Посебноизданиена
Geologica Macedonica,
Nō.5

МАКЕДОНСКО ГЕОЛОШКО ДРУШТВО - Скопје, 1952

ЧЕТВРТИ КОНГРЕС
на
Геолозите на Република Северна Македонија

ЗБОРНИК НА ТРУДОВИ

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Охрид, 2021

Посебно издание на
Geologica Macedonica,
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Струга, 2021

Издава: Македонско геолошко друштво – Скопје, 1952

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Македонско геолошко друштво Скопје 1952

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OVERVIEW OF THE NATURAL PARAMETERS FROM THE GEOLOGICAL-ECONOMIC ASSESSMENT OF THE ORE DEPOSIT BALTAŠNICA, ORE FIELD SASA

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A b s t r a c t: The results of the latest research on the Pb-Zn ore deposit Baltašnica, were an incentive to make a calculation of some important techno-economic parameters, which would define the economic type of this mineralization. Namely, the ore-bearing degree in these types of ore mineralization is variable, but the calculation of certain levels and of different drill holes gives a more realistic overview of the variable distribution of mineralization within the ore bodies. The calculated ore-bearing coefficient of the sum of lead and zinc is 0.42%, which means that in the boundaries of the ore bodies 58% of the mass has contents under 4.0% Pb + Zn. The calculated value of the coefficient of variation (V) for lead is 89.30% and for zinc 104.13%, values that are in the range of 85-120%, which shows that these ore bodies belong to the second group and the second subgroup of lead-zinc deposits with medium even mineralization. The average contents of lead, zinc, copper, and silver were determined at 2.96% Pb, 1.79% Zn, 0.089% Cu and 15.97 g/t Ag. The minimum economic content (MEC) in the ore deposit Baltašnica, represented by this type of mineralization, was established at 4.0116% Pb. In a similar way, the cutoff grade of lead was also calculated, which showed a value of 2.8879% Pb. The value of the monometal of lead was also calculated, in which the influence of the zinc and the silver presented in the ore is included. The calculated lead monometal, which is 5.6761%, is a solid base for a profitable exploitation of these poor lead-zinc ores. The calculated ore reserves within this ore deposit are 4.5 Mt of ore and the projected life of the mine is 15 years.

Key words: Baltašnica, natural parameters, lead, zinc, silver

ПРЕГЛЕД НА НАТУРАЛНИТЕ ПАРАМЕТРИ ОД ГЕОЛОШКО-ЕКОНОМСКАТА ОЦЕНА НА РУДНОТО НАОЃАЛИШТЕ БАЛТАШНИЦА, РУДНО ПОЛЕ САСА

А п с т р а к т: : Резултатите од најновите истражувања на Pb-Zn рудно наоѓалиште Балташница, беа потик да се направи пресметка на некои важни техно-економски параметри, кои би го дефинирале економскиот тип на оваа минерализација. Имено, степенот на рудоносност во овие типови на рудна минерализација е променлив, но пресметката на определени нивои и на различни истражни дупчотини дава по реален преглед на променливата распределба на минерализацијата во рамките на рудните тела. Пресметаниот коефициент на рудоносност на збирот на олово и цинк изнесува 0,42%, што значи дека во границите на рудните тела 58% од масата има содржини под 4,0% Pb+Zn. Пресметаната вредност на коефициентот на варијација (V) за олово е 89,30% а за цинк 104,13%, вредности кој се во рангот од 85-120%, што покажува дека овие рудни тела припаѓа во втората група и втората подгрупа на оловно-цинкови наоѓалишта со средно рамномерно орудунување. Просечните содржини на олово, цинк, бакар и средбро беа утврдени на 2,96% Pb, 1,79% Zn, 0,089% Cu и 15,97 g/t Ag. Минималната економска содржина (MEC) во рудното наоѓалиште Балташница, предстaвено со ваков вид на минерализации, беше утврдена на 4,0116% Pb. На сличен начин беше пресметана и граничната содржина на олово, која покажа вредност од 2,8879% Pb. Исто така беше пресметана и вредноста на монометал на олово, во која е вклучено влијанието на цинкот и среброто присутни во рудата. Пресметаниот оловен монометал кој е 5,6761% преставува цврста основа за профитабилна експлотација на овие сиромашни оловно цинкови руди. Пресметаните рудни резерви во рамките на ова рудно наоѓалиште се 4,5 Mt на руда и проектиран животен век на рудникот од 15 години.

Клучни зборови: Балташница, натурални параметри, олово цинк, сребро

INTRODUCTION

From a geological and structural aspect, the Pb-Zn ore deposit Baltašnica belongs to the Sasa-Toranica ore region or the Osogovo ore region. This ore region lies entirely in the Serbian-Macedonian massif and according to its basic metallogenetic features is one of the largest and most potential ore regions within the metallogenetic zone Besna Kobila-Osogovo-Thassos. The Baltašnica deposit is located in the Eastern part of North Macedonia, 14-17 km NW of Makedonska Kamenica, near the state border with Bulgaria. The ore deposit is at an altitude of 1450 m to 2025 m. The remains of old mining and metallurgy (old tools, slags, etc.) are visible at the ore deposit Baltašnica. Data for lead-zinc mineralization and occurrences in the Baltašnica ore deposit are presented in the works of Pendzerkovski (1952, 1964), Bogoevski (1964), Djordjevic (1977), Aleksandrov (1979, 1986, 1989, 1992), Gjorgiev (2019) and others.

GEOLOGICAL CHARACTERISTICS

In the geological build of the ore deposit Baltašnica, metamorphic and magmatic rocks generally participate. Both are not unambiguous, i.e. they include rocks of different origins and ages. Thus, the metamorphic rocks are represented by high and low metamorphic representatives, and the magmatic rocks by intrusive and effusive rocks (Figuee 1).

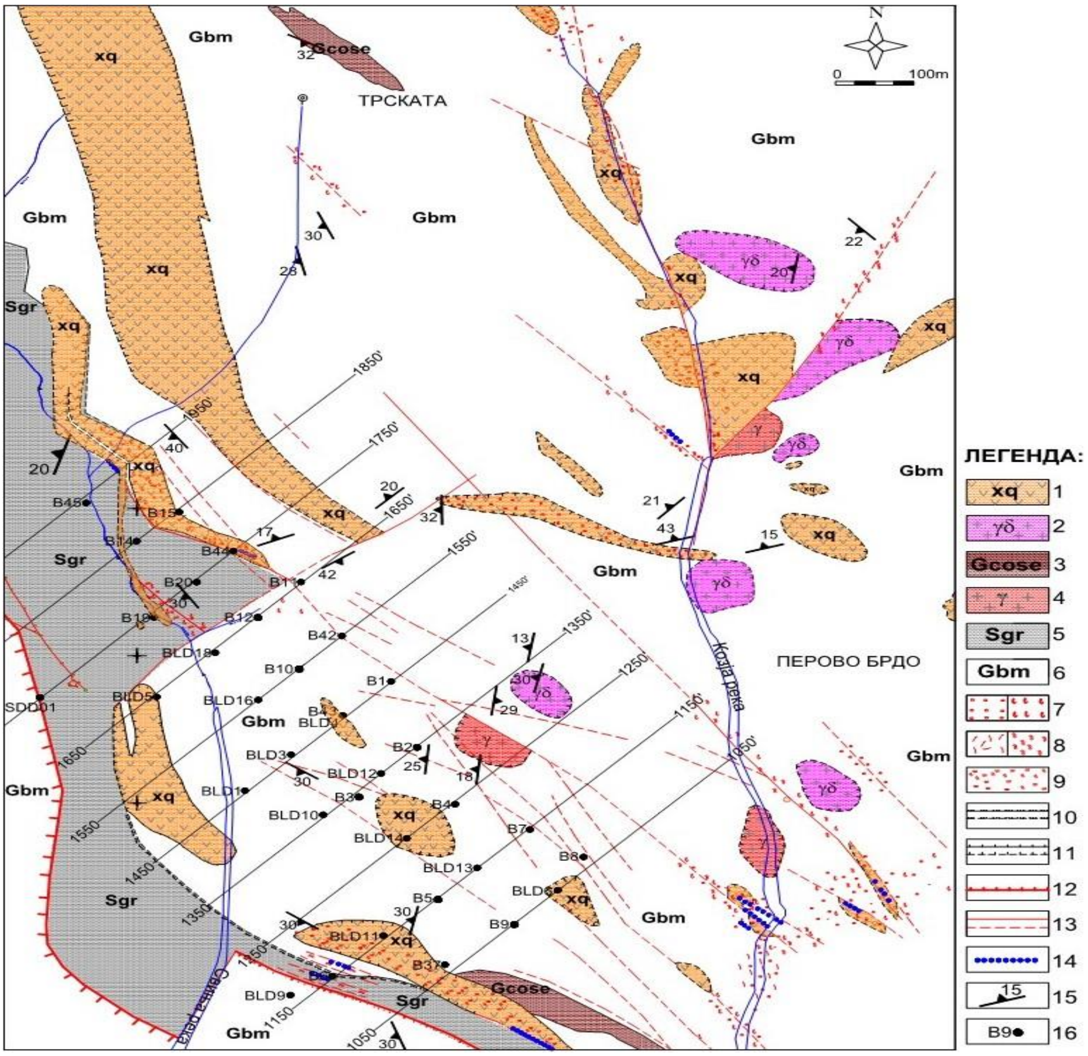

Fig. 1. Geological map of the Baltašnica ore deposit (modified, according to Alexandrov, 1992).
1) Quartzlatite-dacite-lamprophyre; 2) Granodiorite; 3) Chlorite-sericite gneiss; 4) Granite-plagiogranite; 5) Quartz graphite schist; 6) Muscovite-biotite gneiss; 7) Pyritization and limonization; 8) Silification and kaolinization; 9) Propylitization; 10) Transgressive geological boundary (determined and assumed); 11) Intrusive boundary (determined and assumed); 12) Cover forehead; 13) Fault (determined and assumed); 14) PbS-ZnS mineralization; 15) Elements on drop of foliation; 16) Drill hole

The lead-zinc mineralization is spatially connected with fault structures with the stretching direction of 319–325°, with a decline towards the SW (45–60°). They are most often located in the biotite and chlorite-sericite gneisses, and subordinately in the other lithological members (Figure 2). Quite rarely in the Baltašnica ore deposit skarn-metasomatic mineralization also occurs, where adequate conditions for formation for that existed. The ore is formed by filling the empty spaces within the fault structures and around them, regardless of the environment in which they are manifested, while completely subordinated and metasomatical in rhodonite-garnet skarns (Alexandrov, 1992).

Morphologically, the ore bodies have a vein shape; quite often they are with surrounding impregnations, and with greater intensity in the roof parts, and ore bodies with line-stockwork shapes also occur. The strength of the ore veins ranges from 0.2 to 2.0 m, while of the line-stockworks it is from 1.0–40.0 m.

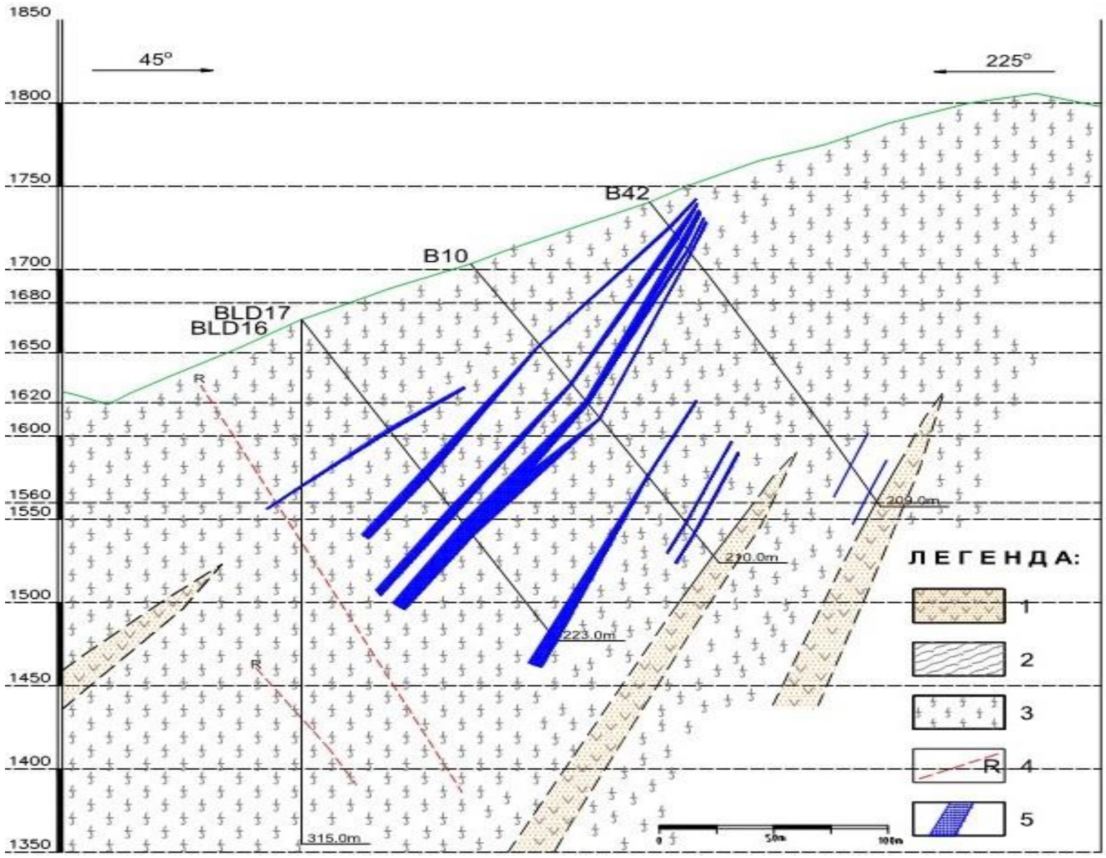

Fig. 2. Transverse profile 1550-1550', Baltašnica ore deposit (Gjorgiev et al., 2019).
1) Quartzlatite-dacite-lamprophyre; 2) Quartz graphite schist, 3) Muscovite-biotite gneiss; 4) Fault (assumed); 5) Pb-Zn ore veins with surrounding impregnations.

MINERAL COMPOSITION

Galena and sphalerite are the leading and at the same time the most important ore minerals for possible future production of lead and zinc in the ore deposit Baltašnica. Permanent followers of the basic ore minerals appear as: chalcopyrite, pyrite, marcasite, and partly pyrotine, aikinite, bismuthine, terardite, tennantite, freibergite, stephanite, native gold, native silver, bornite, chalcocite, etc. (Aleksandrov, 1992).

TECHNO-ECONOMIC PARAMETERS

In this chapter the main parameters of the techno-economic assessment of the Baltašnica ore deposit are presented, which unequivocally indicates the possibility for a productive exploitation of the lead-zinc ore from this special deposit and the possibility to make a profit. Here are given the results from the calculations of: the ore-bearing coefficient, the coefficient of variation, the average concentrations of major ore metals (Pb, Zn, Cu and Ag), the minimum economic content, and the cutoff grade.

Ore-bearing coefficient. - The ore-bearing coefficient defines the ratio between the total mineralized space in the contoured ore bodies and the represented sterile parties (content under the limit of 4.0% Pb + Zn) within the ore bodies. In the ore deposit Baltašnica, from 10 exploration profiles with a total of 38 drill holes and 231.1 m of mineralized surface, 97.4 m are mineralized with over 4.0% Pb + Zn, while 133.7 m have mineralization under the limit of 4.0% Pb + Zn, but significantly above Clark values. With the formula given below, the above-mentioned coefficient is calculated:

$$K_{r(\mathrm{Pb+Zn})} = \frac{m_1}{m_2} = \frac{97{,}4}{231{,}1} = 0{,}42$$

where:
K_r – Ore-bearing coefficient
m_1 – Productive interval (mineralized area >4.0 % Pb+Zn)
m_2 – Total mineralized interval

The ore-bearing coefficient of the sum of lead and zinc at the drill holes in the Baltašnica ore deposit varies in the range of 0.00 to 1.00, while along the exploration profiles it varies in the narrower range of 0.20 to 0.56. The calculated ore-bearing coefficient of the sum of lead and zinc is 0.42%, which means that in the boundaries of the ore bodies, 58% of the mass has contents under 4.0% Pb + Zn.

Variation coefficient. - This coefficient defines the spatial distribution of the useful mineral components in the ore deposit, i.e., the equivalence of the concentration of the useful mineral components in the ore bodies. In the case of the Baltašnica ore deposit, 38 exploratory drill holes have been drilled, which defines the ore bodies. From those 38 exploratory drill holes, 291 samples have been taken, which have defined average contents of Pb, Zn, Cu and Ag. The basic parameters for calculating the coefficient of variation for lead and zinc in the Baltašnica ore deposit have been taken from all 38 exploratory drill holes (Table 1).

First the average content of lead and zinc is calculated, as given below:

$$\bar{C}_{Pb} \cdot \frac{\sum C_{Pb}}{N} = \frac{958{,}651}{291} = 3{,}2943\%$$

$$\bar{C}_{Zn} = \frac{\sum C_{Zn}}{N} = \frac{550{,}7662}{291} = 1{,}8927\%$$

Where:
N – Total number of samples
C_{Pb} – Average lead concentration (Pb%)
C_{Zn} – Average zinc concentration (Zn %)

Then, the medium square deviation and the coefficient of variation are calculated, as given below:

$$\delta_{\mathrm{Pb}} = \sqrt{\frac{\sum X^2_{\mathrm{Pb}}}{N-1}} = \sqrt{\frac{2509{,}95}{290}} = \sqrt{8{,}655} = 2{,}9419$$

$$\delta_{\mathrm{Zn}} = \sqrt{\frac{\sum X^2_{\mathrm{Zn}}}{N-1}} = \sqrt{\frac{1126{,}43}{290}} = \sqrt{3{,}8842} = 1{,}9708$$

where:
$\sum X^2_{Pb}$ – Sum of square deviations from average values for Pb
$\sum X^2_{Zn}$ – Sum of square deviations from average values for Zn
δ_{Pb} – Medium square deviation for Pb
δ_{Zn} – Medium square deviation for Zn

$$V_{\mathrm{Pb}} = \frac{\delta_{\mathrm{Pb}} \times 100}{\bar{C}_{\mathrm{Pb}}} = \frac{2{,}9419 \times 100}{3{,}2943} = \frac{294{,}194}{3{,}2943} = 98{,}30\%$$

$$V_{\mathrm{Zn}} = \frac{\delta_{\mathrm{Zn}} \times 100}{\bar{C}_{\mathrm{Pb}}} = \frac{1{,}9708 \times 100}{1{,}8927} = \frac{197{,}08}{1{,}8927} = 104{,}13\%$$

where
V_{Pb} – Variation coefficient for Pb
V_{Zn} – Variation coefficient for Zn

The value of the coefficient of variation for lead is 89.30%, which indicates medium even mineralization. The value of the coefficient of variation for zinc is 104.13%, which also indicates medium even mineralization. According to that, the Baltašnica deposit belongs to the second group and the second subgroup of lead-zinc deposits, in accordance with the rulebook for classification and categorization of the reserves for solid mineral resources no. 53/1973, Official Gazette of SFRY.

An average concentration of useful component(s). - The average concentration of useful component(s) is the average presence of one or more components within the ore bodies. With the method of vertical parallel profiles for calculating the ore reserves in the Baltašnica ore deposit, it has been determined that for the calculated C1 category of reserves, the average concentrations of the useful components are 2.96% Pb, 1.79% Zn, 0.089% Cu and 15.97 g/t Ag.

In addition to these basic useful components that are taken in the calculation procedure and which in future will be treated as basic useful components with commercial value, in the ore deposit Baltašnica there are accompanying useful components that have their economic value, but their valorization should be requested in the metallurgical processing. Here as accompanying components especially interesting are the following: Cd (100-2000 ppm Cd can be found in the ore), Bi, In and other.

T a b l e 1

Basic parameters for calculating the variation coefficient for lead and zinc in the Baltašnica ore deposit

Profile	Borehole	N	C_{Pb}^{-} (%)	Σx_{Pb}^2	δ_{Pb}	V_{Pb} (%)	C_{Zn}^{-} (%)	Σx_{Zn}^2	δ_{Zn}	V_{Zn}(%)
1050-1050'	B37	4	8,0398	83,9541	5,2901	65,80	0,5124	1,8874	0,7932	154,79
	B9	2	2,2670	3,6612	1,9134	84,40	1,4775	0,0001	0,0106	0,72
	BLD6	3	2,9067	0,3125	0,3953	13,60	2,6800	7,5998	1,9493	72,74
	B8	2	2,2250	0,0265	0,1626	7,31	0,8100	0,0072	0,0849	10,48
1150-1150'	BLD9	4	2,9625	4,5701	1,2342	41,66	2,8850	3,0011	1,0002	34,67
	B6	7	2,4643	6,2014	1,0166	41,26	1,1000	4,6610	0,8814	80,13
	BLD11	2	1,8050	1,0225	1,0112	56,02	2,9150	2,0201	1,4213	48,76
	B5	9	3,2923	123,4565	3,9284	119,32	2,4094	12,3751	1,2437	51,62
	BLD13	3	2,5033	2,0725	1,0180	40,66	2,2733	5,9273	1,7215	75,73
	B7	6	3,8790	64,9478	3,6041	92,91	3,1392	109,0004	4,6691	148,74
1250-1250'	BLD14	2	1,3350	0,7321	0,8556	64,09	1,7550	0,6845	0,8273	47,14
	B4	24	2,7423	121,7037	2,3003	83,88	1,8149	197,2340	2,9284	161,35
1350-1350'	BLD10	5	6,6400	300,7678	8,6713	130,59	2,3700	2,5728	0,8020	33,84
	B3	6	3,3192	51,2375	3,2012	96,45	0,5282	2,5479	0,7138	135,14
	BLD12	3	2,6367	24,0765	3,4696	131,59	0,9633	1,3305	0,8156	84,67
	B2	7	2,6507	6,6110	1,0497	39,60	1,7009	6,2089	1,0173	59,81
1450-1450'	BLD1	8	4,4263	104,7590	3,8685	87,40	0,5050	1,8624	0,5158	102,14
	BLD3	3	8,2100	184,9502	9,6164	117,13	0,6700	1,0446	0,7227	107,87
	BLD4	2	1,8650	0,4705	0,6859	36,78	2,5000	0,8450	0,9192	36,77
	B43	2	1,9100	0,0392	0,1980	10,37	1,5550	3,2005	1,7890	115,05
	B1	4	4,3523	19,0546	2,5202	57,91	2,7920	56,4486	4,3378	155,36
1550-1550'	BLD16	8	2,0263	6,6656	0,9758	48,16	1,0938	4,0998	0,7653	69,97
	B10	10	3,2379	76,3688	2,9130	89,96	3,0595	102,1403	3,3688	110,11
	B42	16	1,7813	28,8717	1,3874	77,89	1,5774	13,9178	0,9633	61,06
1650-1650'	BLD5	3	3,3400	13,2696	2,5758	77,12	1,0567	0,8973	0,6698	63,39
	BLD18	3	2,1767	8,5741	2,0705	95,12	2,7833	5,3313	1,6327	58,66
	B12	29	2,6010	106,8866	1,9538	75,12	1,5515	31,2549	1,0565	68,10
	B11	8	2,3690	26,9356	1,9616	82,80	1,4479	10,0139	1,1961	82,61
1750-1750'	SDD01	13	3,7012	59,0190	2,2177	59,92	1,6757	53,7511	2,1164	126,30
	B19	14	4,7960	196,5060	3,8879	81,07	1,9364	189,7989	3,8210	197,33
	B20	21	2,9261	94,9645	2,1790	74,47	2,3547	69,1180	1,8590	78,95
	B44	7	2,7839	14,4327	1,5509	55,71	2,2451	5,5807	0,9644	42,96
1850-1850'	SDD08	8	2,5750	6,7050	0,9787	38,01	2,1119	7,6398	1,0447	49,47
	BLD7	6	1,1450	0,8914	0,4222	36,88	1,2467	1,5807	0,5623	45,10
	B14	10	1,7300	3,5972	0,6322	36,54	2,2670	19,8836	1,4864	65,57
	B15	8	11,3670	573,4181	9,0508	79,62	0,9524	6,4575	0,9605	100,85
1950-1950'	B45	19	3,2989	188,2178	3,2337	98,02	3,1620	184,5005	3,2016	101,25
Sum		291	3,2943	2509,951	2,9419	89,30	1,8927	1126,425	1,9708	104,13

Calculating of the Minimal Economic Concentration (MEC). - MEC is a natural indicator of the geological-economic assessment, and this term means the lowest medium content of the useful component (or sum of components) in one ore deposit. Based on this, the exploitation provides coverage of all costs necessary for obtaining and primary processing of the mineral raw material, by achieving the required level of profitability in relation to the engaged funds. MEC is one of the most important indicators for geological-economic assessment and it plays a crucial role in separating the balance reserves from the off-balance reserves. Here the calculation is made of the MEC of the conditional component lead (as the main component) in the complex ore deposit Baltašnica, which also contains zinc, copper and silver.

The following parameters are included in the calculation of MEC for lead:

S – Costs of underground exploitation and processing (gravity pre-concentration and flotation) of 1t ore (Te and To) – 49,05 US$/t

I_e – Dillution coefficient during underground exploitation – 15 % (0,85)

I_{oPb} – Coefficient of extraction during enrichment of Pb – 90%

I_{oZn} – Coefficient of extraction during enrichment of Zn – 80%

I_{mPb} – Efficiency coefficient during metallurgical processing of Pb – 92 %

I_{mZn} – Efficiency coefficient during metallurgical processing of Zn – 85 %

C_{oPb} – Market price of lead (at the moment of calculation) – 2100 US$/t

C_{oZn} – Market price of zinc (at the moment of calculation) – 2750 US$/t

S_{mPb} – Costs of metallurgical processing of the final product unit of lead – 300 US$/t

S_{mZn} – Costs of metallurgical processing of the final product unit of zinc – 300 US$/t

S_t – Cost of transport per ton ore concentrate – 30 US$/t

g_{Pb} – Concentration of lead in ore Pb-concentrate – 52 % Pb

g_{Zn} – Concentration of zinc in ore Zn-concentrate – 42 % Zn

The minimum content for the conditional component lead is calculated by the formula of G. G. Gudalin (Janković and Milovanović, 1985):

$$MEC = \frac{100 \cdot S}{Ie \cdot Io_{Pb} \cdot \mathrm{Im}_{Pb} \cdot \left(Co_{Pb} - Sm_{Pb} - \left(\frac{100 \cdot St}{g_{Pb} \cdot \mathrm{Im}_{Pb}} \right) \right)} = \frac{100 \cdot 49{,}05}{0{,}85 \cdot 0{,}90 \cdot 0{,}92 \cdot \left(2100 - 300 - \left(\frac{100 \cdot 30}{52 \cdot 0{,}92} \right) \right)} =$$

$$= \frac{4905}{0{,}7038 \cdot (1800 - 62{,}71)} = \frac{4905}{1222{,}70} = 4{,}0116\% Pb$$

The coefficient for rendering the zinc content to the content of the conditional component lead is:

$$K(prZn \to Pb) = \frac{Ie \cdot Io_{Zn} \cdot \mathrm{Im}_{Zn} \cdot \left(Co_{Zn} - Sm_{Zn} - \left(\frac{100 \cdot St}{g_{Zn} \cdot \mathrm{Im}_{Zn}} \right) \right)}{Ie \cdot Io_{Pb} \cdot \mathrm{Im}_{Pb} \cdot \left(Co_{Pb} - Sm_{Pb} - \left(\frac{100 \cdot St}{g_{Pb} \cdot \mathrm{Im}_{Pb}} \right) \right)} = \frac{0{,}85 \cdot 0{,}80 \cdot 0{,}85 \cdot \left(2750 - 300 - \left(\frac{100 \cdot 30}{42 \cdot 0{,}85} \right) \right)}{0{,}85 \cdot 0{,}90 \cdot 0{,}92 \cdot \left(2100 - 300 - \left(\frac{100 \cdot 30}{52 \cdot 0{,}92} \right) \right)} = \frac{1367{,}53}{1222{,}70} = 1{,}1184$$

The medium content of the conditional component lead in the Baltašnica ore deposit is:

$$1{,}1184 \cdot 1{,}79\% + 2{,}96\% = 4{,}96\% Pb$$

Calculation of monometal. - The ore reserves calculated in the ore bodies of the Baltašnica ore deposit have shown that it is a natural product that contains on average 2.96% Pb, 1.79% Zn, 0.089% Cu and 15.97 g/t Ag. Comparing those values of the useful components with the required MES (4.01% Pb), we can conclude that the ore bodies have contents higher than the minimum. Because in the Pb-concentrate the content of Cu is 0.59%, and in the Zn-concentrate the content of Cu is 0.43%, it follows that Cu has no economic value, because its content in both concentrates is under 1% and it is not paid from the smelters. Therefore, the content of silver is considered to be an accompanying component reduced to the monometal of lead as a basic component, which is later compared with the required MEC, i.e. the balancedness of ore reserves is assessed. That calculation has been performed using the factor of rendering (f) on the accompanying component (Ag) of the basic (Pb), but now expressed as a monometal. The rendering factor is calculated as follows:

$$f_{Ag} = \frac{C_{Ag} \cdot Io_{Ag} \cdot \mathrm{Im}_{Ag} \cdot Co_{Ag}}{(C_{Pb} \cdot Io_{Pb} \cdot \mathrm{Im}_{Pb} \cdot Co_{Pb}) \cdot 100}$$

where

C_{Ag} – Average content of Ag in ore (15,97g/t)

Io_{Ag} – Usage efficiency of Ag in the flotation process (ore Pb-concentrate) (91,0%)

Im_{Ag} – Metallurgical usage of Ag (92,0%)

Co_{Ag} – Silver in concentrate (230g/t)

C_{Pb} – Average content of Pb in ore (2,96%)

Io_{Pb} – Usage efficiency of Pb in flotation process (90,0 %)

Im_{Pb} – Metallurgical usage of Pb (92,0 %)

Co_{Pb} – Lead in concentrate (52,0 %)

The calculation of monometal on the ore deposit Baltašnica:

$$f_{Ag} = \frac{15{,}97 \cdot 0{,}91 \cdot 0{,}92 \cdot 230}{(2{,}96 \cdot 0{,}90 \cdot 0{,}92 \cdot 52) \cdot 100} = \frac{3075{,}12}{12745} = 0{,}2413$$

$$Pb_{monometal} = C_{Pb} + (C_{Zn} \cdot K(prZn \rightarrow Pb)) + (C_{Pb} \cdot f_{Ag}) = 2{,}96 + (1{,}79 \cdot 1{,}1184) + (2{,}96 \cdot 0{,}2413) =$$
$$= 2{,}96 + 2{,}0019 + 0{,}7142 = 5{,}6761\%$$

The calculation above shows that the useful components calculated on Pb monometal give a value of 5.68% Pb, which is higher than the required calculated for MES (4.01% Pb) and in that direction the ore reserves can be considered economically viable in themselves.

Cutoff grade. - It is the lowest content of useful components in the ore which can be exploited without profit but also without loss. The cutoff grade is determined by the formula of G. G. Gudelin (Janković and Milovanović, 1985):

$$GS = \frac{100 \cdot S'}{Ie \cdot Io_{Pb} \cdot \mathrm{Im}_{Pb} \cdot \left(Co_{Pb} - Sm_{Pb} - \left(\frac{100 \cdot St}{g_{Pb} \cdot \mathrm{Im}_{Pb}} \right) \right)}$$

where:

S' – Variable costs of underground exploitation and processing (gravity pre-concentration and flotation) of 1t ore (Te and To) – 35,31 US$/t

The other parameters are the same as in the calculation of MES.

From where it follows:

$$GS = \frac{100 \cdot 35{,}31}{0{,}85 \cdot 0{,}90 \cdot 0{,}92 \cdot \left(2100 - 300 - \left(\frac{100 \cdot 30}{52 \cdot 0{,}92} \right) \right)} = \frac{3531}{1222{,}70} = 2{,}8879\% Pb$$

The total geological ore reserves of 4 526 723 t (C1 category) with medium content of 2.96% Pb, 1.79% Zn, 0.089% Cu and 15.97 g/t Ag in the ore deposit Blatashnica have been calculated by the method of vertical profiles.

CONCLUSION

The Baltašnica ore deposit is a new explored lead zinc ore deposit in the Sasa ore field, with calculated ore reserves of 4.5 Mt (C1 category) with an average content of 2.96% Pb, 1.79% Zn, 0.089% Cu and 15.97 g/t Ag. Accompanying useful metals which are especially interesting in the Baltašnica ore deposit are Cd, Bi, In and other. The ore-bearing coefficient has been calculated at 0.42%, the coefficient of lead variation at 89.30%, the minimum economic content at 4.01% Pb and cutoff grade at 2.89% Pb. The calculated monometal of lead has the value of 5.68% Pb. All these techno-economic parameters should have positive effects on the possible exploitation of this mine, which has a projected life of 15 years.

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