1307256.00 tons and production demands of 605793 [t/year] the mine longevity is expected to be 2.15 years, and the average nickel and accompanying components percentage in the entire source is: Ni = 1.29%, SiO_2 = 44.82%, Fe_2O_3 = 20.74%, MgO = 11.64%, Co = 0.03%.

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Дискретизація та оцінка якості нікелю на шахті "Главиця", Косово

Р. Зекірі

Мета. Моделювання геологічної будови рудного тіла, що представляє промисловий інтерес для високоточної якісно-кількісної оцінки родовища нікелю на шахті "Главиця".

Методика. З огляду на інтенсивний розвиток професійного програмного забезпечення в області вирішення завдань гірничорудної промисловості, на шахті "Главиця" була використана програма Surpac v.6.2, яка дозволяє провести якісну та кількісну оцінку покладів нікелю в Косово. Використовувалися дані дослідницьких бурових робіт зі щільністю сітки 25×25 метрів на довжині 125 м, а потім сітка буріння склала 50×50 метрів.

Результати. Ґрунтуючись на даних геологічної розвідки, буріння та взяття зразків породи, було визначено якість руди в лежачому і висячому боках рудного покладу. За допомогою Surpac v.6.2 був досліджений клас руди в контексті поздовжнього геологічного профілю, для чого дані по кожній пробуреній свердловині були оцифровані та перетворені у файли для кількісного аналізу зразків, файли для знаходження мінімуму/максимуму і маркшейдерські файли. Визначено очікуваний термін служби рудника – 2.15 років з урахуванням запасів руди 1.307 млн т і рівня виробничих потреб в 605.7 тис. т/рік, а також встановлено середній відсоток нікелю і супутніх компонентів у родовищі, який становить: Ni = 1.29%, SiO_2 = 44.82%, Fe_2O_3 = 20.74%, MgO = 11.64%, Co = 0.03%.

Наукова новизна. Надана високоякісна оцінка родовища нікелю в умовах шахти "Главиця" на основі застосування адекватного програмного забезпечення, створення баз даних у відповідності зі значеннями, отриманими при натурних геологічних вимірах.

Практична значимість. Геологічна розвідка забезпечує безпечну розробку рудників протягом всього періоду їх експлуатації і дозволяє відокремити породні блоки, які відрізняються від інших в плані якості руди. Таким чином, дискретизація покладу дозволила нам оцінити реальну якість і кількість руди в порівнянні з даними, отриманими методом профілізації.

Ключові слова: *рудник, нікель, вміст у руді, розробка, моделювання*

Дискретизация и оценка качества никеля на шахте "Главица", Косово

Р. Зекири

Цель. Моделирование геологического строения рудного тела, представляющего промышленный интерес для высокоточной качественно-количественной оценки месторождения никеля на шахте "Главица".

Методика. Учитывая интенсивное развитие профессионального программного обеспечения в области решения задач горнорудной промышленности, на шахте "Главица" была использована программа Surpac v.6.2, которая позволяет произвести качественную и количественную оценку залежей никеля в Косово. Использовались данные исследовательских буровых работ с плотностью сетки 25×25 метров на длине 125 м, а затем сетка бурения составила 50×50 метров.

Результаты. Основываясь на данных геологической разведки, бурения и взятия образцов породы, было определено качество руды в лежачем и висячем боках рудной залежи. При помощи Surpac v.6.2 был исследован класс руды в контексте продольного геологического профиля, для чего данные по каждой пробуренной скважине были оцифрованы и преобразованы в файлы для количественного анализа образцов, файлы для нахождения минимума/максимума и маркшейдерские файлы. Определен ожидаемый термин службы рудника – 2.15 лет с учетом запасов руды 1.307 млн т и уровня производственных потребностей в 605.7 тыс. т/год, а также установлен средний процент никеля и сопутствующих компонентов в месторождении, который составляет: Ni = 1.29%, SiO_2 = 44.82%, Fe_2O_3 = 20.74%, MgO = 11.64%, Co = 0.03%.

Научная новизна. Дана высококачественная оценка месторождения никеля в условиях шахты "Главица" на основе применения адекватного программного обеспечения, создание баз данных в соответствии со значениями, полученными при натурных геологических измерениях.

Практическая значимость. Геологическая разведка обеспечивает безопасную разработку рудников в течение всего периода их эксплуатации и позволяет отделить породные блоки, которые отличаются от других в плане качества руды. Таким образом, дискретизация залежи позволила нам оценить реальное качество и количество руды в сравнении с данными, полученными методом профилизации.

Ключевые слова: *рудник, никель, содержание в руде, разработка, моделирование*