Minerals of bismuth and antimony in original deposits of zarmitan gold zone, located in granitoid intrusion (Uzbekistan)

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Abstract. Modern methods of nanomineralogy (electron microscopy, electron probe microanalysis) were used to study the ores of one of the largest industrial facilities of Uzbekistan - the Zarmitan gold zone, which includes the Zarmitan, Urtalik, Guzhumsay deposits, which are located in the Koshrabadgranosyenite 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, sulfoantimonidesPb, Fe, Ag: plagionite, jamsonite, boulangerite, goodmundite, ovichiite 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 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.

1 Introduction

Zarmitan gold ore zone includes three deposits: Zarmitan, Urtalik, and Guzhumsay, 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 intrusive" [5]. Three to six mineral associations were distinguished, and gold, quartz, arsenopyrite, pyrite, galena, bismuthine, antimonite, scheelite, etc., are indicated as the main minerals. At the end of June 2021, the balance of gold and foreign exchange reserves of Uzbekistan decreased by about 1.4 billion dollars and amounted to 34.1 billion dollars. The main factor in the decline was another decline in gold quotes. This factor has reduced our reserves to about $ 1.2 billion. In the past, in the field of comprehensive geological study of the subsoil in the country, ensuring the effective implementation of programs for

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the development and replenishment of long-term mineral resources, rational use of mineral resources, and further increase their investment attractiveness. Several comprehensive measures have been taken to establish a single geological service to implement state policy.

At the same time, to increase the reserves of minerals in this area and ensure their rational use in the future, first of all, to create a sufficient raw material base for the organization of modern industrial production in the regions, special attention should be paid to:

- in-first, to fully adapt the system of training, retraining, and advanced training of specialists needed for the needs of the geological industry to modern requirements;
- secondly, to ensure an adequate link between education, science, and practice in the field of geology, the conditions for a real integration process between the earth sciences, including their fundamental areas and practice created;
- third, the introduction of clear criteria and effective mechanisms for the commercialization of scientific developments in the field of earth sciences;
- fourth, to attract honest and highly qualified staff to higher education institutions by creating financial incentives in the training system.

2 Methods and Materials

The implementation of investment projects for developing and processing gold deposits "Zarmitan" has necessitated the construction of the 4th hydrometallurgical plant in the Zarkent fortress in the short term. Construction of the plant began in September 2009 and was completed in July 2010. This is the only plant built rapidly in the plant system. The state-of-the-art technology and equipment manufactured abroad have been installed at the 4th hydrometallurgical plant. Sorting of crushed ore in a modern Finnish crusher S-125 is carried out in an automated system of hydrocyclones produced by a German company. Due to the commissioning of the plant, for the first time, the gravity sorting of fine gold is carried out by five centrifugal gravitational machines manufactured by the Canadian company Falcon. It is worth noting that the plant's technology is unique; the technological processes used modern technology and equipment, which has no analogs in the Commonwealth. The Zarmitan deposit, containing 84 major orebodies and numerous smaller veins, is partially hosted by the Koshrabad granitoid intrusion, the geochemical characteristics of which indicate a late orogenic affinity. The gold-bearing veins are distributed as a complex anastomosing east-west striking and concave to the north swarm. The strike length of this zone is approximately 7 km, and the thickness varies from 200 to 1,500 m. The total resource of the 84 major lodes is 32 million tonnes (Mt) at 9.8 g/t Au and 14.6 g/t Ag. Gold mineralization is associated with reverse vertical movement and left-lateral strike-slip displacement along high-angle faults, representing splays off the Karaulkhana-Charmitan fault zone. This fault is one of the major structures in the Northern Nuratau area. It is a major control on mineralization along the southern contact of the Koshrabad pluton, including the Zarmitan deposit. The highest gold grades and highest Au/Ag ratios are found in gold-bearing veins from the central part of the Zarmitan deposit, which is also characterized by abundant hydraulic breccias. This study considers new field and mine data from Zarmitan with earlier studies of the deposit and with recent models for intrusion-related gold deposits.

Six months after the commissioning of the plant, the crushing section, the second mill block in June 2012, and the second stage of the sorption section in February 2013 were commissioned. Hundreds of local workers are currently working at the plant.

Notably, the net volume of gold in reserves increased by 200 thousand troy ounces or 6.2 tons. Due to their micro-nanosize, tellurides, sulfosalts, selenides, and other minerals were considered rare, minors. However, they determine the geochemistry and mineralogy of gold, forming regular micro-nano-assemblies with it. The study's objectives included the study of the mineralogy and geochemistry of gold ores to determine the type of deposits, mineralogical, geochemical, and other indicators of the forecast and search for objects of a similar type. The ores of the Zarmitan, Urtalik, and Guzhumsay deposits were studied on polished sections and briquettes with concentrates extracted from bulk samples. They accumulate and extract gold and have the highest probability of occurrence of tellurides, sulfosalts, and other "rare" minerals. We used a JXA Superprobe 8800R electron probe microanalyzer at the Institute of Geology and Geophysics and 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].

3 System analysis

The Zarmitan gold ore zone is located in the North Nurata Mountains in the Turkestan accretionary complex of the Kyzylkumo-Nurata segment (Fig. 1). 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 (Fig. 2). The deposits are located in the southern and contact of Koshrabadgranitoid intrusion and partly in sandy-shale deposits of the Dzhazbulak Formation (S1) (Fig. 3). Intrusive rocks are classified as biotite-amphibole granosyenites [11] or mafic and quartz monzonites and granites with a rapakivi structure [12].

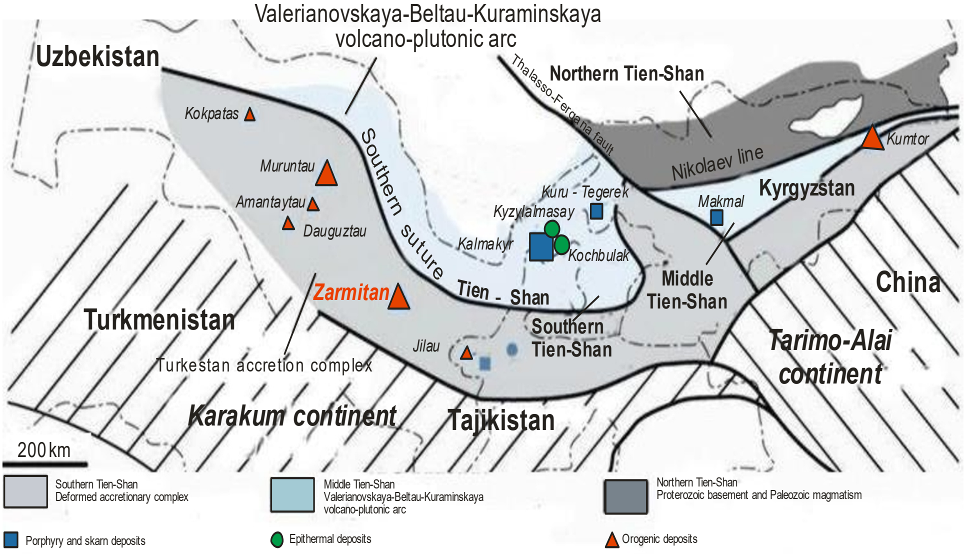


Fig. 1. Geodynamic settings and key gold deposits in Tien Shan [8]

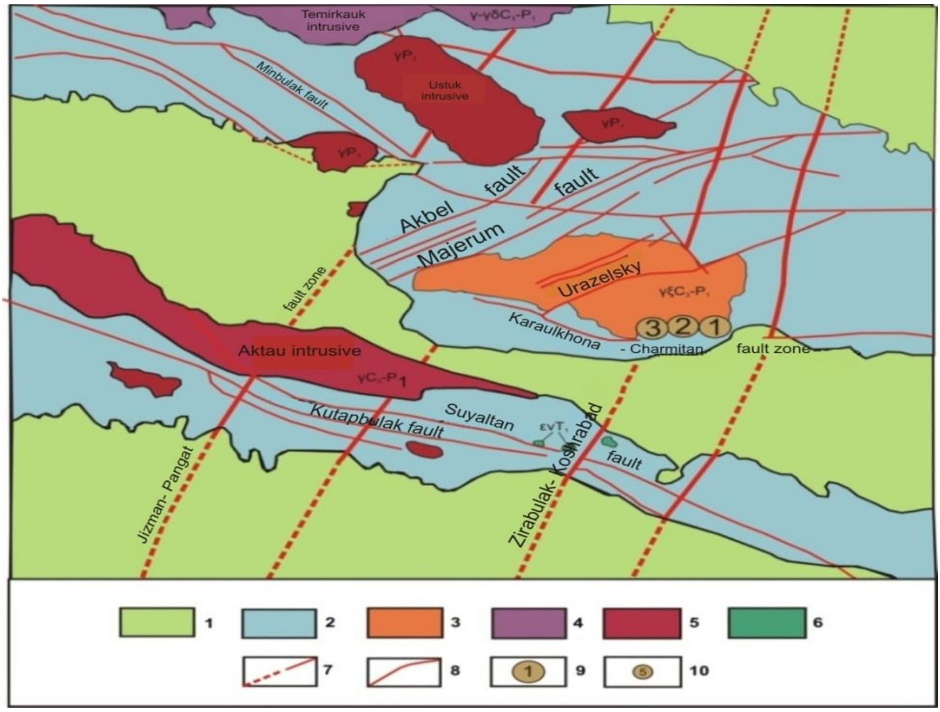


Fig.2. Schematic geological map of the North-Nurata mountains region [9]: 1 is Mesozoic-Cenozoic deposits; 2 is Paleozoic deposits; 3 is granosyenites; 4 is granites and granodiorites; 5 is granites; 6 is alkaline basalts; 7 is foundation faults; 8 is tectonic disturbances; 9 is deposits (1 is Zarmitan, 2 is Urtalik, 3 is Guzhumsay).

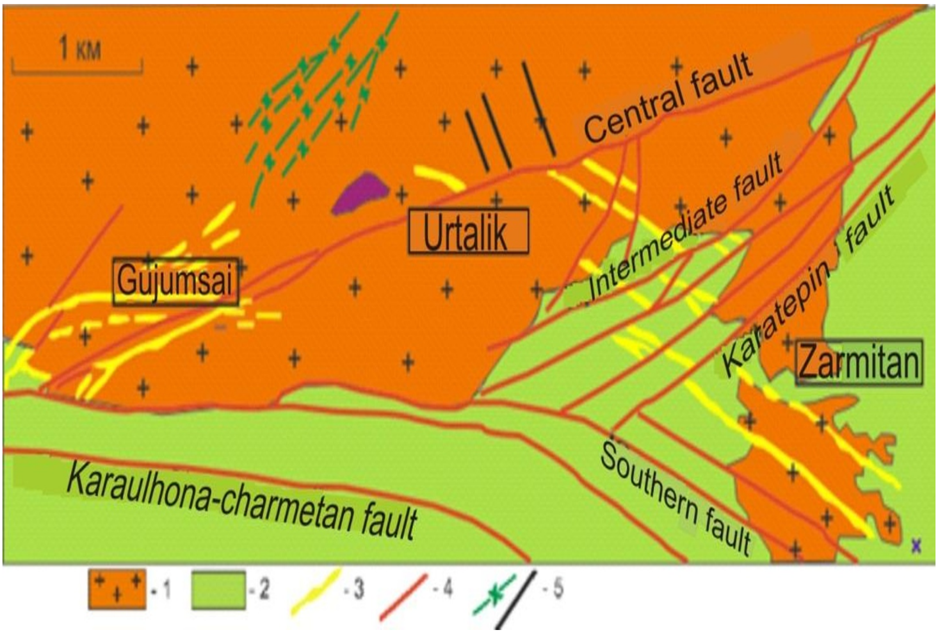


Fig. 3. Geological map of the Zarmitan gold zone: 1 is Koshrabad multiphase array (C2); 2 is sandy-shale rocks (S1dzb); 3 is gold ore zones; 4 is faults; 5 is dikes [10]

Koshrabad multiphase array (C2); 2 - sandy-shale rocks (S1dzb); 3 - gold ore zones; 4 - faults; 5 - dikes [10] mineralization by pyrite (Os-Re) is 283-286 Ma [8, 13]. Ore bodies form vein systems, linear stockworks, and plate-like mineralized deposits. Samples of gold-quartz ores in Fig. 4. In the exocontact of the intrusion, andalusite schists, hornfelses, marbleization, and skarnings are developed. Near-ore alterations are represented by feldspar-quartz metasomatites (humbeyites), beresites, and rarely argillisites [11].

4 Mineralogy of ores

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. Tsoi, I.V. Koroleva, M.A.Kim, T.Graupner, R.Seltmann and others.

AM Glotov, EIGromova [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 TE Eshimov, EI Gromova, and others [15, 16, 17]. E.B. Bertman [1] distinguished scheelite-gold-quartz, pyrite-arsenopyrite, polysulfide, and antimonite ore stages at the Zarmitan deposit. Scheelite is accompanied by maldonite, tetradymite, hedleyite; in polysulfide-boulangerite, jamsonite, zincenite, sulfovismutides, tellurides Au, Ag. NS 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 et al. [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 [14] 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. MS Koloskov refers to the "stages of hydrothermal fracturing" of the Charmitan, Guzhumsay, and 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. VD Tsoi et al. [15] at the Guzhumsay and Urtalik deposits distinguish gold-pyrite-arsenopyrite-quartz, gold-polysulfide-carbonate-quartz and (gold) -silver-sulfoantimonide mineral associations productive for gold. Later associations note the development of sulfoantimonides, minerals of the composition Bi-Ag-Sb-Fe-S and maldonite (Au2Bi).

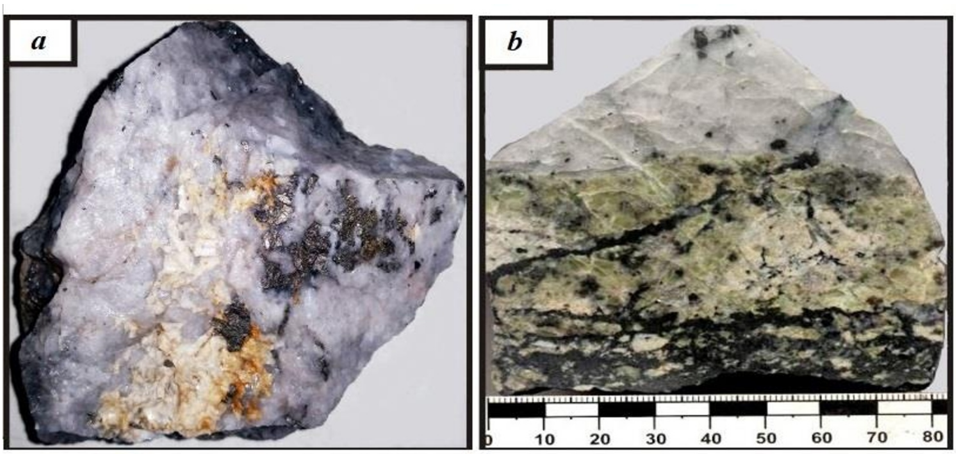


Fig. 4. Samples of ores from the Zarmitan gold ore zone. a is quartz-sulfide ore with scheelite, Zarmitan; b is quartz-sulfide ore in altered granosyenites, Urtalik

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. Tsoi do not distinguish the bismuth-telluride association of minerals.

5 Results

Earlier, it was found 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]. The fineness of gold in an ensemble with bismuth minerals is 850-980 ‰, with impurities of Bi, Hg, Se, Te (Bi and Hg up to 1%); with antimony - 750-850 ‰, Hg impurities up to 1.4%, rarely Cu. Values from 700 to 350 ‰ are 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 (Table 1). Bismuth mineralization is distinguished in pyrite, arsenopyrite, quartz (Fig. 5, a, b, c), antimony, and galena (Fig. 5, d, e, f). Nanomineralogical and geochemical studies carried out at the deposits of the Zarmitan gold ore zone showed that a standard formed the ores, sequential 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 / (Table 2). 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.

An example of Au-Sb deposits is Olympiad (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.

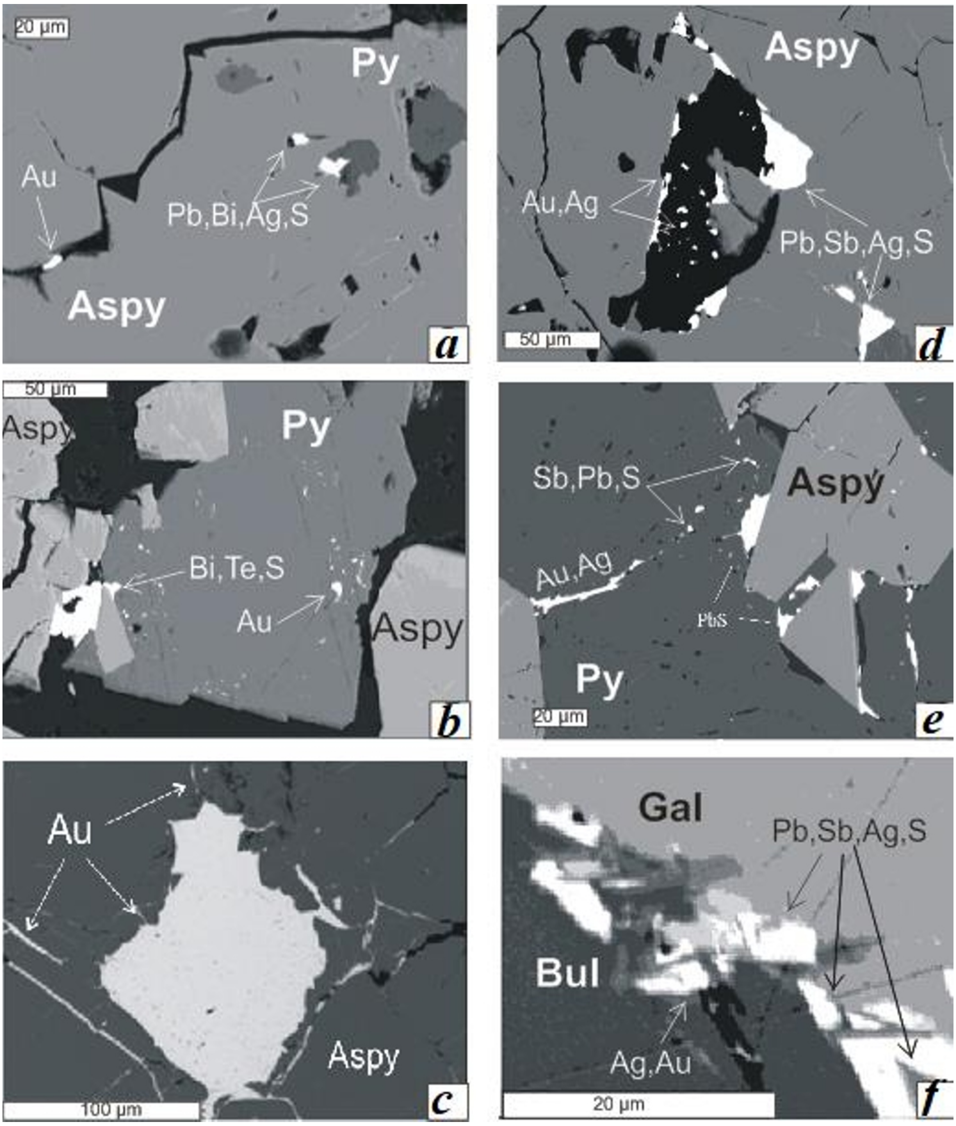


Fig. 5. Micro-nano-assemblies of gold (Au, Ag), bismuth (a, b, c), and antimony (d, e, f) minerals in arsenopyrite (Aspy), pyrite (Py), galena (Gal), and boulangerite (Bul)

Table 1. Chemical composition of bismuth and antimony minerals of Zarmitan gold ore zone deposits (mass,%)

Mineral	Au	Bi	Sb	Pb	Ag
Minerals of Bi					
Maldonite Au_2Bi	66.60	33.61	-	-	-
	66.19	33.55	-	-	-
HeadleyiteBi_7Te_3	-	77.15	0.35	-	0.57
	-	78.08	0.41	-	0.71
Tsumoite BiTe	-	62.15	-	-	0.39
	-	61.12	0.49	-	0.82
Tellurobismutite Bi_2Te_3	-	51.69	-	0.73	1.96
	-	51.59	-	0.94	2.36
Joseit B $Bi_4Te_2S_2$	-	74.62	-	0.72	-
	-	74.37	-	0.83	-
Tetradymite Bi_2Te_2S		57.21	1.32	-	-
		58.07	0.43	-	-
Volynskite $AgBiTe_2$	-	40.12	-	0.72	16.15
	-	40.68	-	0.74	15.09
Matildite $AgBiS_2$	-	55.13	2.11	0.90	28.24
Treasure $Ag_7Pb_6Bi_{15}S_{32}$	-	50.24	1.29	20.14	9.69
Minerals of Sb					
Aurostibit$AuSb_2$	45.93	0.53	52.53	-	-
	46.42	3.50	51.53	-	-
Plagionitis $Pb_5Sb_8S_{17}$	-	-	36.51	40.89	-
	-	-	37.18	40.47	-
Jamsonite $Pb_4FeSb_6S_{14}$	-	-	35.61	38.11	0.30
	-	-	35.85	38.79	0.37
Berthierite $FeSb_2S_4$	-	-	57.98	-	0.31
	-	-	57.28	-	0.45
Goodmundite FeSbS	-	-	58.50	-	0.22
	-	-	57.95	-	0.30
Ovihiitis $Ag_2Pb_5Sb_6S_{15}$	-	-	28.91	47.03	5.13
	-	-	29.12	46.87	5.57
Ag-boulangerit $(Pb,Ag)_5Sb_4S_{13}$	-	-	23.31	53.98	5.14
	-	-	23.16	54.56	4.37
	-	-	23.73	54.71	4.31

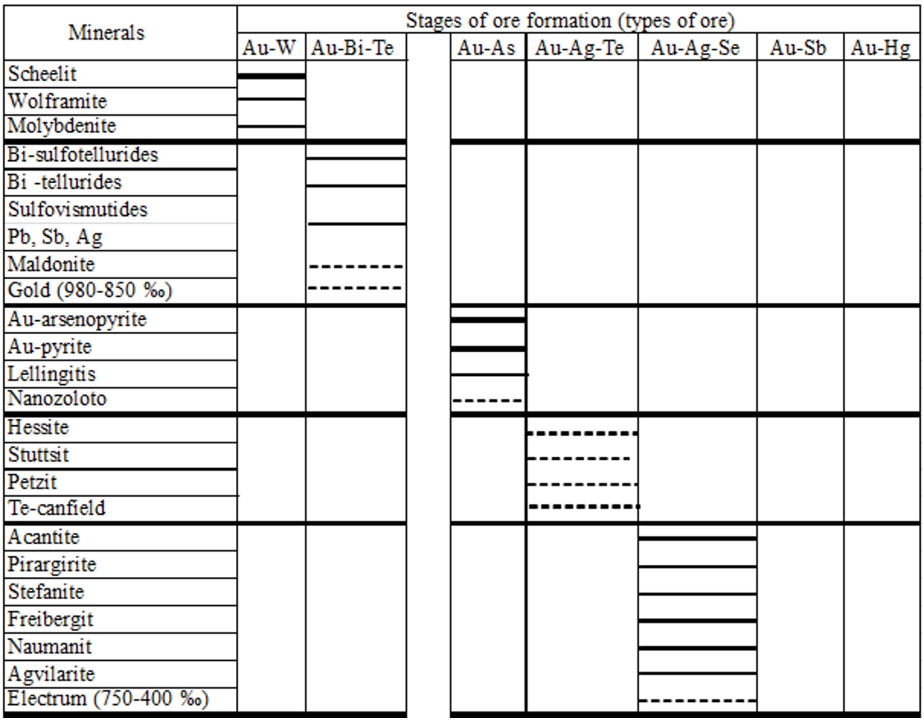
Continuation of table № 1.

Mineral	Fe	As	Te	Se	S	Σ
Minerals of Bi						
Maldonite Au_2Bi	-	-	0.27	-	-	99.48
	-	-	0.39	-	-	99.74
HeadleyiteBi_7Te_3	-	-	21.08	0.27	0.48	99.90
	-	-	19.83	0.18	0.35	99.56
Tsumoite BiTe	-	-	36.57	-	0.51	99.23
	-	-	36.72	-	0.56	98.89
Tellurobismutite Bi_2Te_3	-	-	46.00	-	0.44	98.96
	-	-	45.30	-	0.98	98.81
Joseit B $Bi_4Te_2S_2$	-	-	22.29	0.30	2.82	100.75
	-	-	22.81	0.16	2.81	101.01
Tetradymite Bi_2Te_2S	-	-	35.78	0.42	4.68	99.41
	-	-	36.17	0.35	4.26	99.28

Continuation of table № 1.

Volynskite $AgBiTe_2$	-	-	42.10	-	0.20	99.29
	-	-	41.78	-	0.28	98.57
Matildite $AgBiS_2$	-	-	-	-	12.75	99.13
Treasure $Ag_7Pb_6Bi_{15}S_{32}$	0.17	0.72	-	-	16.49	98.74
Minerals of Sb						
Aurostibit$AuSb_2$	-	-	-	-	-	100.99
	-	-	-	-	-	101.45
Plagionitis $Pb_5Sb_8S_{17}$	0.37	0.11	-	-	22.60	100.48
	0.25	0.23	-	-	21.71	99.84
Jamsonite $Pb_4FeSb_6S_{14}$	3.25	0.21	-	-	21.70	99.18
	3.09	0.89	-	-	21.01	100.00
Berthierite $FeSb_2S_4$	12.71	-	-	-	29.57	100.57
	13.23	-	-	-	29.78	100.74
Goodmundite FeSbS	27.91	-	-	-	14.43	100.00
	27.47	-	-	-	14.36	100.00
Ovihiitis $Ag_2Pb_5Sb_6S_{15}$	-	-	-	-	19.35	100.42
	-	-	-	-	19.07	100.63
Ag-boulangerit $(Pb,Ag)_5Sb_4S_{13}$	-	-	-	-	17.93	100.36
	-	-	-	-	17.92	100.01
	-	-	-	-	16.85	99.60

Table 2. Stages of mineral formation in the Zarmitan gold ore zone



Minerals	Stages of ore formation (types of ore)						
	Au-W	Au-Bi-Te	Au-As	Au-Ag-Te	Au-Ag-Se	Au-Sb	Au-Hg
Scheelit	—						
Wolframite	—						
Molybdenite	—						
Bi-sulfotellurides		—					
Bi -tellurides		—					
Sulfovismutides		—					
Pb, Sb, Ag							
Maldonite		- - -					
Gold (980-850 ‰)		- - -					
Au-arsenopyrite			—				
Au-pyrite			—				
Lellingitis			—				
Nanozoloto			- - -				
Hessite				- - -			
Stuttsit				- - -			
Petzit				- - -			
Te-canfield				- - -			
Acantite					—		
Pirargirite					—		
Stefanite					—		
Freibergit					—		
Naumanit					—		
Agvilarite					—		
Electrum (750-400 ‰)					- - -		

Continuation of table № 2.

Minerals	Stages of ore formation (types of ore)							
	Au-W	Au-Bi-Te		Au-As	Au-Ag-Te	Au-Ag-Se	Au-Sb	Au-Hg
Antimony							▬▬▬	
Bulangerite							———	
Jemsonite							———	
Sulfonamides								
Pb,Fe,Cu,Ag							———	
Aurostibit							- - - -	
Gold (800-650 ‰)							- - - -	
Cinnabar								———
Congsbergitis								- - - -
Hg-gold								- - - -

6 Discussion

Comparison with the well-known gold-ore giant Muruntau [15] 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 northeastern, 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 (Fig. 1) [6].

7 Conclusion

As a result of the conducted studies, 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-Temineralization 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 sulfoantimonidesPb, 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 diffused 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 wide development of Au-Bi-Te mineralization, the presence of scheelite, skarnification, the close age of mineralization, and granitoid intrusion, allow the objects of the Zarmitan gold-ore zone to be attributed to the orogenic type of deposits [15] associated with intrusions [14]. Deposits with Au-Sb-Ag mineralization belong to the same type. NS Bortnikov [2], T. Graupner [4] established that the formation of gold mineralization of the Zarmitan deposit is provided by fluids of different origins. 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, result from 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.

References

1. Tukhtabaev, J.S., Rakhmonov, A.N., Uktamov, K.F., Umurzakova, N.M., & Ilxomovich, R. Econometric Assessment of Labor Productivity in Ensuring the Economic Security of Industrial Enterprises. International Journal of Modern Agriculture, 10(1), 971-980. (2021).
2. Dinora Alisherovna Baratova, Khayrullo Nasrullayevich Khasanov, Ikromjon Sobirkhon Ogli Musakhonzoda, Maftuna Yuldashboy Qizi Tukhtarova, Khusniddin Fakhriddinovich Uktamov. Econometric Assessment of Factors Affecting the Development ofLife Insurance in Uzbekistan. Revista geintec-gestao inovacao e tecnologias (Management, Innovation and Technologies) Journal.Vol. 11 No. 2 (2021).
3. Uktamov Kh. F. and act. Improving the Use of Islamic Banking Services in Financing Investment Projects in Uzbekistan. Revista geintec-gestao inovacao e tecnologias (Management, Innovation and Technologies) Journal.Vol. 11 No. 2 (2021).
4. Akbarovich Yadgarov, A., Khotamov, I., Fakhriddinovich Uktamov, K., Fazliddinovich Mahmudov, M., Turgunovich Yuldashev, G. and Ravshanbek Dushamboevich. Prospects for the Development of Agricultural Insurance System. Alinteri Journal of Agriculture Sciences,. 36(1): 602-608.
5. Graupner T., Niedermann S., Phede D., Kempe U., Seltmann R., Williams C., Klemd R. Multiple sourses for mineralizing fluids in the Charmitan gold(-tungsten) mineralization (Uzbekistan), Miner Depoosita, , Vol. 45, № 7, pp. 667-682 (2010)
6. Koneev R.I., Khalmatov R.A., Kim M.A. Nanomineralogical signs of prospecting, typification, assessment of prospects and technological properties of ores of orogenic gold deposits in Uzbekistan (South Tien-Shan) // Geology and Mineral Resources, №6, pp. 39-45. (2017)
7. Koneev R.I., Khalmatov R.A., Nanomineralogy and Nanogeochemistry of Ores from Gold Deposits of Uzbekistan. Geol. of Ore Dep., Vol. 52(8), pp. 755-766. (2010)
8. Dolgopolova A, Seltmann R, Konopelko D, Biske Yu, Shatov V, Armstrong R, Belousova E, Pankhurst R, Koneev R, DivaevA. Geodynamic evolution of the western Tien Shan, Uzbekistan: Insights from U-Pb SHRIMP geochronology and Sr-Nd-Pb-Hf isotope mapping of granitoids // Gondwana Research, Vol. 47, pp. 76-109. (2017)
9. Vasilevsky B.B., EzhkovYu.B., Rakhimov R.R. TuresebekovA.Kh., ZhuraevA.Zh., Khantemirov R.M., Novikova I.V. Problems of large-scale gold and copper deposits in Uzbekistan. Tashkent: GP NIIMR, p. 116. (2012)
10. Atlas of models of ore deposits in Uzbekistan. T: GP NIIMR, 100s. (2010).
11. Seltmann R., Koneev R.I., Divaev F.K., Khalmatov R.A. New data on the absolute age of magmatism and gold mineralization in Uzbekistan // Geology and Mineral Resources, no. S. 10-15. (2014)
12. Koloskova S.M. Staging of the hydrothermal process and structural conditions for the location of mineralization in the postcollisionalUrtalik gold deposit // Modern problems of the connection between geodynamics, magmatism and mineralization. Tashkent: pp. 56-59. (2012)
13. Kim M.A., Tsoi V.D., Divaev F.K., Koroleva I.V. To mineralogy of the Guzhumsay and Urtalik deposits / Actual problems of geology, geophysics and metallogeny, IGiG, pp. 174-176. (2017)
14. Kempe U, Graupner T, Seltmann R, Boorder H, Dolgopolova A.Emmichoven M. The Muruntau gold deposit (Uzbekistan): A unique ancient hydrothermal system in the southern Tien Shan // Geoscience Frontiers, , Vol. 7, № 3, pp. (2016)