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Mineral And Geochemical Features Of Mineralized Zones Eastern Jamansai Section (Sultan-Uvais Ridge)

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ABSTRACT

This article is devoted to analyzes the issues of mineral and geochemical features of mineralized zones: eastern Jamansai section (Sultan-Vvais ridge). Productive mineralization of the eastern Jamansai site is associated with metamorphogenic transformations of rocks of the Sultanuvai, Jamansai, Beshmazar, Kazansai formations, metamorphosed under the conditions of the green-shale facies. Mineralized zones of the site are confined to narrow faults in tectonic zones of the northeastern and northwestern directions.

KEYWORDS

Sultan-Uvais, mineralized zone, Sultanuvai Formation, Jamansai Formation, hornfels-like quartz metasomatites, carbonaceous-mica-quartz silty schists, ore occurrences, metasomatites, gold-bearing mineralization, hydrothermal and hypergene processes, petrographic composition, gold composition, gold, content, search criteria, mineralization.

INTRODUCTION

The main form of manifestation of gold-bearing mineralization is small steeply dipping veins, lenses, nests, non-extended systems of conformal and intersecting quartz veinlets containing disseminated pyrite, arsenopyrite, chalcopyrite and pyrrhotite, which are represented by the gold-carbonate-quartz natural type of ore.

THE MAIN FINDINGS AND RESULTS

The Jamansai area (27 km^2) is located on the territory of the Karauzyak region of the Republic of Karakalpakstan in the southwestern part of the Sultan-Uvais mountains (Fig-1).

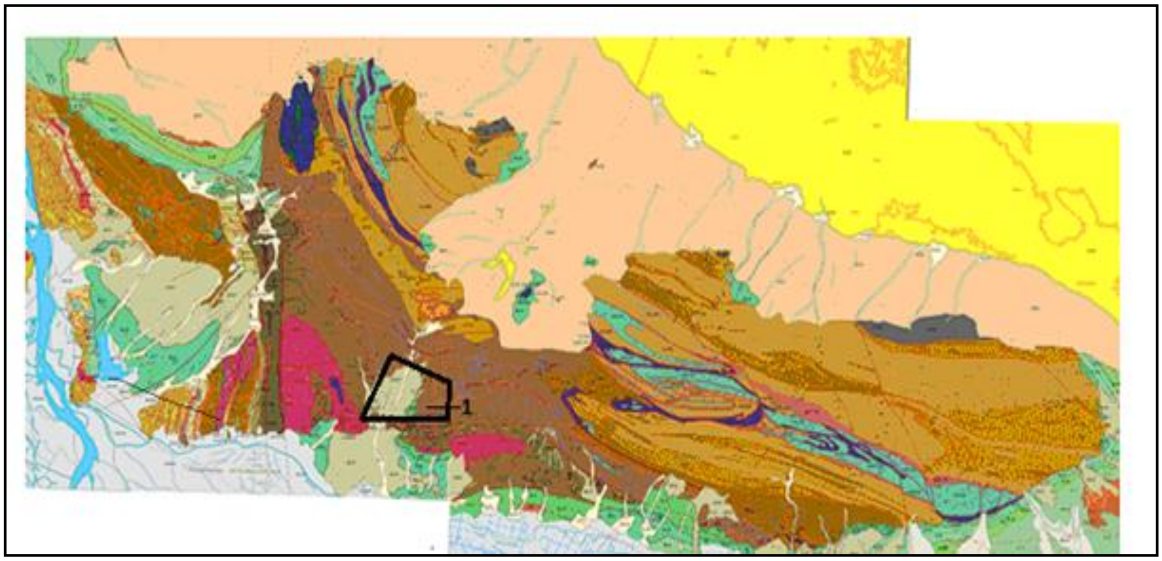

Figure 1. Geological map of the Sultan-Uvais mountains at a scale of 1: 50,000. Nikitina O.N., 2007 (1- the location of the mineralized zones of the eastern Jamansai site)

The area is located on the western wing of the structure of the junction of plicative deformations of the Tien Shan and Ural directions in the western part of the Sultanuvai anticlinorium. The reversal area of the structures is, in fact, a large horizontal fold with a steep, almost vertical hinge. The fold core is complicated by fine injection folds. The strikes and thicknesses of the members often and sharply change here. The fold wings are complicated by flexural bends, which play an important role in the placement of gold mineralization (Fig. 2).

The structure of the area is determined by the horizontal reversal of large plicative structures (anticlinoria), latitudinal flexural bending of the strike of the strata and faults of sublatitudinal and northwestern strikes, many of which are considered structures that feather the Urusay deep fault.

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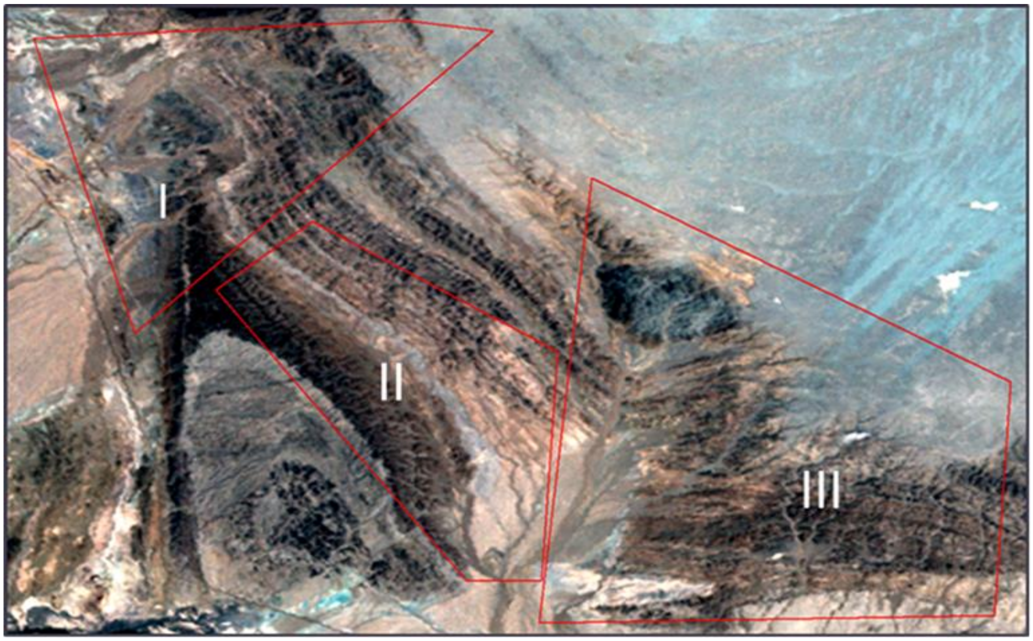

Figure 2. Cosmo-structural map of Jamansai area:

I-Northern-Jamansai area,

II-Central Jamansai area,

III- Eastern Jamansai area

The study of the material composition of the mineralized zones of the East Jamansai site was carried out by L.Z. Paley, V.V. Baranov, K.M. Kramskoy, G.Yu. Alferov, A.A. Kulesh, S.S.Shultz, K.A. Keshishyan , G.R.Yusupov, D.T.Boyonov, Kornienko.Yu.N., O.N. Nikitina, Kh.Shomuratov, V.A.Khokhlov and many others.

The area is composed of terrigenous and volcanogenic formations of the Sultanuizdag and Jamansai formations of the Lower and Middle Devonian age, metamorphosed under the conditions of the sericite-chlorite sub-facies of green shales, respectively.

Sultanuizdag Formation S (?) Sl. The formations of the suite are framed in the northeast and north by the Aktau granodiorite massif and its eastern field. The suite is composed of foliated metasandstones and meta-siltstones of quartz-feldspar composition with interlayers of mica-quartz, amphibole, phyllitic and carbonaceous-quartz-siliceous biota. The formation is 800 m thick.

Jamansai Formation D1-2dž. The formation is traced from the Tebinbulak intrusion in the northwest to the left bank of the Jamansai and further southeast to the lower reaches of the Kakhralysai. The section of the suite is subdivided into three units: at the base (unit 1) - a horizon of marbleized radiolarian limestones 25–120 m thick; Unit 2 - interbedding of siliceous quartzite and quartz-mica, carbonaceous-quartz, carbonate shales and thin layers of limestone and chert with goethite-pyrolusite dissemination 250 m thick; Member 3 - siliceous, quartzite, quartz-plagioclase, mica-quartz-plagioclase amphibole schists with thin interlayers of marbleized crinoid limestones and micaceous schists with a horizon of greenstone-altered effusive rocks (metabasalts) up to 330 m thick.

The material composition of mineralized zones

In the East Jamansai site, six varieties of rocks are noted, which are represented by several lithological varieties with an intense manifestation of hydrothermal and hypergene processes. Below is a description of the varieties of breeds.

I. Coal-mica-quartz silty schists. The rocks are dark gray, almost black in color, shale, with a banded texture; in some areas there is micro-folding. Subconforming interlayers of fine-grained quartz are noted. The banding is expressed by the uneven distribution of schistosity-oriented sericite flakes, veins of carbonate, hematite, and lenticular quartz grains. Accumulations of carbonaceous particles are noted along the schistosis cracks, and biotite is often found in these areas.

The rock contains a single dissemination of pyrite. Some ore minerals are represented by goethite, hematite, and limonite. The gold content in this difference is <0.01 g / t, silver 0.8-1 g / t. Of the accompanying elements, there are (n · 10-3%): Pb 0.2-20; Zn 0.07-20; Cu up to 3; As up to 30; Sb up to 5-15; Bi up to 0.07.

II. Hornfelike quartz meta-somatites. Macroscopically, these are greenish-gray rocks, fine-grained. The structure is granoblastic, hornfels, the texture is massive, less often schistose, platy. The rock consists of polygonal quartz grains tightly adjacent to each other. The amount of quartz reaches 50.0 - 90-95%, the grain size is 0.03-0.05 mm.

The gold content in this difference is from <0.1 to 0.02-0.12 g / t, silver 0.2-0.9 g / t, from the accompanying elements, the following elements are installed (n 10-3%): Pb 0.2-20; Zn 3-20; Cu 3-30; As 1-7 to 15-30; Sb 5-15; Mn 20-50 to 200-700.

Fragments of meta-effusive rocks are sometimes noted among the granoblastic mass of quartz.

III. Crystalline intensely altered amphibole schists. The rocks are coarsely shale, with areas of massive texture; the structure is uneven-grained, nematolepidogranoblastic, nematogranoblastic. The rocks are chloritized, epidotized, and zoisite is widely developed. Coloring from bluish gray to greenish. The chemical composition is as follows (%):

Mineral composition (%): hornblende (47-50), quartz (14-15), pyrite (8-10), epidote, zoisite (3-5), chlorite (12-18), carbonate up to 5, iron hydroxides (3-4), leucoxene, rutile (1-1.5).

The dissemination of ore minerals is ubiquitous. The gold content in this difference is <0.1 g / t, silver 0.8 g / t. Among the impurities noted (n · 10-3%): Zn 3-5; Cu 0.1-10; As10.3 to 20; Sb 0.5-3; Mn 70, rarely up to> 1000.

IV. Manganese-bearing metasomatites, massive, almost black, granular rocks. In this variety, garnet-rhodonite and quartz-rhodonite-rhodochrosite varieties are distinguished.

The chemical composition of the garnet-rhodonite difference is as follows (%):SiO_2 43,4; Fe_2O_3 10,2; FeO 0,1; TiO_2 0,36; MnO 22,5; Al_2O_3 11,7; CaO 5,6; MgO 1,62; Na_2O 0,4; K_2O 0,02; P_2O_5 0,11; Total. 0,07; nnn 4,0; CO_2 1,76; SO_3 0,16; H_2O 0,46. Gold content <0.1 g / t, silver 0.6-1.1 g / t.

Mineral composition (%): garnet-50; rhodonite-36; carbonate-4; iron hydroxides - 10.

Quartz-rhodonite-rhodochrosite metasomatites have the following chemical composition (%): SiO_2 17,2; Fe_2O_3 11,9; FeO 0,1; TiO_2 0,1; MnO 40,2; Al_2O_3 0,17; CaO 4,5; MgO 0,43; Na_2O 0,12; K_2O 0,02; P_2O_5 0,11; Total. 0,07; nnn 26,5; CO_2 26,0; SO_3 0,03; H_2O 0,3. Gold content 0.023g / t, silver 0.9g / t.

V. Carbonate marbleized rocks with nested accumulations of quartz and limonite impregnation along cracks. The texture is massive; the structure is mostly fine-grained, although there are also more coarse-grained varieties.

The amount of carbonate is up to 90-100%. The carbonate contains quartz, single laths of biotite and chlorite. Gold content 0.042g / t, silver 1.8-1.93g / t.

VI. Vein quartz with fragments of rocks of various compositions, carbonate, nesting accumulations of feldspar, often kaolinized with limonite. Native gold is found in some veins. Gold content <0.1-3.46 g / t, silver 0.1-0.3 g / t.

Mineral composition of ores

At the site, 24 minerals were identified, of which 18 are hypogenic and 6 are hypergenic. Below is a description of the main minerals (Betekhtin, 1950, Spravochnik ..., 1988, Winchell, 1949).

Native gold was found in two polished sections ranging in size from <0.003 to 0.2x0.03 ÷ 0.05mm. Color from bright yellow (sunny) to light yellow. The shape is from dotted to elongate with thickenings. Native gold is confined to goethite, ocher accumulations of limonite, carbonate and quartz.

The content of gold and silver, according to X-ray spectral local analysis, is not identical, but varies from 58.18 to 90.94% gold and from 41.41 to 84.66% silver. This indicates the presence of high-grade gold and electrum.

Pyrite. It is found in an amount from single grains to 0.1-0.3% in almost all varieties of rocks. Grain size from <0.003 to 0.02-0.07 mm; form - cubic crystals, xenomorphic grains and relics in goethite-limonite accumulations. The form of manifestation is dissemination, threadlike accumulations of schistosity. It is confined to the contacts of grains, to rock cracks. Most of the pyrite is replaced by goethite and limonite.

Pyrrhotite. A rare mineral. It is found in vein quartz, contains ingrowths of nonmetallic minerals. Size up to 0.03mm, irregular shape.

Goethite. A widespread mineral in all identified rock varieties. Distributed very unevenly, from 0.11 to 10-13%. The shape is different - cubic, xenomorphic, aggregative clusters of crystals. Size from <0.01 to 1-3mm, very rarely up to 1x0.3cm. It is confined to cracks, grain contacts, boundaries of quartz and rock fragments, to carbonate. It is distributed unevenly, forming thickenings along the shear planes. Goethite replaces pyrite everywhere, and itself passes into ocher limonite.

Hematite. It occurs in garnet-rhodonite metasomatites as pseudomorphs after goethite. The forms of excretion are lamellar, edged, and lacy. Content up to 1.5%.

Pyrolusite. It is found in rhodochrosite-rhodonite varieties of metasomatites, where it often replaces Mn-carbonate. Forms of excretion are loose, powdery black clusters.

Distribution of basic and associated rock elements

Gold. The gold content in all types of rocks does not exceed 0.1 g / t. In carbonate-quartz veins with limonite, elevated gold contents are rarely observed (3.46 g / t). The mineral form of manifestation is native gold, electrum.

Silver. The silver content in all types of rocks does not exceed 0.1-1.8 g / t. Silver is part of electrum, native gold.

Barium. It is found in small amounts in silty schists (10-5) · 10-3%, in hornfels and quartz veins. The content of the element in them does not exceed 3-20 $\cdot 10^{-3}$%. Barium is practically absent in amphibole schists and quartz-garnet-rhodonite metasomatites.

Beryllium is noted sporadically. The content (n$\cdot 10^{-3}$%) in silty schists (0.03-0.7), in hornfels and amphibole schists up to 0.07-0.2. It is practically absent in other types of rocks.

Vanadium. In silty schists, it is present in an amount of 15÷>100$\cdot 10^{-3}$%. In hornfels, the content reaches 11,5-30$\cdot 10^{-3}$%, in carbonate rocks 0,3-1,5$\cdot 10^{-3}$%, in quartz 0,5-15$\cdot 10^{-3}$%. In amphibole schists, rhodonite-bearing metasomatites are practically absent. Apparently, vanadium is part of the clay minerals formed from feldspar.

Bismuth. It is noted in the amount of 0,07-0,2$\cdot 10^{-3}$% in all types of rocks with the exception of amphibole schists and rhodonite-bearing metasomatites.

Tungsten. It is constantly observed in silty schists, hornfels and carbonates in the amount of 0,07-5$\cdot 10^{-3}$%. In half of the samples in quartz, it is noted in the amount of 1-3$\cdot 10^{-3}$%.

Gallium. It is present in all varieties in a content of 0,2-10$\cdot 10^{-3}$%.

Germanium. The content in the rocks is 0,1-2$\cdot 10^{-3}$%, very rarely reaches >10$\cdot 10^{-3}$% in rhodonite metasomatites. Absent in carbonate rocks.

Cadmium. It occurs sporadically in metaterrigenous rocks, and is absent in carbonate rocks, amphibole shales, and rhodonite metasomatites. Content - 0,05-0,2$\cdot 10^{-3}$%.

Cobalt. Widespread element. The maximum contents - 20-50$\cdot 10^{-3}$% are recorded in rhodonite metasomatites. In other types, the content of cobalt with its uniform distribution does not exceed 0,05-7$\cdot 10^{-3}$%.

Manganese. In rhodonite with pyrolusite rocks, it is the main element; it is a part of carbonates, silicates and Mn oxides. Quite high contents are found in quartz veins (up to >1000$\cdot 10^{-3}$%). In other types of rocks, the Mn content varies from 5 to 700$\cdot 10^{-3}$%. Mineral form - rhodonite, rhodochrosite, pyrolusite.

Copper. The maximum copper content is established in rhodonite metasomatites - 50-100$\cdot 10^{-3}$%. In silty shales, the contents vary within 3-100$\cdot 10^{-3}$%, in hornfels ~ 45% of the samples contain copper in an amount of 3-30$\cdot 10^{-3}$%, and in carbonate rocks the copper content does not exceed 1,5$\cdot 10^{-3}$%. The mineral form, apparently, is a fine dissemination of chalcopyrite.

Molybdenum. It is constantly present in silty schists (1-10$\cdot 10^{-3}$%), hornfels - 0,01-1,5$\cdot 10^{-3}$%, amphibole shales - 0,02-0,1$\cdot 10^{-3}$%. In rhodonite metasomatites, it is noted in 60% of samples in the amount of 0,5-1$\cdot 10^{-3}$%; in carbonate rocks, the content of molybdenum is 0,5-1$\cdot 10^{-3}$%, and in quartz veins - 0,3-1,5$\cdot 10^{-3}$%.

Arsenic. It is a widespread element. In silty schists, the content (n$\cdot 10^{-3}$%) is 10-50, hornfels - 1-30; amphibole shales up to 0.3-20; rhodonite metasomatites - 30-70, rarely dropping to 2. In carbonate rocks, the As content is 7-10, in 60% of quartz veins it ranges from 7-15 to 100-200, in 40% of veins As is absent.

Nickel. It is present in all types of rocks, with the exception of rhodonite metasomatites. In silty schists and hornfels, the Ni content is -0,7-15·10^{-3}%; amphibole shale 0,1-20·10^{-3}%; carbonates 0.3-0.7; quartz veins 1-10·10^{-3}%.

Tin. It is noted almost everywhere (Table 4.1.6). The content in all types of rocks is 0,05-0,5·10^{-3}%. Only in rhodonite metasomatites does it rise to 10-20·10^{-3}%.

Lead. It occurs in an amount of 0,3-20·10^{-3}%. The maximum content (20·10^{-3}%) is recorded only in the hornfels. In amphibole shales, lead is practically absent.

Antimony. It occurs in all types of rocks with the exception of rhodonite metasomatites. The Sb content in silty shales is 7-10·10^{-3}%, hornfels 0,5-3·10^{-3}%, amphibole shales 0.5-3 10-3%, carbonate rocks content in some samples does not exceed 1,5·10^{-3}%.

Zinc. In silty schists, the zinc content (n·10^{-3}%) is 0.07-70, hornfelses 3-20, amphibole schists up to 3-5, in 78% of quartz veins the Zn content is 1.5-10.

Thus, the elements accompanying gold in the studied types of rocks are present in very small quantities. These elements include - As, Pb, Bi, Zn, Cu, Ag.

CONCLUSIONS

1. Productive mineralization of the Vostochny Jamansai site is associated with metamorphogenic-metasomatic transformations of thinly interbedded volcanogenic and terrigenous-sedimentary host rocks of the Sultanuvai and Jamansai formations metamorphosed under the conditions of the green-shale facies.
2. The main form of manifestation of gold-bearing mineralization is small steeply dipping veins, lenses, nests, non-extended systems of conformal and intersecting quartz veins (vein thickness from 0.1-0.2 m to 0.5-1.0 m in swells, silicified selvages more than 10 m). Ore quartz from off-white to gray, brownish-gray color, intensely fractured, containing poor dissemination of pyrite and very insignificant amounts of arsenopyrite, chalcopyrite and pyrrhotite.
3. Thin zones of mineralized rocks are confined to areas of increased dislocation of rocks due to the influence of the structures of the Urusay deep fault, axial zones of compressed folds or flexural bends of strike.
4. Native gold is confined to goethite, ocher accumulations of limonite, carbonate and quartz.
5. In native gold, according to the data of X-ray spectral local analysis, from 58.18 to 90.94% of gold and from 41.41 to 84.66% of silver are found, which indicates the presence of high-quality gold and electrum.
6. There are practically no significant gold grades in various types of rocks. The complex of elements accompanying gold is very insignificant (As, Pb, Bi, Zn, Cu, Ag.). The form of gold occurrence is native and electrum, associated with early sulfide pyrite-arsenopyrite paragenetic mineral association.
7. On the eastern Jamansai site, ore mineralization is represented by - gold-carbonate-quartz natural type of ore.

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