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Research Article

MINERALOGICAL TRANSFORMATIONS OF A COMPOSITION WITH A WEAK ALBITIZATION OF GRANITE-SYENITE OF URTALIK MINES AND THEIR INFLUENCE TO THE FORMATION OF A GOLD, RARE AND RARE-EARTH MINERALIZATION

Alisher Musayev, *Denis Jumaniyozov, Feruza Karimova
Institute of Geology and Geophysics named after Kh.M.Abdullaev
49 Olimlar st. 100041, Tashkent, Uzbekistan
**Author for Correspondence*

ABSTRACT

On the studied site of the Urtalik ore deposit, rare, rare-earth and polymetallic mineralization is shown. Rare elements zirconium and niobium can have restite character which gets a steady state at the recrystallization of ore-bearing minerals. At the same time a rare element zirconium and a rare-earth element ytterbium selectively concentrate in the zircon and apatite respectively. Rare (Se, Te), noble (Au, Ag), polymetallic (Fe, Ni, As, Sb, Cu, Zn) elements make sulfides of them.

Keywords: *Rare-Earth Elements, Mineralisation, Metasomatite, Metallizing Process, Charmitan ore Field*

INTRODUCTION

The gold deposit Urtalik as an independent object for studying is allocated with search and evaluation works, and as a part of flanks in the course of the researches of fields Charmitan and Guzhumsay was partially studied before.

Gold mineralization on the field Urtalikis localized in granitoids (P_1) and in much smaller degree-in sedimentary metamorphic rocks of the lower Paleozoic (the southern flank). It is controlled in the south of Karaulkhon - Charmitan zone of faults and belongs to fracture structures of North-East (Guzhumsay type), South-West (Charmitan type) and the subwidth extension. The Urtalik area is a link between fields Charmitan and Guzhumsay (which proved very precisely) and these areas arecharacterized by common geological structure, uniformity of structural morphological types of ores, their material structure and properties.

MATERIALS AND METHODS

The revealed ore bodies on the Urtalik field are direct continuation of ore bodies of Charmitan and Guzhumsay at and locate at the same hypsometric level with them (Abdullaev, 1954).

Figure 1. Type of locally albitizated granite-syenite of the Koshrabad intrusive on the Urtalikfield

The hydrothermal alterations of granitoids which are widely shown in medium temperature conditions in local zones of tectonic structures of the raised fracturing and permeability in the form of albite and albite - chlorite metasomatite, often bear the increased concentration of uranium, gold and rare elements (Abdullaev HM, 1963). Such changes have shown clearly on the Urtalikfieldof Zarmitan ore-bearing zone. (Fig. 1)

RESULTS AND DISCUSSION

According to the microprobe analysis coarse-grained granite-syenite with hypidiomorphic granular texture is subjected to process of a regional albitization with allocation of plenty of accessory minerals, containing rare Earth elements, concern to them apatite, zircon, rutile where release happens due to metasomatic substitution of biotitization of primary amphibole bearing rock. As a part of fresh biotite, the small content of an oxide of calcium indicates the development of biotite in amphibole. Quite high content of alumina at low value of an oxide of iron can exist also due to synchronous decomposition of a plagioclase, promoting increase in activity $A1_2O_3$.

Table 1: Compositions of biotites according to roentgen-spectrometric analysis YXA8800R Superprobe

№ of an analysis	Oxides									
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	SO_3	H_2O	∑
13	34	21,51	2,43	1,82	2,66	-	8,21	3,99	24,54*	75,46
14	43,62	28,88	0,73	1,85	0,83	-	8,95	3,43*	14,34*	85,66
4	44,24	28,36	0,56	1,86	-	-	7,84	0,17	16,98	83,02

**-not included in the sum*

From the given results it is visible that the beginning of an albitization brings at the normal content of silicic acid and alumina in biotite the content of annite mineral (Fe_2O_3) remains still low, while the normal value (2,43) is corresponding to phlogopite mineral (MgO). Small content of lime indicates quite acid structure of a plagioclase of rock replying to oligoclase. Low value of sodium alkalinity (0,47) is connected, obviously, only to the beginning of process of an albitization of plagioclase. At admissible potassium alkalinity, an increase of contents of water with CO_2 impurity (24,54%) indicates high extent of hydration at process of an albitization. It is favorable for migration of the components making biotite and the corresponding new minerals formed by them, with overwhelming value of iron sulfides and (As, Sb, Zn) that as confirmation serves quite considerable content of sulfuric anhydrite (3,29%) to.

Strengthening of an albitization as it is seen from analyses 14 and 4 comes with considerable increase of a silicon content and aluminia content. The magnesium oxide at the same time behaves indifferently significantly without changing the contents. Obviously, the begun process of sulphidization of rock promotes leaving 2/3 parts of iron to them. The oxide of sodium is entirely spent for albite new growths, it causes considerable reduction of primary plagioclase that is visible from reduction of CaO on 2/3. After binding of all sodium in albite, activity of K_2O considerably increases in comparison with initial value (the analysis 13). The increase in a potassium contents accompanied with increase of aluminia and silicon contents testifies to the beginning of a sericitization, which is the process of transition of quartz-field-spar metasomatose to a beresite formation.

Availability of the accessory minerals presented by zircon, apatite, rutile and pyrite with the increasing content in the given order is characteristic of this rock (Ivanov IP, 1984).

Zircon meets in the form of dipyramidal prismatic grains, small to 0,01 mm, light-brown, sometimes more dark color in the passing light. There are quite often almost isomeric dipyramidal prisms. Places of edge of grains of a circle a dark border - representing pleochroic doubles. Seldom roundish more prismatic xenomorphic crystals meet. The constant satellite as a part of mineral is rare-earth hafnium in the small content, which is not exceeding 2%. Chemical composition of one of grains according to the X-ray spectral analysis looks like: SiO_2 – 33,15; ZrO_2 – 65,37; HfO_2 – 1,49 while the sum is 100%. Apparently from these data zircon quite pure and does not contain impurity of other elements except a hafnium oxide. Mineral often meets as inclusion in a plagioclase and in the spread-out dark-colored minerals (amphibole and biotite).

Apatite is the constant carrier of a number of rare-earth elements. In this rock with apatite connected the largest content of the heavy rare earth of Yb_2O_3. It occurs due to manifestation of the main feature of rare earths-phosphor-calcifilinity noted by E. I. Semenov and I. Kh. Khamrabayev (Khamrabayev *et al*., 1964).

In a rock apatite is met in the form of long dipyramidal prisms, length of which is in tens and more time exceeds their width. Usually it is colourless, or in crossed nicols rough-gray. Often forms chadacryst in field spars, quartz, and also in dark-colored minerals. At substitution of oikocrysts - the owner's minerals apatite crystals partially recrystallize with other more low-temperature minerals, forming roundish shapeless units. At the same time, its optical properties almost do not change.

In this rock it is met in a pure type, without additions of other elements except ytterbium (the analysis 8) and the insignificant content of an oxide of manganese (the analysis 1). Probably it is promoted by an optimum parity of phosphoric acid with a calcium oxide in the post-magmatic solution, which provides stability of crystals of apatite. Perhaps impurity of an oxide of magnesium is gained by apatite during its recrystallization at post-magmatic processes. Structures of apatites studied by X-ray-spectral and microprobe are reflected in the table No. 2.

Table 2: Composition of apatite according to X-ray-spectral analysis UKA8800 Superprobe

№ of an analysis	Oxides					
	P_2O_5	CaO	MnO	Yb_2O_3	Ce	∑
1	45,05	51,67	0,28	0,78	Не опр.	97,77
2	46,06	53,29	-	0,65	-	100,00

** Compositions of biotites according to the X-ray-spectral analysis UKA8800R. Superprobe, the analyst D.V.Mukhamedzhanova*

Kolumbite-ilmenite-rutile is met, like a zircon in the form of isomeric, rounded platy shapes with a big optical negative axis. Black color in the polarized light indicates the small content of iron. This, as a result of the chemical analysis at high TiO_2 brings closer this mineral to the ilmenite-rutile, which has noticeable quantity of an oxide of rare-earth niobium (1,50%).This indicates presence at composition of mineral of kolumbite minal without impurity of rare-earth elements (lanthanides), that more often meets among the spread-out dark-colored mineral or on its joint with quartz and field spar. The chemical composition of mineral in results of two RSM analyses is given in the table No. 3.

Table 3: Composition of kolumbity ilmenite-rutile according to X-ray-spectral analysis UKA 8800R

№ of an analysis	Oxides					
	SiO_2	TiO_2	V_2O_5	FeO	Nb_2O_5	∑
1	0,66	95,45	1,54	0,80	1,56	100
2	0,41	96,42	1,46	0,46	1,25	100

From results of the analysis, existence of mineral of pentoxide of vanadium is visible. It is association with belonging of a mineral to rutile group with small traces of elements of ilmenite accessory. It is possible to notice positive correlation of a rare element of niobium with a ferruginosity while the correlation from titanic and silicium components of mineral is negative. It is an indicator of difference of mineral from properties actually - columbite.

Thus, it is possible to conclude that ilmenite-rutile selectively includes in its structure a rare-earth element - niobium.

In the figure 2 allocations of stringers of kolumbite-ilmenite-rutile accumulation of crystals among the cracks which contain quartz grains are shown.

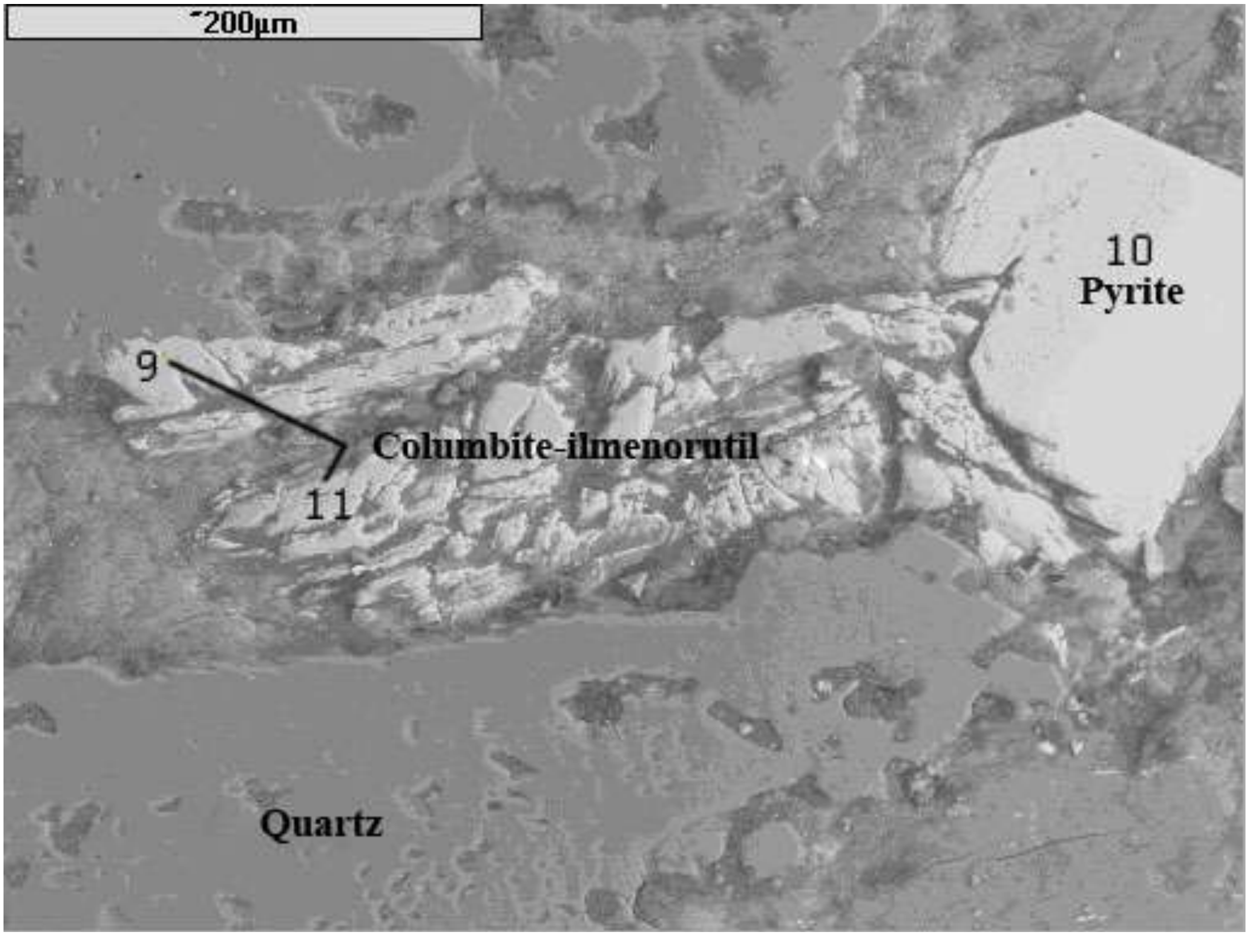

Figure 2. Release of rare-metal kolumbite-ilmenite-rutile occurring at different times with later porfireblast of well crystallized gold-bearing fahlore pyrite. The last partially envelops ilmenite-rutile losing the crystal outline on contact (the analysis 10)

At areal albitization of granite-syenite of the Koshrabat intrusive, this albitization is replaced by beresitization with increasing of silicium and aluminia content in a rock, at the same time there exists a considerable partition of ore-forming solutions which are in equilibrium with ore-bearing rocks. In conditions of temperature decreasing there is a decrease of solubility of all ore-forming elements complex that leads them to increasing their effective concentration or activity (Musaev *et al.*, 2012) promoting their accommodation. This stage is characteristic for development of sulfide mineralization, which is telescoping beresite rocks of the Urtalik mine of the Charmitan ore field. In this case all sulfides have complex structure, which is characteristic for faded ores. It is connected with rather low-temperature conditions of their allocation in comparison with pure from impurities arsenopyrites and pyrites which can be met quite often in certain sites of the field. Structures studied by X-ray - spectral microanalysis for faded ores with characteristic features of pure sulfides (gloss, coloring, density, conductivity, etc.) are specified in the table 4.

Table 4: Compositions of sulfides according to the X-ray - structural microanalysis of the Urtalik mine of the Charmitan ore field

№ of an analysis	Weight of elements in %											
	S	Fe	Ni	As	Te	Se	Ag	Sb	Au	Cu	Zn	∑
5	67.61	31.62	0.30	0.20	-	0.29	-	-	0.05	-	0.08	100.0
6	68.08	30.61	0.06	2.18	-	-	0.24	-	-	-	-	100.0
7	21.40	34.62	0.09	49.51	-	-	0.06	0.18	-	0.06	0.08	100.0
10	66.51	32.83	0.09	0.51	0.03	-	-	-	0.18	-	-	100.0
12	67.98	31.25	0.08	0.51	-	-	0.04	0.06	0.08	-	-	100.0
15	54.98	44.81	0.13	-	-	-	-	0.04	-	0.04	-	100.0
16	67.85	32.07	-	-	0.07	-	-	-	-	-	-	100.0
17	66.95	32.61	0.02	0.08	0.08	-	-	0.05	0.10	0.07	-	100.0

The results of analyses given in this table accurately confirm complexity of composition of the sulfides, which are mainly allocated with different extents of their transformation into faded ores though there are rather pure telluride pyrites (the analysis 16). The negative correlation of arsenic with tellurium and gold, obviously happens because of a low-temperature conditions of formation of faded ore with positive correlation of arsenic with Ag, Sb, the Sb, Zn in a counterbalance nickel – arsenic gold-bearing nickel - telluridal pyrite (analyses 10, 16, 17), and also gold-bearing nikel-selenious arsenopyrite (the analysis 5) which is confirmed by existence of sulfides release.

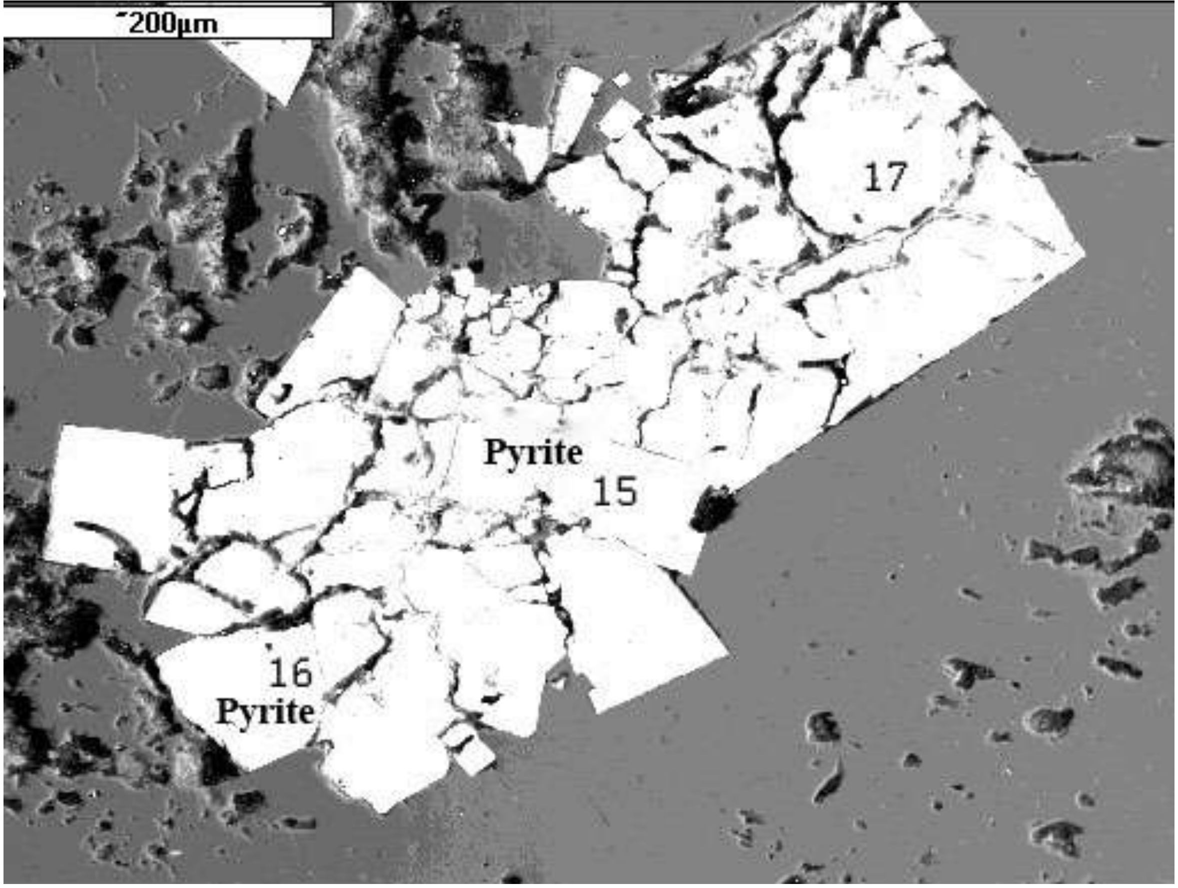

Figure 3. A segregation of late gold-bearing pyrite with accurate crystal outlines (light) in pro-fibrous inclusions of surrounding quartz (gray).

CONCLUSION

Thus, at a regional albitization final stage of propilitization processes, there is an essential redistribution of ore-forming elements. It is connected to approach of processes berezit-listvenite metasomatic formation which is integrated to a process of an ore deposition. The polichronity of release of metallic minerals causes the changing of associations of the last according to the mode of physical and chemical conditions of ore formation on temperature, pressure, density of solutions, changing of the effective concentration and solubility of ore-forming elements. On the studied site of the Urtalik field rare, rare-earth and polymetallic mineralization is shown. Rare elements zirconium and niobium can have restite character which gets a steady state at the recrystallization of ore-bearing minerals. At the same time a rare element zirconium and a rare-earth element ytterbium selectively concentrate in the zircon and apatite respectively. Rare (Se, Te), noble (Au, Ag), polymetallic (Fe, Ni, As, Sb, Cu, Zn) elements make sulfides of them.

All these properties are the searching signs of acid metasomatites of the Urtalik field of the Charmitan ore field. They can be used for assessment of ore-bearing and other sites of this ore field.

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