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MINERALS OF THE GUZHUMSAY DEPOSITS OF THE ZARMITAN GOLD FIELD LOCATED IN THE GRANITOID INTRUSIVE (UZBEKISTAN)

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ANNOTATION

Modern methods of nanomineralogy (electron microscopy, electron probe microanalysis) were used to study the ores of one of the largest industrial facilities of the Republic of Uzbekistan – the Zarmitan gold zone, including the Zarmitan, Urtalik, Guzhumsay deposits, which are located in the Koshrabad granosyenite massif. The development of / Au-W / Au-Bi-Te / Au-As / Au-Ag-Te / Au-Ag-Se / Au-Sb-Ag / Au-Hg / types of ores. Productive mineral-geochemical types of ores are Au-Bi-Te gold-bismuth-telluride, represented by maldonite, tellurides and sulfosalts of bismuth: hedleyite, joseite, tsumite, tetradymite, matildite, treasure, and also Au-Sb-Ag gold-silver-sulfoantimonide type represented by aurostibite, sulfoantimonides Pb, Fe, Ag: plagionite, jamsonite, boulangerite, goodmundite, ovikhiite and gold-pyrite-arsenopyrite with nanogold, lellingite, gersdorfite. The main industrial resource of gold is provided by Au-Bi-Te, Au-Sb-Ag and partially Au-As types. The objects of the Zarmitan zone belong to the orogenic type of gold deposits associated with the intrusion. The established mineral and geochemical features of ores are direct signs of prospecting, typification and assessment of hidden gold mineralization of orogenic belts.

Keywords: Uzbekistan, orogenic, Zarmitan, Urtalik, Guzhumsay, Bi tellurides, sulfoantimonides, typification, searches.

INTRODUCTION

Zarmitan gold ore zone includes three deposits: Zarmitan, Urtalik, Guzhumsay, which are located in the Koshrabad intrusive. The most studied is the Zarmitan or Charmitan deposit [1, 2], which was considered as "gold-quartz", "gold-tungsten" [3, 4] or as "located in an intrusion" [5]. From three to six mineral associations were distinguished, and gold, quartz, arsenopyrite, pyrite, galena, bismuthine, antimonite, scheelite, etc. are indicated as the main minerals. Tellurides, sulfosalts, selenides and other minerals, due to their micro-nanosize, were considered rare. secondary, although they determine the geochemistry and mineralogy of gold, forming regular micro-nano-ensembles with it. The objectives of the study included the study of mineralogy and geochemistry of gold ores in order to determine the type of deposits, mineralogical, geochemical and other indicators of the forecast and search for objects of a similar type.

The study of the ores of the Zarmitan, Urtalik and Guzhumsay deposits was carried out on polished sections and briquettes with concentrates extracted from bulk samples. They accumulate, extract gold and the highest probability of occurrence of tellurides, sulfosalts and

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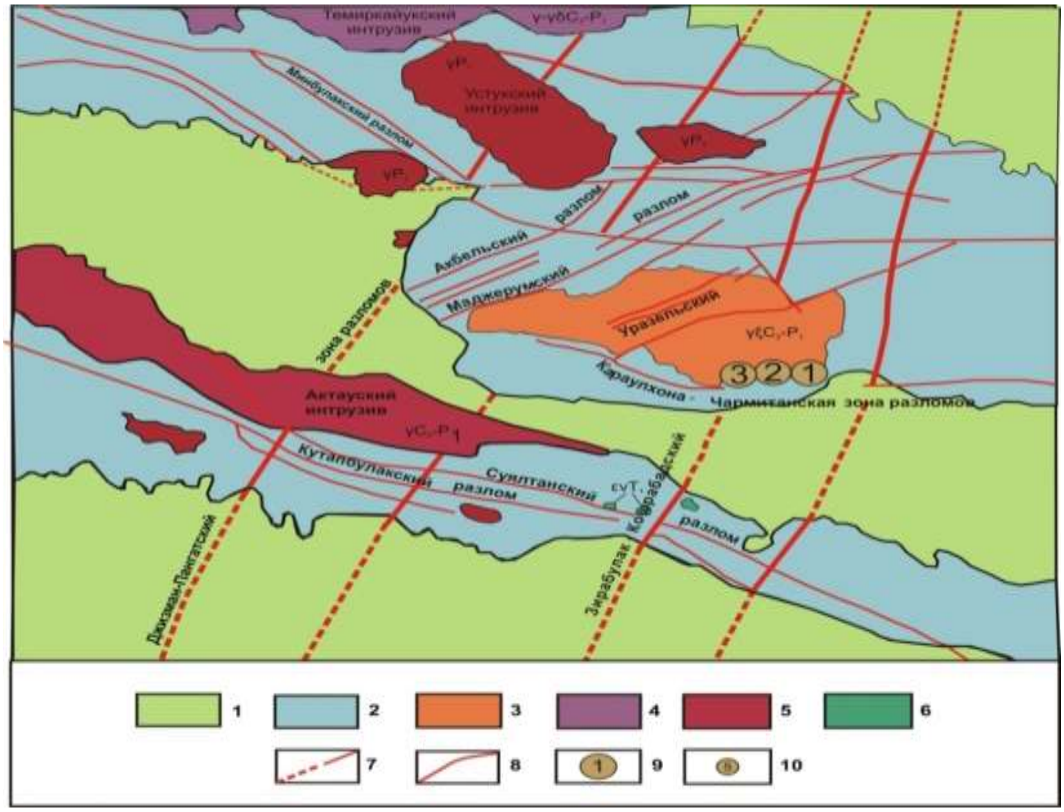
other "rare" minerals. We used a JXA Superprobe 8800R electron probe microanalyzer at the Institute of Geology and Geophysics, a Carl Zeiss electron microscope (SEM-EDX) at the Center for Advanced Technologies, Tashkent. In connection with the micro-nanosize of gold and accompanying minerals, the approaches developed for nanomineralogical studies were used [6, 7].

MATERIAL AND METHODS

The Zarmitan gold ore zone is located in the North Nurata mountains in the Turkestan accretionary complex of the Kyzylkumo-Nurata segment. Tectonically, the zone is confined to the junction of the intersection of the sub-latitudinal Karaulkhona-Zarmitan fault zone with the northeastern, hidden Zirabulak-Koshrabad fault, considered as a transform fault (Picture 1). The deposits are located in the southern endocontact of the Koshrabad granitoid intrusion and partially in the sandy-shale deposits of the Dzhazbulak suite (S1) (Picture 2). Intrusive rocks are classified as biotite-amphibole granosyenites [11] or mafic and quartz monzonites and granites with a rapakivi structure [12]. The age of the intrusion (U-Pb) and the age of mineralization by pyrite (Os-Re) are 283-286 Ma [8, 13]. Ore bodies form vein systems, linear stockworks, plate-like mineralized deposits. Samples of gold-quartz ores in Fig. 4. In the exocontact of the intrusion, andalusite schists, hornfels, marbleization and skarnings are developed. Near-ore alterations are represented by feldspar-quartz metasomatites (humbeyites), beresites, and rarely argillisites [11].



Picture 1. Schematic geological map of the North Nurata Mountains region

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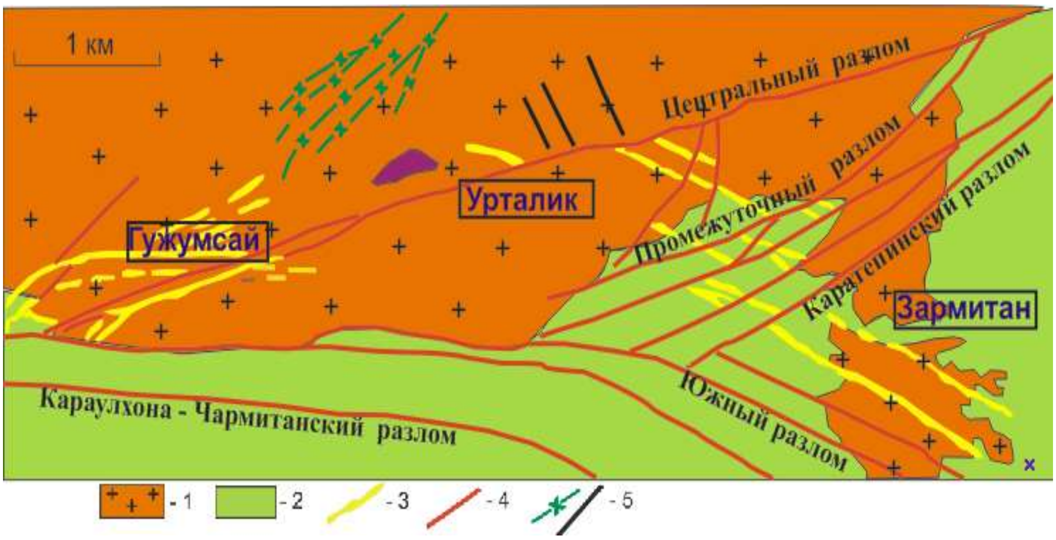
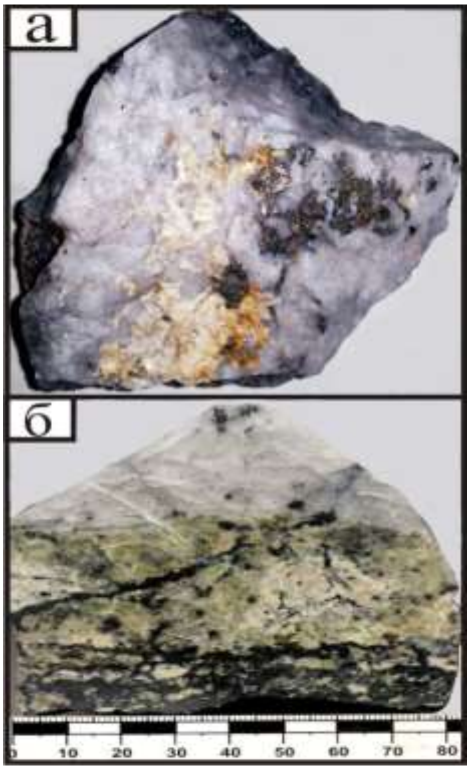
1-Mesozoic-Cenozoic deposits; 2-Paleozoic deposits; 3-granosyenites; 4-granites and granodiorites; 5-granites; 6-alkaline basalts; 7-foundation faults; 8-tectonic disturbances; 9-deposits (1-Zarmitan, 2-Urtalik, 3-Guzhumsay).



Picture 2. Geological map of the Zarmitan gold zone
1-Koshrabad multiphase array (C2); 2-sandy-shale rocks (S1dzb); 3- gold ore zones; 4-faults; 5-dikes.

The mineralogy of the ores of the Charmitan ore field was studied by R.P.Badalova, E.B.Bertman, N.S.Bortnikov, A.I.Glotov, E.I.Gromova, N.V.Kotov, V.A.Khorvat, G.M.Chebotarev, T.E.Eshimov, S.M.Koloskova, V.D.Soy, I.V.Koroleva, M.A.Kim, T.Graupner, R. Seltmann and others.

A.M.Glotov, E.I.Gromova [14] among the mineral associations of the Zarmitan deposit, distinguished gold-quartz, gold-bismuth-telluride, quartz-pyrite-arsenopyrite with scheelite and gold, polysulfide-sulfoantimonide with Ag tellurides and electrum. The development of gold-bismuth and gold-silver-antimony mineralization in ores was indicated by T.E.Eshimov, E.I.Gromova and others [15, 16, 17]. E.B.Bertman [1] distinguished scheelite-gold-quartz, pyrite-arsenopyrite, polysulfide, antimonite ore stages at the Zarmitan deposit. Scheelite is accompanied by maldonite, tetradymite, hedleyite; in polysulfide – boulangerite, jamsonite, zincite, sulfovismutides, tellurides Au, Ag. N.S.Bortnikov [2] distinguished five stages at the Charmitan deposit: I – quartz-scheelite-feldspar; II – quartz-gold-telluride; III – quartz-pyrite-arsenopyrite; IV – quartz-sphalerite-sulfoantimonide; V – quartz-carbonate-antimonite. T.Graupner and others [3, 4] distinguish 4 stages: I – quartz-feldspar; II – quartz-pyrite-arsenopyrite-scheelite-gold; III – quartz-sphalerite-galena-pyrite-sulfosalt-gold; IV – quartz-carbonate-fluorite-pyrite. I.O.Khamroev [18] classifies bismuth-telluride, pyrite-arsenopyrite and sulfide-polymetallic stages of the ore stage as productive for gold. He considers the early gold-bismuth-telluride stage to be the most important, and considers gold in the products of the pyrite-arsenopyrite stage to be inherited (reprecipitated) from the products of the previous bismuth-telluride stage. M.S.Koloskov [19] refers to the “stages of hydrothermal fracturing” of the Charmitan, Guzhumsay, Urtalik deposits: gold-quartz vein-vein; gold-pyrite-arsenopyrite-quartz vein-veinlet; pyrite-carbonate-chlorite breccia; gold-polysulfide-sulfosaline-quartz vein, veinlet; pyrite-melnikovite-chlorite and quartz-carbonate veinlets. V.D.Soy and others [20, 21] at the Guzhumsay and Urtalik deposits distinguish gold-pyrite-arsenopyrite-quartz, gold-polysulfide-carbonate-quartz and (gold)-silver-sulfoantimonide mineral associations productive for gold. In later associations, they note the development of sulfoantimonides, minerals of the composition Bi-Ag-Sb-Fe-S and maldonite (Au2Bi).



Picture 3. Samples of ores from the Zarmitan gold ore zone
a-quartz-sulfide ore with scheelite, Zarmitan; b-quartz-sulfide ore in altered granosyenites, Urtalik

Over the years from 1977 to 2017 information about the number and composition of mineral associations is changing. E.Bertman, T,Graupner, S.Koloskova, V.Soy do not distinguish the bismuth-telluride association of minerals.

RESULTS

It was previously established that As-Te-Bi-Au-Sb-Ag-Se-W-Pb-Hg are the geochemical leaders in the ores of the Zarmitan, Urtalik, Guzhumsay deposits in terms of concentration clarkes [6, 7]. Gold ores are distinguished, Au: Ag – 2: 1, Te: Se – 1: 2 and gold-silver, Au: Ag 1:12, Te: Se – 1: 5. The main vein minerals are quartz, albite, chlorite, sericite, and carbonates. Ore minerals are represented by scheelite, pyrite, arsenopyrite, chalcopyrite, sphalerite, galena, tetrahedrite, bismuthine, and antimonite. Sulfides make up 0.5-15% of ore bodies [11]. Fineness of gold in an ensemble with bismuth minerals is 850-980 ‰, admixtures of Bi, Hg, Se, Te (Bi and Hg up to 1%); with antimony – 750-850 ‰, Hg impurities up to 1.4%, rarely Cu. There are values from 700 to 350 ‰ associated with Au-Ag mineralization, petcite, hessite, naumanite, and aguilarite [6, 7]. Microanalyzer studies have shown that, in addition to native gold, maldonite (Au2Bi) and aurostibite (AuSb2) are found. Maldonite forms micro-nano-ensembles with tellurides, sulftellurides, Bi sulfosalts, aurostibite with Sb, Pb, Fe, Ag sulfoantimonides. Bismuth mineralization is distinguished in pyrite, arsenopyrite, quartz, antimony also in antimonite, galena. Nanomineralogical and geochemical studies carried out at the deposits of the Zarmitan gold ore zone showed that the ores were formed by a standard, consistent series of mineral-geochemical types of ores: / Au-W / Au-Bi-Te / Au-As / Au-Ag-Te / Au-Ag -Se / Au-Sb-Ag / Au-Hg. The main productive types are / Au-Bi-Te / gold-bismuth-telluride, / Au-As / pyrite-arsenopyrite, / Au-Sb-Ag / gold-antimonite-sulfoantimonide types; Au-Ag-Te, Au-Ag-Se, Au-Hg are not widespread. Au-As type of ore with nanogold is developed in all deposits, together with quartz, carbonates, occupying the main volume of ore bodies. The industrial resource is determined by Au-Bi-Te and Au-Sb-Ag types of ores.

Comparison with the well-known gold-ore giant Muruntau [24] shows that despite the different host environment - carbonaceous-terrigenous strata on Muruntau, granosyenites in the Zarmitan zone are identical in other parameters of the deposit: they are located in the South Tien Shan orogenic belt, at the intersection of its north -eastern, anti-Tien Shan, transform faults; granitoid magmatism and ore formation of a similar age (280-290 Ma); skarnification, feldspar metasomatism; multistage mineral formation process with a similar range of ore types; the same composition of the main productive types - / Au-Bi-Te / Au-As / Au-Sb /. As for the Au-Sb-Ag type, if in the Zarmitan zone it is combined in ore bodies with the previous ones, then in the Muruntau ore field the Au-Sb type is productive at the Amantaytau and Daugyztau deposits [6].

An example of Au-Sb deposits is Olympiada (Russia). According to SG Kryazhev, MS Rafailovich and others, the deposit is located in carbonaceous-terrigenous shales, framed by orogenic intrusions of granites and granite-gneisses. The productive stages are gold-arsenopyrite-pyrrhotite, polysulfide and gold-scheelite-antimonite-berthierite. The ores contain aurostibite, antimonite, berthierite, bournonite, jamsonite, and goodmundite. Gold fineness 910-997 ‰. Note that if there are no independent antimony and antimony-mercury deposits on the territory of Uzbekistan, then in the eastern part of the South Tien Shan orogenic belt, on the territory of Kyrgyzstan, such industrial objects as Kadamzhai and Khaidarkan are known. Note also that Au-Sb, antimonite-sulfontimonide mineralization is absent in the epithermal and Au-Cu porphyry deposits of the Chatkal-Kuramin region.

CONCLUSION

As a result of the studies carried out, it was established that Au-Bi-Te and Au-Sb-Ag types of ores are widely developed at the Zarmitan, Urtalik and Guzhumsay deposits, which, together with Au-As pyrite-arsenopyrite mineralization, provide the industrial resource of the Zarmitan gold zone. Au-Bi-Te mineralization is represented by tellurides, sulftellurides, Bi sulfosalts. This type of ore is the most productive for gold and is developed in all deposits. The Au-Sb-Ag type with boulangerite, jamsonite and other sulfoantimonides Pb, Fe, Cu, Ag is inferior to Au-

Bi-Te and its amount increases from Zarmitan to Guzhumsai. The Au-As type is the source of the disseminated nanogold. The rest of the types are not productive. The most striking feature of the development of certain types of gold ores is the presence of maldonite (Au2Bi) or aurostibite (AuSb2). The widespread development of Au-Bi-Te mineralization, the presence of scheelite, skarnification, the close age of mineralization and granitoid intrusion, make it possible to classify the objects of the Zarmitan gold ore zone as an orogenic type of deposits [22] associated with intrusions [23]. Deposits with Au-Sb-Ag mineralization obviously belong to the same type. N.S.Bortnikov [2], T.Graupner [4] established that the formation of gold mineralization of the Zarmitan deposit is provided by fluids of different origin. T. Graupner points out that data on isotopes of noble gases (3He / 4He) indicate the participation of deeply located sources in ore formation. DL Konopelko et al. [12] believe that mafic rocks, locally developed in the central part of the Koshrabad massif, are the result of fractional crystallization of alkaline-basaltic mantle melt.

The complex of geological, magmatic, structural, geochemical and mineralogical features is decisive as predictive and prospecting signs of hidden mineralization of Au-Bi-Te-W and Au-Sb-Ag types in orogenic belts.

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