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## Koytash Deposit As A Prospective Object Of Uzbekistan For Expanding Resources Of Wollastonite, Precious Metals And Other Associated Elements

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### ABSTRACT

The article discusses complex and conjugated formation of wollastonite, sulfide-rare metal and silver-base polymetallic ores of Koytash deposit. Forms recommended for co-extraction, mineral composition and elements-impurities of them have been revealed. These data on rare-metal sulfide and sulfide-polymetallic ores of Koytash skarn-rare metal deposit proves its prospects in extraction of both rare metal and noble metals, bismuth and wollastonite.

### KEYWORDS

Koytash, skarn, skarnoid, rare-metal mineralization, sulfide-rare-metal and silver-polymetallic ores, wollastonite, platinoids, gold, silver, bismuth, complex ores, reserves, prospects.

### INTRODUCTION

Koytash deposit has been sealed due to changes in prices for tungsten on the world market in recent years. It should be noted that

Koytash deposit ores are of a complex nature [6], including nonmetallic minerals and wollastonite [1, 2, 3]. More than 50 known

deposits and occurrences of wollastonite are found in the Republic of Uzbekistan and only Koytash has confirmed reserves of wollastonite ores. Established ore reserves of central Koytash field are about 5 million tons, while wollastonite's smaller findings are also found in near fields - Northern, Eastern, Dunyotepa and Ugat sites [9].

Deposits within ore fields are reflected as separate granitoid sites with limestone productive layer where skarn ore is formed. Main useful component of the ore is tungsten, as well as copper and molybdenum as associated components (Ore deposits of Uzbekistana, 2001) [11].

Koytash-Ugat deposit line covers western part of Koytash intrusion's southern contact between Ugat and Koytash fields and stretches for 3,5-4 km from Saganaksai in the west to Savryuksai in the east.

Western part of Koytash-Ugat deposit line was explored by the Koytash Ore Administration by rock trenching and underground drilling. There were found contact skarn elements and several isolated sheet-like garnet-pyroxene-wollastonite, monomineral coarse-crystalline wollastonite elements of skarnoids. Parameters of the latter are determined in Horizons 700-660 of "Razvedochnaya" mine by strike-tunnels, underground drilling and crosscut holes every 50 m. Scarnoid bodies are traced throughout the explored contact

(about 800 m) of the granitoid intrusion with productive carbonate stratum and form independent and isolated stratum-like bodies. Thickness of the main skarnoid body is more than 10 m with up to 100-150 m length along dip. Content of wollastonite in the skarnoid is 30-80%. [1, 2, 3, 5].

Also, in the process of studying main minerals, sulfide-rare-metal and sulfide-base polymetallic ores of Koytash deposit with the use of electron microprobe method, high contents of platinum, palladium, gold and rare earth elements are found in sulfides.

**Platinoids.** Due to non-typical nature of platinum group elements for skarn deposits, as well as lack of reliable methods for their determining in minerals, literature contains little information about content of platinoids in of skarn-rare metal ore deposits in Uzbekistan [7, 8].

Platinoids are mainly found in the form of impurities in sulfide minerals of Koytash deposit. In pyrrhotite, platinum content reaches 0.67%, palladium up to 0.23% with a frequency of 65%; whereas in chalcopyrite platinum is 0.5%, palladium - 0.21% with respective frequency of occurrence is 47% and 59% (Table 1.).

Table 1.

**Impurity elements in pyrrhotite and chalcopyrite of sulfide-rare metal ores of Koytash deposit according to microprobe analysis**

Mineral	Mineral association	Number of findings	Impurity elements (in%)							
			Au	Ag	Pt	Pd	Se	Te	Ni	Co
pyrrhotite	Chalcopyrite-pyrrhotitic	63	0.81	0.14	0.67	0.23	0.28	0.26	0.64	0.49
			Frequency of occurrence (%)							
			57	34	65	65	23	fifty	71	55
chalcopyrite	Pyrrhotite - chalcopyritic	17	0.61	0.22	0.5	0.21	0.29	0.06	0.18	-
			Frequency of occurrence (%)							
			41	65	47	59	12	5	35	-

Considering significant reserves of sulfide-rare-metal ores of Koytash deposit mainly composed of pyrrhotite (54%), it should be noted that this deposit has high prospects for extraction of platinoids as associated components.

**Bismuth** minerals are found in all skarn-rare metal deposits of Western Uzbekistan [6], but it is most intensively manifested at Koytash deposit (Table 2)

A relatively high concentration of bismuth mineralization in comparison with other same type deposits is noted at Ugat skarn-scheelite deposit, being actually one of Koytash deposit sites [7, 8]. Also, new ore deposits have been discovered in Koytash-Ugat deposit line in recent years that can be distinguished by wide development of sulfides within rare-metal ores. According to their mineral composition, these ores are classified as skarn-sulfide-gold-rare-metal formations. The study of their composition also showed enrichment with

complex associated useful components, including bismuth in a number of mineral forms – native, telluride, sulfide, as well as in unknown compound forms with mixture of ash, silver and bismuth. At the same time, 55% of the discovered bismuth minerals is native bismuth and 30% - tellurobismutite [10].

Bismuth minerals are also widely developed in silver-polymetallic ores and represented in the forms of Ag-burzaite, pilsenite, wittite, galenobismutite and cannizzarite. Burzaite, platinum, heyrovskite, weibulite are less common and were first discovered at Koytash deposit.

The study of monomineral fractions of sulfides according to mass spectrometric analysis of skarn-rare metal ores showed that its content is higher in chalcopyrite (260-2140, average 912.6 g / t) and twice less – in pyrrhotite (288-1670, average 481 g/t).

During our research of 11 studied samples, virgin bismuth and tellurium bismuthate are

found in 5 cases, bismite – in 2 samples and Ag-bismuthate in one samples.

**Selenium** is found in all types of ores. Its amount in pyrrhotite-chalcopyrite massive sulfide ores is 0.53 g/t - 1.01 g/t, average 30.8 g/t (Table 2). Selenium amount in pyrrhotite is

109.8 g/t, in chalcopyrite - 60 g/t, in molybdenite - 122.6 g/t, in pyrite - 61.5 g/t. It should be noted that in sulfide-rare-metal ores maximum content of selenium is observed in pyrrhotite (up to 263 g/t), and in skarn-rare metal ores - on molybdenite (up to 140,6 g/t) [4].

**Table 2 - Average amount of noble and other metals in the ores of Koytash-Ugat deposit line according to mass spectrometric analysis data**

No.	Name of rocks and ores	in g/t					in %	
		Au	Ag	Bi	Se	Those	Cu (%)	WO <sub>3</sub> (%)
1	Massive pyrrhotite-chalcopyrite-pyrite ore	0.97 (125)*	2.2 (98)	380 (125)	30.8 (125)	85 (120)	0.67 (120)	0.35 (120)
2	Pyrrhotite-sphalerite-galena ore with scheelite	not def.	120 (14)	not def.	45.6 (15)	78 (40)	0,48 (18)	0.012 (18)
3	Pyroxene skarn with sulfides	0.2 (31)	1.51 (31)	157.8 (31)	15.7 (48)	74.9 (31)	0.27 (40)	0.25 (40)
4	Apogranites (oligoclase-quartz-chlorite metasomatite) with sulfides	0.17 (23)	1.28 (23)	190 (23)	5.8 (23)	24.5 (23)	0.29 (45)	0.31 (42)
5	Scarred hornfel with sulfides and quartz veins	0.18 (4)	1.23 (4)	185 (4)	5.5 (4)	not def.		0.12 (32)
6	Quartz-sulfide vein with fahlores	not def.	not def.	540 (3)	not def.	not def.	not def.	not def.

\* number of analyzes.

**Tellurium.** Highest concentration of tellurium is noted in massive sulfide ores of pyrrhotite-chalcopyrite composition (85 g/t) and pyrrhotite-galena ores (78 g/t). In apogranite

types of tungsten ores with sulfides, tellurium content ranges from 0.15 to 81 g/t (average 24.5 g/t), as well as in skarns of pyroxene, pyroxene-garnet composition with sulfides -

average 74.9 g/t (Table 2). In rare metal sulfide ores maximum content tellurium is concentrated in pyrrhotite (from 150.3 to 510 g/t, average 281,7 g/t). High tellurium contents are also found in molybdenite (50 g/t) and pyrite (22.9 g/t) [4].

Tellurium in the ores of the deposit line forms its own minerals in the form of compounds with bismuth, gold and silver-hessite, stucite, kervelleite, hedleite, tellurium-bismuthate, joseite-A, pilzenite, in association with virgin bismuth, bismuthine, pyrite, sphalerite, galena and other ore minerals.

In **conclusion**, we can say that at the example of skarn-rare metal Koytash deposit there are sites with sulfide-rare-metal and silver-polymetallic types of ores and this shows that complex mining of tungsten, silver, bismuth and other associated components will increase their economic value by inclusion into industrial processing and recycling.

Despite rather detailed study of mineral composition of ores, they seem not enough for full assessment of Koytash deposit's mineralization potential. Therefore, it is necessary to carry out further detailed geological exploration which will open new aspects of the ore field as a complex object – with perspectives of not only tungsten but also silver, bismuth and other elements, as well as wollastonite.

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