

MINERALOGY OF THE OXIDIZED GOLD ORES OF AUMINZA MOUNTAINS (CENTRAL KZYLKUM)

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ABSTRACT

The article presents information about the formation characteristics of the oxidized ores of the Auminzatov Mountains and their mineralogical description. Ore bodies are located on the surface of the field, located above the limits of the oxidation zone, characterized by the appearance of strongly ironized and crushed sections of rock. In them, different paragenese associations are located in a zonal position, each of which has its own set of minerals.

INTRODUCTION

In geological prospecting, the study of oxidized zones and their mineralogical description is an important part of research. The study of the material composition of minerals is of great importance in the development of minerals, because the results of such research are important in the effective use of mineral raw materials of certain deposits, and in the prediction of new and unconventional types of minerals. For this reason, special attention is paid to it in researching the mineralogical composition of gold mineralization associated with different rocks in new prospecting areas (Amirov *et al.*, 2019; Bukharin *et al.*, 1985; Karabaev, 2017).

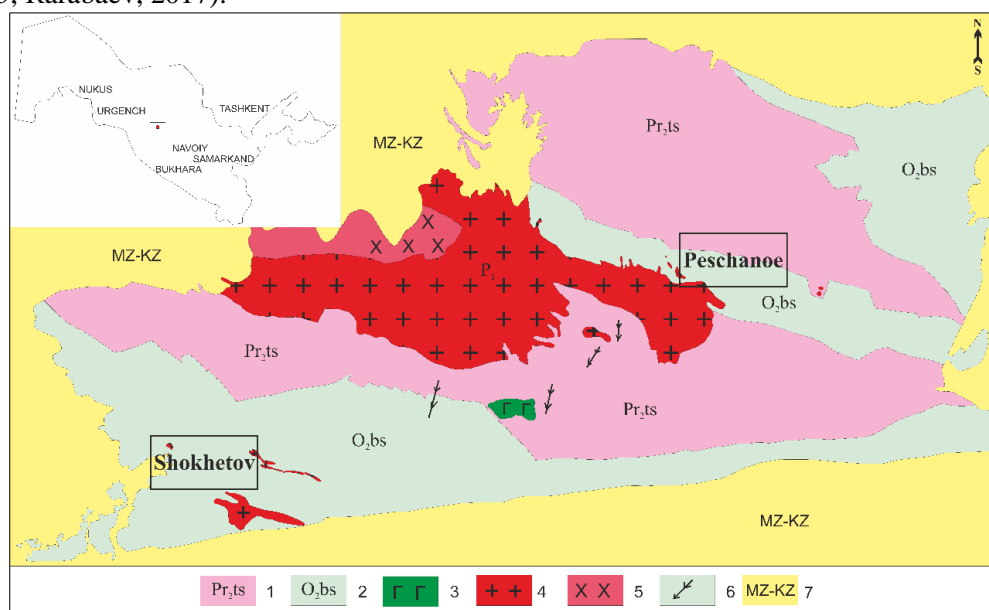


Figure 1. Schematic geological map of the Auminzatov Mountains (compiled according to S.N. Shafransky *et al.*, 1989). 1 - taskazgan suite; 2 – besapan suite, 3 – gabbro-dolerites of the Southern Auminzatov intrusion, 4 – granodiorites of the main phase of the Auminzatov intrusion, 5 – granites of the late phase of the Auminzatov intrusion, 6 – dyke formations of different composition, 7 – Mesozoic-Cenozoic deposits.

MATERIALS AND METHODS

In this work, the results of the study of oxidized ores and determination of the characteristics are

highlighted. Since gold, the main useful component of the field, and its accompanying ore minerals are in a finely dispersed state, the research made extensive use of special micromineralogical studies using a highly sensitive high-resolution electron microanalyzer (Superprobe JXA-8800R Jeol, Japan) (Institute of Geology and Geophysics, Analytical M .A.Kim).

The Auminzatov Mountains are located in the southwestern part of Central Kyzylkum, and geotectonically belong to the Zarafshan-Turkestan folded system of the Southern Tien-Shan structural-formation zone (Bukharin *et al.*, 1985; and Shayakubov *et al.*, 1998). The Shokhetov prospective field is located in the southwestern part of the Auminza Mountains, in the tectonic branches of the Southern ore zone, and the Peschanoe deposit is located in the central part of the area (Karabaev, 2017; Kotov and Poritskaya 1991; Sshcherban *et al.*, 1990; Shayakubov *et al.*, 1998] (Fig. 1). The composition of the rocks surrounding the mine is different, and the Besapan (Shayakubov *et al.*, 1998) suite belonging to the Late Paleozoic Erathem is composed of carbonaceous shales, siltstones and sandstones (Amirov, 2019). Some researchers who worked in the central Kyzylkum region paid attention to the study of rocks of the Besapan suite and noted that this suite consists of terrigenous rocks as well as volcanogenic formations (Kotov and Poritskaya 1991). In Shokhetov and Peschanoe fields of the studied West Auminzatov field, magmatic formations were manifested as small natural openings of granite-porphyry intrusion. The studies conducted on determining the location of geological and structural conditions in the location of mineral objects and deposits in the region show that the folded foundation formations contain mineral minerals such as gold, silver, uranium and copper (Shayakubov *et al.*, 1998).

RESULTS

The ore bodies are located close to the surface of the fields, and the rocks located above the limits of the oxidation zone appear as strongly ironized and crushed sections. The oxidation zone is composed of dissolved rock-forming minerals and a loose mass of unevenly distributed residual limonite grains, which make up 30-40% of the rock mass. The secondary minerals of the oxidation zone consist of mixtures of goitite, hydrogyotite, limonite, jarosite, clay minerals, and others (Table 1).

Table 1: Mineral composition (oxidized minerals) according to the separation data of hypogene ore mineral rocks

Descriptions of mining zones		Processes of grinding, fertilizing, quartzization and hypogenic recrystallization of rocks and minerals			
Sample weight, in grams	Primary	200	200	200	
	Heavy fraction	0,2-1,2	0,6-4,9	0,4-1,3	0,2-3,3
	Light fraction	98-143	76-145	64-130	56-132
Output of heavy fraction, in %		0,03-0,4	0,15-0,6	0,08-0,4	0,02-0,18
Mineralogical composition of fractions, in %	Heavy fractions	Goethite-hydrogoethite (45-80), jarosite (5-8), scorodite, pure gold, quartz (5-22), host rock fragments (5-10)			
	Light fractions	Host rock fragments (55-80), quartz (5-25 fuu izin o), carbonate (0-10), gypsum (0-1), iron hydroxides (5-10)			

Located directly above the boundary of the oxidation zone, gold-jarosite-hydrolyte containing pure gold is located in the lower part, and gold-hydrogeotite-kaolinite associations are located above it (0-25m). Directly at the ground level, all formations have undergone severe weathering (thickness 50-80 cm).

Secondary iron minerals are formed as a result of the exchange of sulphides and other iron-bearing minerals. They are located in the grains of sulphide minerals and in the cracks of the crushing zone of rocks. The latter situation is formed due to the infiltration and circulation of specific solutions to the surface along the exposed rock mass.

RESULTS AND DISCUSSION

These solutions alkalinize the ore components from the decomposed minerals and form secondary mineral assemblages of high-abundance ore components, including gold mineralization, at various depths below the earth's surface.

Based on the weak migration of gold in the oxidation zone of sulphide ores, there is no possibility of its secondary enrichment zone, and the amount of gold in the oxidation zone is close to its primary ore composition, it was mentioned that "it is possible to draw conclusions about their deep mineralization in oxidized ores (Gureev, 1969).

As mentioned above, oxidized types of ore bodies were formed as a result of infiltration of surface waters (hypergenic solutions). These solutions leached sulphide minerals and minerals from the exposed rock mass and deposited and re-deposited them into shear zones. Oxidized ores are manifested in cases where the latter are relatively strongly cracked and, as a result, conditions for maximum circulation of solutions are created, and are a favorable factor for the formation of colorful mineral associations.

Thus, during the formation evolution of the oxidation zone, all large amounts of gold are redeposited in the oxide-hydroxide zone below the weathering zone. Enrichment of useful components, including gold, occurs here, and this process is more strongly manifested in fractured zones.

The main typomorphic mineral of the lower parts of the oxidation zone of the ore is hydromica minerals, and the primary rocks are yarozone cemented with residual limonite. Jarosite forms a thin granular loose mass of brown to brown color. Jarosite is located in the form of cells and cystic formations. Pseudomorphic interchanges of pyrite and jarosite are observed

In the upper parts, in the jarosite-hydromica associations, yellow-gray borders, cellular bundles of jarosite alternate with hydroxytite and goethite. That is, these minerals are replaced by cellular aggregates of jarosite consisting of a mass of unevenly distributed iron hydroxides in the eroded zones of rock-forming minerals, which make up 30-40% of the total rock mass. The main minerals of iron hydroxides are goethite, hydroxytite (15-20%) and jarosite (up to 3-5%) in a small amount. The main rock-forming mineral is relict quartz mixed with clay minerals of hypergene origin.

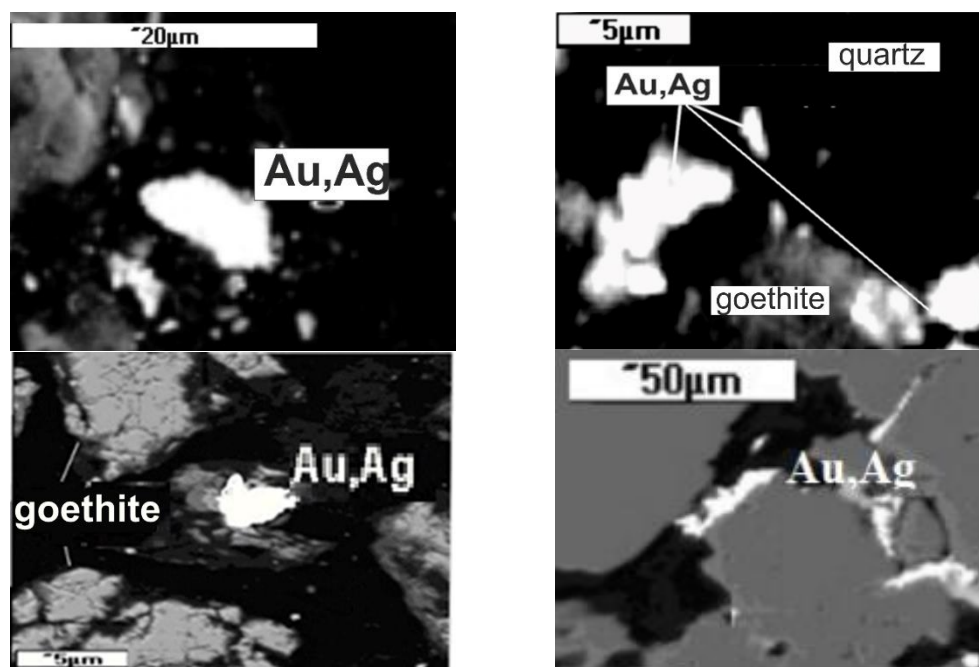


Figure 2. Morphology and sizes of pure gold grains in association with iron hydroxides in oxidized ores.

For the oxidation zone, pure gold is thin-grained (up to 3-10 μm ; Fig. 2). The amount of purity varies from 645 to 952.

Table 2: Chemical composition of primary and oxidized minerals in mineral deposits

Components in %	Oxidized minerals		Primary minerals	
	III-21	III-28	III-42	III-47
SiO ₂	68,44	69,71	72,23	67,28
TiO ₂	0,6	0,48	0,61	0,84
Al ₂ O ₃	12,62	13,56	11,78	14,34
MgO	1,62	1,56	2,02	2,21
MnO	0,01	0,02	0,01	0,02
CaO	1,72	1,32	1,22	1,24
Na ₂ O	2,21	1,86	1,36	1,16
K ₂ O	1,92	2,12	2,28	2,28
P ₂ O ₅	0,17	0,16	0,17	0,18
SO ₃	0,63	1,08	1,5	1,63
SO ₃	0,52	0,88	0,16	0,18
S	0,1	0,12	0,48	0,87
Fe ₂ O ₃	5,68	4,32	3,73	4,16
Fe ₂ O ₃	4,84	3,52	2,16	2,44
FeO	0,45	0,51	1,24	1,36
ppp	3,02	2,96	2,43	4,1
H ₂ O	0,58	0,12	0,14	0,28
CO ₂	0,42	0,4	0,45	0,22
Elements** g/t	The amount			
Au***	1,20	1,4	1,60	1,20
Ag***	1,0	0,4	0,3	0,5
Pt	0,011	0,006	0,007	0,006
Te	0,08	0,08	0,11	0,08
Se	4,59	4,08	4,64	4,08
As	266	102	17,3	10,2
Sb	13,2	10,6	8,2	10,6
Bi	0,33	0,3	0,24	0,29
Cu	25	43	27	43
Pb	16,4	19,7	14,7	19,7
Zn	46	106	162	106
W	5,91	2,35	1,83	2,35
Mo	3,29	4,91	4,32	4,91
Sn	3,08	3,14	2,55	3,14

The chemical compositions of endogenous (primary) and exogenous (secondary oxidized) ores in the field were determined (Table 2).

The amount of Fe₂O₃ in the chemical composition of oxidized ores, and the amount of sulfur sulfide in primary ore is much higher. There are no significant differences in the chemical composition of minerals in terms of other main components. Fractional changes in silica content depend on the composition of primary rocks and their degree of quartzization. The amount of harmful additives in the mine is not very high: margiumush - 10-266 g/t, antimony - 10.6-13.2 g/t, sulfur sulfide - 0.48-0.72%.

According to information: *chemical; ** mass spectrometric; ***probe analysis

The mineralized zones on the surface of r are manifested in the form of zones of grinding, quartzization and strong ironization of the rocks, which are almost parallel to the sublatitudinal direction (Fig. 3). It should be noted that the location of these zones may correspond to the zones of strong crushing and strong quartzization of rocks (probably with the directions of placement of vein-magmatic bodies).

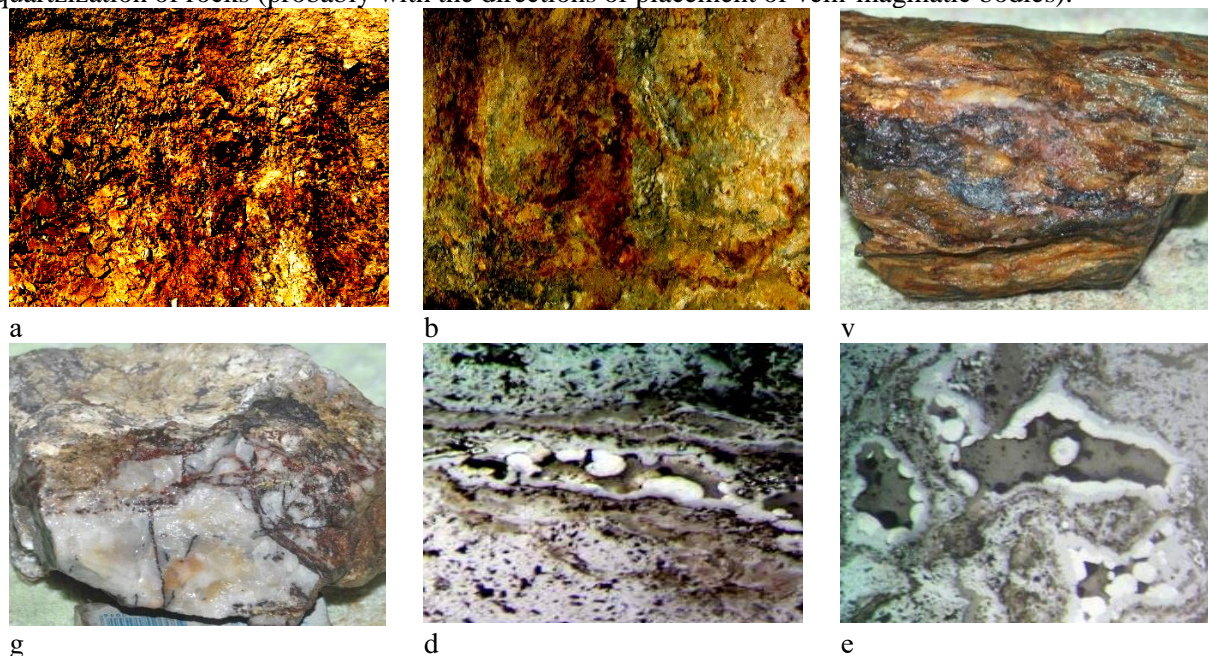


Figure 3. Mineralized zones located on the surface of the earth (a-b); association of iron hydroxides and quartz in mineralization zones (v-g); Vein-flow formations of hydrogethite developed on jarosite (d-e)

DISCUSSION

Many cracks in the form of cells, lenses and crossing veins are observed in the quartz veins (Fig. 3c). They are filled with secondary minerals goitite, hydrogyotite. Along the quartz cracks (Fig. 3g) iron hydroxide and various elongated separations - intersecting veins, veinlets and lens-like bodies are developed.

The fertilizing zone in shales is composed of limonite mass and is characterized by uneven distribution of rock-forming eroded and residual mineral grains, which make up 60-70% of the total rock mass. Limonite is formed from mixtures of iron hydroxides, the main components of which are goethite and hydrogyotite.

CONCLUSION

In the Shokhetov and Peschanoe fields in the Auminza Mountains, the oxidized ores are located above the limits of the oxidation zone and are composed of a loose mass of weathered rock-forming minerals and unevenly distributed residual limonite grains. Gytite, hydrogyotite, limonite, jarosite, clay minerals and others can be mentioned as the main minerals of the oxidation zone. In the oxidation zone, pure gold has

formed fine-grained particles, the degree of authenticity varies in the range of 645-952.

Mineral assemblages in the oxidation zone are located in a unique zoning pattern: in the lower part, directly above the boundary of the oxidation zone, there are gold-jarosite-hydrolyte associations containing pure gold, and above it there are gold-hydrogeotite-kaolinite associations. Directly on the surface of the earth there are secondary rocks that have undergone strong weathering.

REFERENCES

Amirov EM (2019). Accessory minerals of rocks of Shokhetov leucogranite complex in Auminzatov mountains (Western Uzbekistan). Reports of the Academy of Sciences of the Republic of Uzbekistan. **5**, pages 107-113

Amirov EM, Karabaev M.S., Djurabaev AB, Orolov AK (2019). New information on the composition of intrusive rocks of Auminzatov Mountain (Western Uzbekistan). Collection of Materials from International Conference and practice conf. Actual problems of oil and gas geology and innovative methods and technologies of the development of hydrocarbon potential. 293-298 p.

Bukharin AK, Maslennikova IA, Pyatkov AK (1985). Domeozoic structural and formation zones of Zapadnogo Tyan-Shanya, T. *Science*, 152 p.

Karabaev MS (2017). Mineralogical and Geochemical Features of Gold and Gold-Rare Metal Mineralization of the Auminzatau and Bukantau Mountains, and Prospecting-Evaluation Criteria: *Author's Abstract of Doctoral Dissertation in Geological and Mineralogical Sciences*. 78 p.

Kotov NV, Poritskaya LG (1991). Features of Geological Structure, Mineral Associations of Metasomatites, and Questions of the Genesis of the Muruntau Gold Deposit (Central Kyzylkum Desert). *Proceedings of the All-Russian Mineralogical Society*. **4** 59-69 p.

Protsenko VF Gold Ore Mineragenesis in Chernozlantsev Thickets in Western Uzbekistan. In: *Proceedings of the Uzbekistan Geological Society*, Issue 40, 24-30.

Shayakubov TN, Golovanov IM, Tsoi R.V (1998). PhD Thesis: Geology and Mineral Resources of the Republic of Uzbekistan. Pages 534-577

Sshcherban IP, Tsoi RV, Ivanov IP (1990). PhD Thesis: Ore-Bearing Metasomatites of Western Uzbekistan. Moscow, Nauka, 189 pages.