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CONTENT AND DISTRIBUTION OF IMPURITY ELEMENTS IN MAIN MINERALS OF SCARN AND ORE WESTERN UZBEKISTAN

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Abstract:
This article studies the change in impurities of skarn and ore minerals with depth and in the flanks of the deposits. Mathematical statistics were used to study their parameters (average content in ppm, standard deviation, asymmetry, kurtosis and coefficient of variation) in the vertical section of mineralization, as well as the chemical composition of scheelite monominerals, pyroxene, garnet and sulfide minerals.

Keywords: Western Uzbekistan, pyroxene, garnet, scheelite, limestone, dolomite, trace elements, spectral and chemical analysis, asymmetry.

INTRODUCTION

The territory of the Republic of Uzbekistan has long attracted the attention of researchers by the peculiarities of the geological structure, the richness of minerals, environments: which are gold, copper, uranium, tungsten, tin, molybdenum, lead, zinc, iron, radioactive and rare metals [1, 2, 3]. The relevance of the rare metal direction in Uzbekistan is determined in addition to gold, uranium, honey and other minerals tungsten is a strategically important raw material in the development of industry. In the middle of the last century, tungsten was intensively mined and the extraction was carried out in the unique large skarn-scheelite deposits Lyangar, Koytash, Ingichka. Re-studying their flanks and deep horizons would give opportunities to expand the raw material base of tungsten in the Republic of Uzbekistan.

Trace elements in skarn-ore deposits of Western Uzbekistan were previously described in detail on a regional scale [4, 5, 6, 7, 8, etc.]. Comparing some deposits and ore occurrences with others within Western Uzbekistan, including Yakhton, Chashtepa, Khojadik, Karatyube (Karatyube-Chakylkalyansky mountains), Ingichka, Tym (Zirabulak-Ziaetdinsky mountains) and Koytash, Langar and others (Nurata mountains), they identified the main features and changes in the quantitative parameters of trace elements of skarn and ore minerals of Western Uzbekistan.

METHODOLOGY

By the scale of development, most of the ore fields are occupied by granitoid rocks; Tl, Be, Mo, W, Ga, Ge are found in them from I to 5 g/t; Co, Ta, Cr. Sn, Cu 5-10 g/t; less than 50 g/t Li, Pb, Nb, and more than 50 g/t Rh, Ba, Zn, Sr. Increased contents of up to 100 g/t W, Sn are noted in the Zirabulak intrusions, as well as ∑TR2 up to 0.2 g/t and Au 0.0042 g/t [9, 10, 11].

A significant part of the ore fields is occupied by marbled limestones and dolomites. According to the results of the chemical analysis of limestones in individual samples, an increased content of MgO was noted, according to the data of spectral analysis, it was found (in, %) impurities of W, Mo, Sn, Cu - 0.00003; Pb, Ni, Zn, Co, V - 0.00001; Ti - 0.001; Mn - 0.003; Sr - 0.01. As can be seen from the results of the analysis, the limestone is relatively pure, only the contents of V, Ti, Ni, Co, etc. are probably mechanical impurities, and the content of other elements does not exceed the clarke.

We have studied the change in impurities of skarn and ore minerals with depth and in the flanks of the deposits.

Below we will consider elements-admixtures of skarn and ore minerals and changes in their parameters (average content in g/t, standard deviation, asymmetry, kurtosis and coefficient of variation) in the vertical section of mineralization.

The main skarn mineral is pyroxene (hedenbergite-diopside-johansenite composition); trace elements are W, Ba, Sn, Be, Ni, Co, Bi, Pb, Zn, Ag, Cu, Mo, Ga, Ge, Zr, Sr. The results of statistical analyzes (table №1) show that in pyroxene as impurities, W (250 g/t), Zn (173.23 g/t), Sn (55.62 g/t) are noted as impurities. In a vertical section, W, Zn, Sn in pyroxene are uniformly distributed (normal). The content of trace elements Ba, Bi, Ag varies widely, indicating the distribution of elements in the lower or upper horizons. For example, Ba (medium, sod. 7.69 g/t) decreases 2-3 times with depth from the average content, and Bi (13.15 g/t), Ag (6.38 g/t) increases by 3 -5 times, copper, like Ba, Bi, Ag, has the greatest kurtosis, but the maximum copper content (table 1) (standard deviation with a probability of 99.73% shows the limit of vibrations of elements in the 3σ range) σ = 159,12 corresponds to the average ore level of the sections.

RESULT AND DISCUSSION

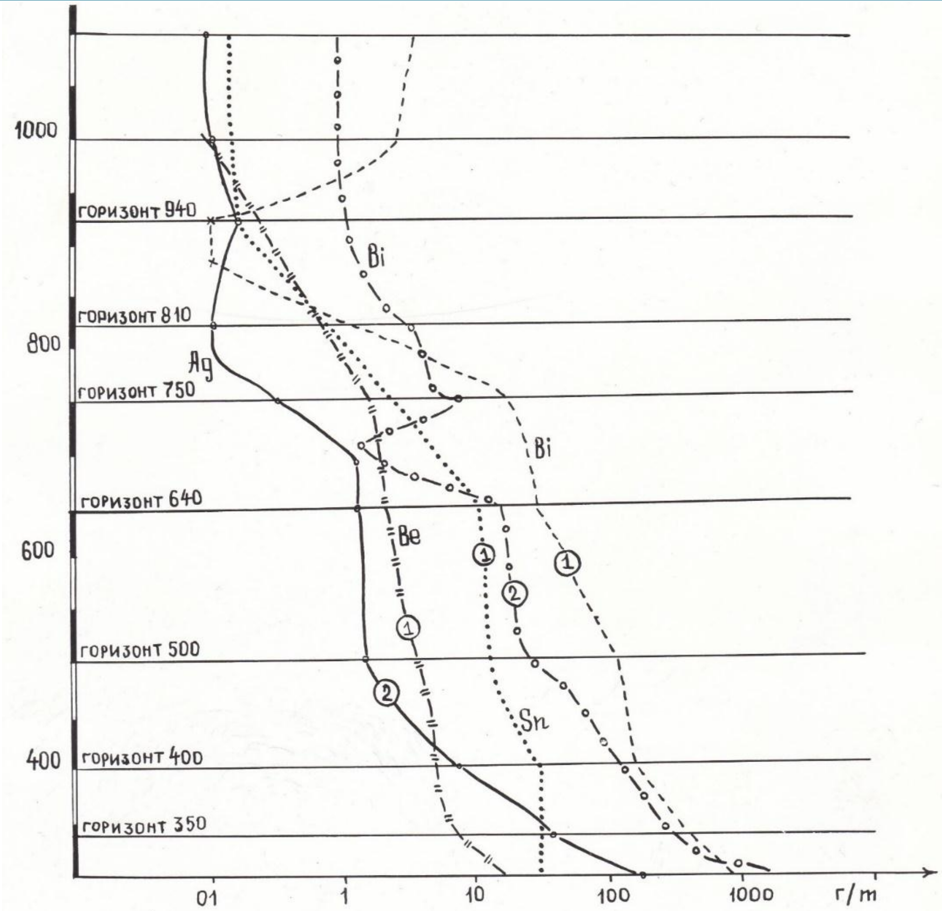
Table 1

EVALUATION OF THE NUMERICAL CHARACTERISTICS OF IMPURITY ELEMENTS IN PYROXENE

Elements of impurities in scheelite	Wednesday values (g/t) $x = \frac{\sum xi}{\mathrm{N}}$	Mean square deviation σ=$\sqrt{S^2}$ $S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - X)^2$	Asymmetry A=$\frac{m_3}{S^3}$	Excess $E = \frac{\sum_{i=1}^{n}(X_i - X)^4}{S^4 \cdot N} - 3$	Coefficient of variation $\upsilon = \frac{S}{X} \cdot 100$
W	230,00	183,85	0,56	1,94	79,93
Ba	7,69	4,88	3,53	12,57	323,50
Sn	55,62	54,14	1,68	5,24	97,35
Be	5,38	4,61	0,53	2,36	85,60
Ni	5,08	2,02	1,59	5,28	39,77
Co	4,92	4,61	-0,00	0,70	93,62
Bi	13,15	23,07	2,44	7,38	175,40
Pb	30,23	82,07	3,46	2,25	27,48
Cu	29,54	53,04	3,21	11,16	179,56
Ag	6,38	13,38	3,36	11,22	191,60
Zn	170,23	317,40	2,01	5,15	177,19
Sr	34,62	47,37	0,73	1,18	36,84
Zr	34,62	39,71	0,99	2,88	114,72
Ga	1,54	7,18	0,36	0,84	62,26
Ge	7,85	4,10	-0,39	2,20	52,25

Of the skarn minerals, garnets are similar in composition to grossular. According to the data of spectral and chemical analyzes, it was found that they constantly contain 1-10 g/t of Ba, Mo, Zr, Ga, Ge, Cu, V, Be, Sn.

Garnet with a high content of iron and manganese (according to the data of chemical analysis), in terms of impurity elements, significantly differs in an increased (up to 100 g/t) content of Mo, Sn, Be and up to 10 g/t in the appearance of Jb, It from higher the given grenade. Trace elements of garnet from Ingichka with increased content of Sn, W, Be and decreased content of Ge, V, Ta differ from that from the Koitash ore field. In garnet in a vertical section (according to the data of statistical analysis), an increase in the Be content from the media was noted, the content (average 8.3 g/t) by 5-10 times or more (Fig. 1).



Cjntent of trace-elevents

Fig. 1. Graphs of the distribution of trace elements in scheelite (1) and pyroxene (2) monominerals depending on the depth using Ingichka as an example.

Scheelite, as noted above, is an industrial mineral. Its impurity elements change from the localization condition, and constantly there are Cu, Pb, Zn, Bi, Sn, U, Mo, Mn, Ga, less often Ba, Se, Sr, Li, Ag. In a vertical cut, the impurity elements in scheelite fluctuate, so for example table. No. 2 "Evaluation of the numerical characteristics of trace elements in scheelite", Bi, Sn, Be increase with depth, Zn, Pb decreases slightly. Cu, Mo, Mn, Ga are evenly distributed. Scheelite-1 contains 1-5 g/t Be, Cu; 10-20 g/t Mo, Sn. In the lower and deep horizons, an increase in Bi up to 100 g/t is noted.

Table 2

EVALUATION OF THE NUMERICAL CHARACTERISTICS OF TRACE ELEMENTS IN SCHEELITE

Elements of impurities in scheelite	Wednesday values (g/t) $x = \frac{\sum xi}{\mathrm{N}}$	Dispersion σ=$\sqrt{S^2}$ $S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - X)^2$	Asymmetry A= $\frac{m_3}{S^3}$	Excess $E = \frac{\sum_{i=1}^{n}(X_i - X)^4}{S^4 \cdot N} - 3$	Coefficient of variation $\upsilon = \frac{S}{X} \cdot 100$
Cu	3,50	1,87	1,03	3,37	53,45
Pb	15,43	23,46	2,03	5,70	152,04
Zn	49,71	105,66	3,22	11,46	212,53
Bi	66,07	90,77	1,70	4,48	137,38
Sn	13,64	16,69	1,67	4,05	122,30
Be	2,36	2,17	1,73	4,51	92,06
Mo	17,14	15,18	0,83	2,64	88,52
Mn	361,43	206,58	0,00	3,12	57,16
Ga	8,57	7,19	0,58	1,93	83,84
Ba*	44,29	* Marked in isolated cases, and the data of the numerical characteristics are overestimated or underestimated and the reliability of the assessment of their parameters is not possible.			
Se*	7,14				
Ib, I*	1,43				
Li*	5,71				
Ag*	0,36				

In scheelite-II (from scheelite-pyrrhotite-chalcopyrite ore associations), the bismuth content increases with depth from 10 to 100, rarely 500 or more g/t, while the Mo content decreases from 100 to 10 g/t in Koitash and is absent in Ingichka.

An increased content of trace elements Ba (up to 100 g/t) and Pb (60 g/t) is noted in scheelite from the scheelite-galena-sphalerite ore association.

Media, their content: Ba = 60.24 g/t, Pb = 23.26 g/t, which is 2-3 times higher than in relation to other scheelite associations. In scheelite from scheelite-galena-sphalerite ores, the Mo content sharply decreases and is often absent as an impurity in scheelite.

Scheelite-III from 1 to 10 g/t Be, Pb, Ga, less often La, Li, J, from 10 to 100 and more ppm Sn, Mn, Mo. In scheelite-III, from the results of statistical analyzes, a high content of impurity elements Be, Sn, which increases with depth, is noted.

Molybdenite from proper scheelite ores contains 1-10 g/t, Bi, Re, Be; In the Ingichka ore field, bismuth is absent in molybdenite. Molybdenite from scheelite-sulphide ores in terms of impurity elements differs from the above-described molybdenite by an increased content of Bi, Re, Be (up to 50 g/t) and the presence of 10 g/t and more Cu, Pb. In molybdenite from sulfide ores, the impurities of Se, Re increase with depth [5, 7, 8, 12].

According to the analysis data, impurity elements Te, Co, Se, Ga, Ge, Bi, Pb, Zn, Sn were found in pyrrhotite. Pyrrhotite from the Ingichka ore field is characterized by an increased content of Se, Co, Ga, Ge and a lower content of Te, Bi than in Koitash. In the vertical section, the content of impurity elements Ag, Te increases with depth, while Ga, Ge decreases.

Chalcopyrite contains impurity elements Sn, Bi, Ag, Te, Ni, Co, Se, Ge. From the results of statistical analyzes, it was revealed that, in quantitative terms, the content of Bi, Sn, Ni, Co impurities increases with depth, while Ge decreases. In the chalcopyrite of the lower and deep horizons, the content of Ag, Au, Te increases sharply. Sphalerite contains impurities of Be, Se, Te, Bi, Co, Ni; from scheelite-galena-sphalerite ore associations, impurities of Bi and Te, the content of which varies within 1-50 g/t, while Be, Se, Ag does not change. Jb, It terms of trace elements, the Ingichka sphalerite differs from the Koytash sphalerite in the increased content of Te, Ag and the presence of Be, Sn, Se.

According to the analysis data, in galena, an increased content (n ·100 g/t) of silver, 1-10 g/t Ir, Te, Se, Sb, 10-100 g/t Te, Cd was established. The Ag content in galena increases with depth (up to n · 1000 g/t). In the Ingichka ore field, the Sn content increases with depth within 10 g/t and more, while the Te content decreases.

CONCLUSION

1. Thus, it can be noted that in pyroxene (hedenbergite - 80-30%; diopside - 1-6%, johansenite - 5-15% of the composition), with a depth of the content of impurity elements Bi, Ag increases 3-5 times, and Ba decreases by a factor of 5 or more and the Cu content does not change.
2. Based on the above, it should be noted that the change in trace elements in scheelite depends on the mineral association of ores and the stage of their formation. The content of impurity elements Bi, Mo decreases and Ba, Pb increases with depth (is, from early scheelite to late scheelite) [11].
3. Thus, the elements of impurities in skarn mono minerals (pyroxene, garnet, scheelite, molybdenite and sulfide minerals) vary with depth and from the condition of formation. Trace elements in skarn minerals by primum depend on the composition of the intrusive formation and the stage of their formation, as well as on the composition of the host rocks.

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