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CONDITIONS OF LOCALIZATION AND REGULARITIES OF LOCATION OF TUNGSTEN MINERALS ZERAVSHAN-ALAY METAL BELT (CENTRAL ASIA)

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ABSTRACT

This article examines the localization conditions and patterns of mineralization in the Zeravshan-Alai metallogenic belt. Described are ore-bearing rocks within the ore field of lime-skarn and magnesian-skarn formations, as well as skarnoids of both formations - magnesian and calcareous; near-skarn and near-ore-altered zones, including hornfelses, apogranite and containing various metasomatic formations. The paper describes four types of scheelite generations according to the formation conditions. The distribution of metasomatic zones of skarn ores with scheelite mineralization is natural.

KEY WORDS: zoning, apogranitoid, apometaterrigenous, diorite, leucocratic granite, tin, tungsten, skarn, skarnoid, dolomite. conglomerates, marbles, limestones, scheelite, sulfides, pyrite, pyrrhotite, chalcopyrite, sphalerite.

INTRODUCTION

In recent years, in order to solve the problems of expanding the mineral resource base of noble, non-ferrous and other metals, geological exploration work is being carried out in promising territories of the Republic of Uzbekistan and on the basis of improving the forecast and prospecting models of known deposits.

Thanks to a detailed study of the mineral composition of skarns, skarnoids, hydrothermal, metasomatic, greisen-pegmatite, and other types of alteration of the host rocks, it has been established that the development of the ore process is associated not only with deposits of Au, W, Sn, Mo, Pb-Zn, Hg, etc., but also by metasomatic alteration of both skarns and skarnoids, as well as near-ore and enclosing rocks.

The generalization of the results of the conducted research and the existing ideas on the improvement of the theory of ore formation and the method of forecasting minerals revealed new industrial types and formations of plutonic, volcanogenic-sedimentary, volcanogenic-hydrothermal, metamorphogenic-hydrothermal, apometaterrigenous and apogranitic tungsten-lai-shine ore mineralization of the Zern.

METHOD OF WORK

The general scheme of their formation is analyzed, special attention is focused on the study of the geological and genetic characteristics of gold-rare-metal, rare-metal, tin-tungsten deposits, their forecasting and prospecting. The skarn-tin-magnetite and hydrothermal-tin-magnetite groups of mineralization in the spatio-temporal relation, associated with the basaltoid magmatism of the middle massifs, the skarn and apogranite-pegmatite-hydrothermal mineralization of geo-tin and tungsten-bearing granite zoning, are identified.

With the potential tungsten content of skarn solutions in granites, shales and carbonate rocks, scheelite, scheelite-sulfide, quartz-scheelite formations are formed.

Ore-bearing rocks within the ore field are not only skarns of calcareous and magnesian-skarn formations, but also skarnoids of both formations - magnesian and calcareous; near-skarn and near-ore-altered zones, including hornfelses, apogranite and hosting various metasomatic formations.

Scheelite is the leading ore mineral in the ore field, while sulfides are of limited distribution. Apart from rare finds of dissemination of cassiterite and beryl in pegmatite veins, the skarn formations of the region do not contain beryl and tin mineralization, which in rare cases enter isomorphically into vesuvian and garnet.

Deposits of the leading ore mineral scheelite are of a multistage nature associated with different stages of the formation of the skarn process. With all this, the distribution of scheelite mineralization is scattered, although in places there are areas enriched with industrial concentration. Thanks to detailed studies of the mineral composition of skarns, skarnoids and other types of changes in the host rocks, it was established that the development of the ore process is associated not only with the deposition of scheelite, but, as noted by M. S. Karabaev (2017), "pre-ore paragenesis of minerals of gold-rare metal deposits are associated with the formation intrusions and compose contact-metomorphic and metasomatic formations"[1]. And by metasomatic alteration of both skarns and skarnoids, and near-skarn and host rocks.

In the Zeravshan-Alai belt, the main mass of scheelite is concentrated in calcareous skarns and their apomagnesian varieties. In propermagnesian varieties scheelite is noted as a poor dissemination (Sarykul-Aksai, Karatyubinsk areas).

Magnesian skarns of the magmatic stage are usually replaced by later calcareous skarns.

Within the Ingichka and Yakhton ore fields, due to the complexity of the host rocks and the following many metasomatic processes, zoning in the formation of magnesian skarns encounters great difficulties (diagram).

In the Kuldzhuktau ore complex, magnesian skarns are confined to the contacts of the gabbroids of the Beltau and Tozbulak intrusions with dolomitized limestones of the Silurian.

In a detailed study of the Ingichka ore field [2, 3, 4], it was possible to identify the following zones in the magnesian skarn deposits (diagram).

RESULTS AND DISCUSSION

Bimetasomatic skarns compose bodies with a thickness of 0.5 to 10 m. Magnesian skarns are subdivided into diopside and forsterite-diopside, with which brucite, chondrodite-brucite, and serpentine-brucite rocks formed by dolomites are closely related.

Calcareous skarns are associated with gabbroids of the Beltau and Kyngyrtau mountains. They include pyroxene-garnet, pyroxene-garnet-wollastonite, garnet-wollastonite and pyroxene-wollastonite.

The thickness of the bodies ranges from 0.5 to 50 m. Of interest may be brucite marbles. Limestones of the Upper Silurian, Devonian and conglomerates of the Middle - Upper Carboniferous were screened.

The thickness of the bodies ranges from 0.5 to 50 m. Of interest may be brucite marbles. Limestones of the Upper Silurian, Devonian and conglomerates of the Middle - Upper Carboniferous were screened.

Garnet in skarns is represented mainly by grossular, less often grossular by andradite, pyroxene diopside, and hedenbergite by diopside.

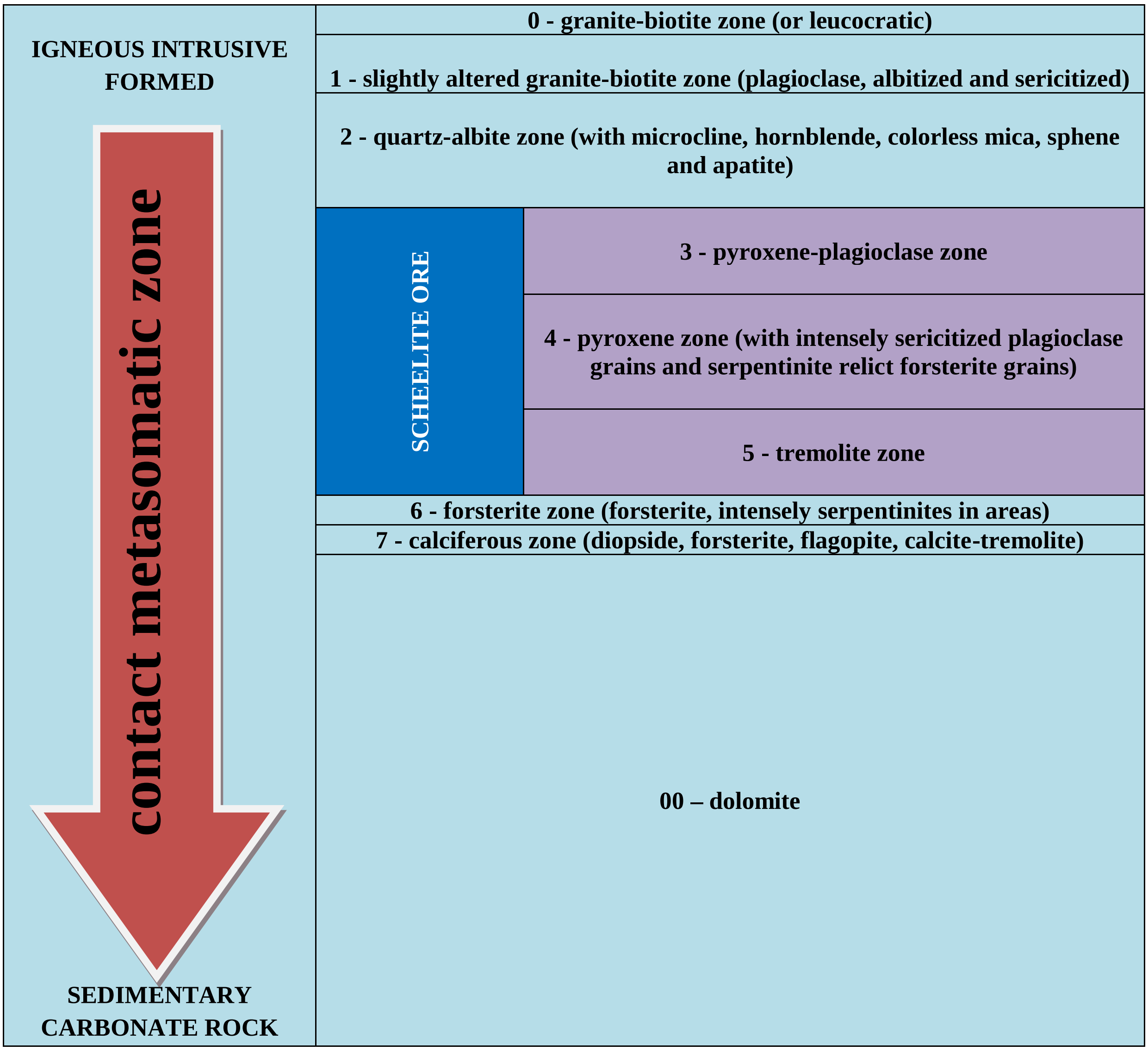
Willuit is found in skarns associated with the Shaydaraz intrusion. They form crystals up to 2 cm long, dark brown with a violet tint. Under the microscope it is painted in brown-lilac interference colors

Ng = 1.720, Np = 1.712. According to spectral analysis, the mineral contains up to 1.5-2% titanium. Of the ore minerals in the Beltau skarns, pyrrhotite, chalcopyrite, arsenopyrite, pyrite, and apatite are noted. The total sulfide content reaches 1%, scheelite is present in sign quantities. The gold content in skarns does not exceed 0.05 g/t.

In the Karatyubinsky ore field, magnesian skarns are widespread in the Sarykul-Aksai, less often in the Karatyubinskaya areas. They are spatially associated with dolomite units and interlayers.In the general case, the structure of the zones of magnesian skarns (the Erikul site), taking into account subsequent superimpositions and postmagmatic changesis represented as follows: the central parts of the zones of magnesian skarns are represented by diopside with a variable amount of phlogopite, on both sides of which calcite-forsterite skarns (exchange-diffusion) are developed (bilaterally).

Magnesian skarns formed at the contact of dolomite interlayers, members with shale-hornfels strata are characterized by a similar bilateral zoning and, in general, the ore field can be represented by: dolomite-calcifer (forsterite + calcite + dolomite) -forsterite skarn (with phlogide skarn (with tremolite) -amphibole-feldspar rock (apostle). As you can see, the zoning from the side of the Dolomites is presented in full, completed form(table).

If we turn to the structure of the zones of magnesian skarns in the Ingichkabolo and Sarykul'say areas, then it differs markedly from those of Erikul'sai: dolomite-calcite-tremolite rocks (with forsterite relics) - diopside skarn-calcite-tremolite rocks - dolomite. If this zoning is restored in its original form: (forsterite skarn-diopside-forsterite skarn), then the disappearance of the calciphyre zone from the previous (Erikul) section will be obvious.



Scheme 1. Model of localization of magnesian skarns(compiled by O.T. Razikov (2018))

Within the region under consideration, several generations of scheelite are noted: Scheelite-I, simultaneous or "accompanying" the skarn process proper and high alkalinity of solutions of their formations[5] forms simultaneously with the stage of formation of calcareous skarns of both formations, including transformed varieties of magnesian skarns, forming uniform dissemination in diopside-scheelite, pyroxene-scheelite, garnet-scheelite, vesuvian-scheelite associations; Scheelite II, acidic (or quartz-ore) stage forms an extremely uneven distribution in pyroxene, pyroxene-garnet-vesuvian and other varieties of skarns, as well as skarnoids subject to zoisitization, tremolitization, silicification and metasomatically recrystallized. Scheelite of this generation usually forms nested, lenticular accumulations in skarns, spatially attaching themselves to silicified and metasomatic altered zones, forming subskar rocks [6]. Scheelite-II, in addition, is widespread in amphibole-feldspar hornfels, which are amphibole-feldspar - quartz metasomatic formations of hornfels texture, usually dark green in color. In them scheelite-II, fine-grained (0.05-5.0 mm), usually yellow in color, is in an unevenly dispersed state. The thickness of ore-bearing hornfelses, usually characteristic of the Sarykul-Aksai area, ranges from 0.3-0.5 to 1-2 m.In addition, scheelite-II, outside the skarns and hornfels zones, gives accumulations in calciphyres, dolomites, in quartz - tourmaline, quartz-amphibole, quartz veins and veins. This type of tungsten mineralization usually creates industrial accumulations not only for the considered, but also for other skarn fields of Western Uzbekistan, they are described by I.Kh.Khamrabaev et al. [7, 8, 9].

The latest generation of scheelite III, IV is manifested at the end of the stage of acid leaching with quartz and sulfides and has a limited development [10] in the form of thin veins in skarn bodies located near the contact with alaskite outcrops. In addition to skarns, scheelite of this generation is also associated with carbonate rocks, forming idiamorphic crystals in them in association with fluorite, with a very uneven distribution. Of the other ore minerals, sulfides are noted, represented by pyrite, pyrrhotite, chalcopyrite, sphalerite, bornite, covellite, etc., but all of them are of very limited distribution and are of no practical interest (table 1).

Table 1Dependence of the composition of hypogenic mineralization on the initial composition of the host rocksin magnesian skarn processes

(compiled by O.T. Razikov based on the materials of M.S. Kuchukova et al., T.Kh. Arifdzhanov, V.N. Ushakov and others, M.I.Ismailova, M.S. Karabaeva, V.D. Otroshchenko and others)

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Process	Stages and stages		Leading associations	MAGNESIAL SCARS					
				contact		exocontact			
				Granodiorites with dolomites	Granodiorite-porphyries with breccias	Vein in dolomites	In breccia over the wreckage		
							dolomites	limestones	Granitoids
Skarnovo - rudnymagmatic	magmatic		Facies of the endocontact	Hornblende					Prev. horns blende.
		Magnesian Skarns	Pyroxene-spinel-forsterite	plagioclase "a" (50-60) dioxide-I, spinel, forsterite, dolomite	plagioclase "a" (50-56), dioxide-I, spinel, forsterite, dolomite	diopside-I, spinel, forsterite, calcite, dolomite			
	Postmagmatic	Early alkaline	Pyroxene-garnet-feldspar	Plagioclase "a" (40-45) plagioclase "v" (40-60) Salite (fm=30-70), Vesuian, androdite (fm =85-95), grossular (fm =15-20), phlogopite (fm=6-7), horns. blende (fm=45), cal. diopside-1 (fm=0-42), forsterite, cannohumite, scheelite	Plagioclase "a" (40-45), plagioclase "b" (65-70), diopside (fm =17-18), grossular (fm=15-18), phlogopite (fm=6-7), Cannohumite * Rogov. blende (fm= 35), zircon, magnetite, calcite	Diopside-2, (fm=0-4) Phlogopite, calcite Magnetite	diopside-II (fm=8-10), phlogopite (fm=6-7), cannohumite, calcite, magnetite	hedenbergite (fm=85-90) androdite (fm=90-94) cal. Scheelitis	Plagioclase "a", diopside (fm=25-26) Grossular (fm=9-13), phlogopite (fm =16-20), vesuvian apatite, horns. blende (fm=45), calcite.

Table continuation

		acidic	Quartz-pyroxene-scheelite	hedenbergite (fm=92-95), quartz, scheelite orthoclase	diopside-III, calcite, ludwigite	diopside-III calcite, quartz, scheelite	diopside -III calcite, ludwigite	hedenbergite (fm=90-95), calcite, scheelite	apatite, calcite
			Epidote quartz Quartz-wollastonite	epidote, quartz, sphene эпидот, кварц, сфен	epidote, calcite, sphene эпидот, кальцит, сфен		epidote, ortite, calcite, sphene		epidote, albite, sphene
			Prehnite quartz	Prehnite, quartz molebdenite, pyrite	Prehnite "a" molybdenite				Prehnite, calcite, molybdenum
		Late alkaline	Quartz-amphirbol-sulfide	Actinolite, tremolite, quartz, arsenopyrite, lellingite, glaucodot	Tremolite, calcite, arsenopyrite			Actinolite, calcite, arseno-pyrite	Actinolite - (tremolite), calcite Arsenopyrite
			Quartz-pyrrhotite serpentine-ludwigite	Quartz, chlorite pyrrhotite, pyrite Serpentine, pludwigite	Serpentine, pyrite, calcite, ludwigite, melnikovite-pyrite	Serpentine, calcite ludwigite, pyrite	Serpentine, calcite ludwigite, pyrite	Chlorite, calcite pyrite	Sericite, calcite, pyrite
			Quartz - chalcopyrite	Quartz, chlorite, chalcopyrite, gold, pyrrhotite, antigorite	Antigorite, calcite, chalcopyrite, gold, pyrrhotite	Antigorite, calcite, chalco-pyrite, gold, pyrite	Antigorite, calcite, chalco-pyrite, gold, pyrite	Chlorite, chalco-pyrite calcite, gold, pyrite	Chlorite, calcite, chalcopyrite, gold, pyrite
			Quartz - carbonate	Quartz, calcite pyrite, talc	Calcitepyrite, talc			Calcite, pyrite	

The most common formation, 28% of carbonate rocks, varies from extremely fine-grained to medium- and even coarse-grained (in marbles) with approaching the contact of granular-carbonate rocks and increases depending on the intensity of the metasomatic process, the texture from extremely thin-layered and banded is determined, first of all, the presence of porous and fractured formations, the permeability of which sharply increases in the axial parts of the folds, to massive.

The paths of movement of solutions in limestone strata along intra-layer cracks and crushing zones, porosity in limestones and dolomites varies widely [11].

An example of the formation of such mineralization is the skarn-scheelite deposits of Ingichka, Karatyube, Yakhton, and others in Western Uzbekistan. During the interaction of hydrothermal fluids with a carbonate environment, primarily calcareous, calcareous-magnesian and calcareous-aluminosilicate skarns with scheelite mineralization are formed, etc.

With the potential tin content of hydrothermal solutions in granites and shales, greisen-cassiterite, quartz-cassiterite and quartz-tourmaline-cassiterite formations are formed. Tungsten-bearing hydrothermal fluids in the shale environment form the mineralization of greisen-quartz-wolframite and quartz-wolframite formations. Under higher temperature conditions, other formations are formed - apogranite-greyzequartz series with wolframite-cassiterite mineralization; 2) skarn and skarn-greisen-quartz series of formations with scheelite mineralization.

In the Zeravshan-Alai metallogenic belt, the apogranite-greisen-cassiterite and pegmatite-greisen-cassiterite-wolframite formations pass into the greisen-quartz-cassiterite, quartz-cassiterite, quartz-tungstenite, and quartzite-carbonate [12] Another formation series of deposits is characterized by the transition of the skarn-greisen-scheelite formation to the skarn-pyroxene-scheelite, skarn-diopside-scheelite, skarn-pyroxene-garnet-scheelite, skarn-molybdenite-scheelite-polymorphic, skarn-molybdenite-scheelite-polymorphic , greisen-scheelite and quartz-scheelite. Deposition of ore minerals occurs during the late early alkaline to acid and late stages, but the bulk of cassiterite, wolframite, and scheelite precipitates into the acid stage.

A relatively large depth of formation of pegmatite, apogranite-greisen-cassiterite (4-7 km) and a different depth of greisen-quartz-cassiterite, quartz-cassiterite, quartz-wolframite formations of the first row and a shallowness (1-4 km) of skarn-scheelite-cassiterite formations are established. row. The temperature of ore formation depends on the position of the formation in the genetic series and the role of magmatism.

Tin-tungsten formations of the Tien Shan geosynclinal zones are spatially and genetically closely related to granitoid magmatism, which is subdivided into two complexes in composition: 1) granite - biotite, two-mica, leucocratic granites;
2) granodiorite - quartz diorites, granodiorites and melanocratic granites. These granitoid complexes are distinguished by spatio-temporal isolation and different ore content. The granite complex is characterized by an increased content in the process of formation - quartz, potassium feldspar (microcline), muscovite and higher concentration of tin clarke (cassiterite), tungsten (wolframite). Two-mica granites contain accessory cassiterite, and leucocratic granites contain wolframite, cassiterite, tourmaline, etc. In addition, in some massifs, intense greisenization with cassiterite mineralization is noted (Lapasskoe occurrence). Most deposits of the first row are represented by veins, vein systems and zones in intrusive massifs. Separate quartz-cassiterite, quartz-tourmaline-cassiterite and quartz-carbonate-cassiterite ore occurrences are located in the exocontact zone.

CONCLUSION

The granodiorite complex is distinguished by increased acid-alkalinity, an increase in the amount of plagioclases, mafic minerals, frequent occurrence of accessory orthite, scheelite, and a relatively high content of tin in the rock-forming mineralstungsten, molybdenum and other elements. In addition, in the endocontact zone of the massifs, there are systems of veins and zones of skarn-greisen-scheelite, greisen-quartz-scheelite and quartz-feldspar-scheelite formations. Quartz-feldspar-scheelite and quartz-scheelite veins are also known in exocontacts among sandy-shale strata.

Depending on the facies of the depth of the formation of intrusions and magmatic complexes of the Zeravshan-Alai metallogenic belt, two independent formational types of ore formation appear, which are the product of two different-type and different-depth intrusive complexes. The first formational type of tin-tungsten mineralization is a product of mid-depth granite magmatism, and the second type is granodiorite magmatism of relatively shallow depths.

Another element of the geological-genetic model is the mineralization source. This issue is covered in the works of many researchers[12, 14, 15], which admit subcrustal - basaltoid, crustal - granitoid and extramagmatic sources of mineralization. Tin-tungsten mineralization of the Tien Shan geosynclinal zones is associated with granitoid magmatism of crustal chambers. However, as can be seen from the foregoing, tin-tungsten mineralization in this case forms two formational types of mineralization, the source of which is associated with granite and granodiorite complexes of the Zaravshan-Alai metallogenic belt.

REFERENCES

1. Karabaev M.S. Comparative analysis of mineral parageneses of rare-metal, gold-rare-metal and gold mineralization of Uzbekistan. In the collection "Actual problems of geology, geophysics and metallogeny" Tashkent State Enterprise "IMR", 2017. - Book 3. - p.170-172.
2. Otroshenko V.D. Criterion of prospective assessment of skarn deposits of tungsten (on the example of some regions of the Tien Shan). Tashkent, publishing house "Fan" UzSSR, 1982, 196 p.
3. Enikeeva L.N. and other Features of the structure and mineral composition of magnesian skarns of the Karatyubinsky ore field. - Tashkent, Uzbek Geological Journal, 1975, No. 3, p. 13-19.
4. Razikov O.T. The role of host rocks in the formation of skarn ores. // Geology and Mineral Resources. -2019. - No. 2, p. 32-35.
5. Ismailov M.I. Mineralogical, genetic and geochemical features of skarn-rare metal deposits. - Tashkent, publishing house "Fan" UzSSR, 1975, 184 p.
6. Shabynin L.I. Formations of magnesian skarn. - M., Nauka, 1973, 214 p.
7. Khamrabaev I.Kh. and others. Regularities of distribution and formation of skarn-rare-metal mineralization (on the example of Ingichkinsky, Koitashsky, Lyangarsky and Karatyubinsky ore fields of Western Uzbekistan). // In the book: Problems of geology and genesis of skarn-ore deposits in Central Asia. - Tashkent, publishing house "Fan" UzSSR, 1977, p. 27-57.
8. Khamrabaev I.Kh. Magmatism and Postmagmatic Processes in Western Uzbekistan. - Tashkent, publishing house of the Academy of Sciences of the Uzbek SSR, 1958, 471 p.
9. Akbarov Kh.A. and some other geological and geochemical features of gold-rare-metal mineralization of the northern slopes of Chakylkalyan // Modern problems of geology and development of the mineral resource base of the Republic of Uzbekistan / Tr. conf. - T .: SE "NIIMR", 2007. - p.184-185.

10. Kuchukova M.S. and others. Skarn-rare-metal and pegmatite formations of Western Uzbekistan. - Tashkent, publishing house "Fan", UzSSR, 1971, 263 p.
11. Umarkhodzhaev M.U., Akbarov Kh.A., Turapov M.K. Theoretical foundations and methodology of local quantitative forecasting of mineral deposits. // Methodology for forecasting mineral deposits. - Tashkent, Tashkent State Technical University., 2009.-359 p.
12. Baymukhamedov Kh.N. Genetic models of endogenous ore formations. Novosibirsk, 1983, publishing house Nauka Sib.otd. AN, p. 14-17.
13. Razikov O.T. and others. Ore content of sedimentary-metamorphic deposits of Western Uzbekistan. // Integration of science and practice as a mechanism for the effective development of the geological industry of the Republic of Uzbekistan. T .: SE "NIIMR", 2016. - p.120-124.
14. Abdullaev Kh.M. Dikes and mineralization. - M GNT publishing house of literature on geology and protection of mineral resources, 1957, 232 p.
15. Dalimov T.N., Ganiev I.N. Evolution and types of magmatism in the Western Tien Shan. Tashkent, University, 2010. –226 p.