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THE HALIDES OF SILVER IN THE HYPERGENE ZONE GOLD-SILVER DEPOSIT ARKHARLY (SOUTH ZHONGAR)

Abstract. Halide minerals of silver in the oxidation zone of the Arkharli deposit, which are located in close intergrowths with native silver and gold, have been identified and studied. Native silver, gold and silver-containing sulphides are sources of silver for halogen minerals, as evidenced by their joint zonal aggregations. In the low flanges, among the halide minerals of silver are determined chlorargyrite, iodobromite, embolite, iodargyrite. The hypergenic nature of gold is indicated by the close paragenesis of silver, silver and silver halides. The favorable conditions in the paleozone of the oxidation of the Arkharly deposit with dry and hot climate led to the dissolution of gold and silver, their migration by acid solutions and their further settlement in the corresponding geochemical barriers, in which it was possible to plant hardly soluble chlorides, bromides and iodites.
Key words: gold, native silver, Arkharly, supergene, deposit.

Introduction. The Arkharli deposit is part of the gold-silver formation, which is described in detail in the works of I.S. Rozhkov, N.A. Shilo [1], Yu.G. Shcherbakova [2], T.M. Zhautikova et al. [3]. It is divided into two subformations: gold-silver adularia and gold-silver secondary quartzite or quartz-hydromicaceous. According to N.V. Petrovskaya, it is a formation of near-surface gold and gold-silver deposits, confined to the volcanic-plutonic belts that make up the upper structural assize of the warehouse regions of Kazakhstan. The formation under consideration was first isolated by V. Lindgren in 1934 under the name epithermal. Also, terms such as shallow, volcanic, propylitic, quartz-carbonate-kaolinite, etc., were used to determine this expression.

Kazakhstan deposits of gold-silver adularia subformation are confined to the Upper Paleozoic ring volcanic-tectonic structures. In their arrangement the leading role belongs to the zones of deep faults (Dauletbai, Kalmakemelsky, etc.), largely hidden under the volcanic structures of the Upper Paleozoic. Zones of faults are represented by a series of subparallel-oriented discontinuous faults, over which dykes and subvulcanbodies [4].

In the age range of occurrences of the gold-silver formation, the deposits of South-Western Dzungaria are the youngest. The late Permian-Early Triassic age of ores is unambiguously determined by the superimposition of mineralization on the Permian-Triassic deposits of the lyparite-basalt formation (K.A. Azbel, M.R. Borukaeva) and by the data of plumbous-isotopic studies N.G. Syromyatnikova, O.G. Koshevoi et al. (the mean value of the model age of plumb from galena for 8 samples was 240±4 million years), The Arkharli deposit is the most typical representative of the formation in this region. In the ore locuses of this deposit, there is a distinct overlap of mineralization on the dykes of the lamprophyre series, intruding Permian-Triassic volcanogenic rocks.

In determining the tectonic features of the Arkharly deposit, the leading role is played by the ruptures imposed on the elements of the palevolcanic structure and formed in the result of the long shear deformation. Ore-bearing quartz veins perform eccentrically echeloned ruptures developing over potential shifts in the foundation of the volcanic structure to some extent subordinate to the elements of the ring volcanic-tectonic structures.

For the deposits of the gold-silver formation, the following features are characteristic: 1) Close structural-paragenetic relationship of the shallow gold mineralization with magmatism of the orogenic volcanic-plutonic belts of Kazakhstan, with which it constitutes a single magmatogen-ore system; 2) The confinement of deposits to zones of long-lived deep faults dissecting complex systems of paleo-volcanic structures, fragments of concentric and radial faults of ring volcanic-tectonic structures, specific ore-bearing explosive structures, often combined with centers of volcanic structures; 3) Widely distributed fields of epidote-actinolite-chlorite propylites or low-temperature secondary quartzites, serving as one of the signs of delimitation of the areas of development of gold-adularia-quartz mineralization; 4) The presence of the actual near-vein metasomatites of the adularia-quartz and hydromica-quartz composition, the primary scattering halos of the Au, Ag, Pb, Zn, Cu, Bi, Mo, As , extensive haloes of potassium, and also distinct mineralogical geochemical character mineralization; 5) Significant variability of Ag/Au ratio of ores of different deposits, at relatively low values of gold probing. There is a certain dependence of the decrease in the test of gold in connection with the increase in sulphidity of ores.

Characteristics of hypogenous mineral formation. The gold-silver deposit Arkharli is located within the Saryozek area of Southern Jongaria, the Upper Paleozoic volcanic-plutonic magmatism and belongs to the typical epithermal post-volcanic hydrothermal deposits. Here, on an area of 8.0x3.5 square meters. km, selected several industrial sites (Central, East I and II, North-Eastern, Kyzyl-Shoky), corresponding to the parameters of independent deposits [5, 6].

The deposit of Arkharly is characterized by a clearly expressed facial zoning of ore deposition. It is most clearly manifested in the adularia-quartz and galena-sphalerite-quartz veins of the deposit [7]. The first in the least eroded part are composed of lightly gold-bearing drusy and crustificationagregates of quartz and adular with an admixture of barite and poor impregnation of pyrite. With depth, they are replaced by low-sulfide adularia-quartz ores of colloform-banded texture. Below in the fall of ore bodies, the amount of silver minerals falls sharply and sphalerite, electrum, chalcopyrite, pyrite become dominant, and pyrite, chalcopyrite, electrum are dominant on the feathering-out of veins. Accordingly, in the direction from the gold-argentine zone to the gold-pyrite-chalcopyrite, the thin-banded colloform texture of the veins is replaced by an unclear and massive band; in veins the content of sulphides, gold, chlorite, adular is reduced; the color of the adular changes from orange to light pink and yellowish, amethyst and baryte disappear; the value of the silver-gold ratio increases (from 5 to 40); the range of fluctuations in the sample of gold decreases and the magnitude of its isolation; variance and average gold sample increase.

The Arkharli field is characterized by sharply variable values (10–50) Ag/Au ratios and relatively low (630–750) fineness of gold. Reduction of fineness of gold values A.M. Grebenchikov is associated with an increase in the sulphidity of the deposit's ores.

Hypogenous gold in the deposit ores was released later than most sulphides. A.M. Grebenchikov [8] established the gold of two generations: gold-I in association with pyrite III, chalcopyrite II, sphalerite I and silver sulphides (adudyrovo-quartz association) and gold-II in association with galena II, sphalerite II, pyrite IV, chalcopyrite II, III and other minerals galena-sphalerite-quartz association.

The fineness of gold-I is 596–635, and gold-II is from 735 to 772.

Low-grade gold-I has a zonal (no more than 2-3 zones) internal structure. Judging by the nature of etching, the fineness of gold in the outer zones is always lower than in the central zone.

Relatively high-grade gold-I has a lumpy, distorted shape of single crystals, dendrites, lamellar particles with a spongy surface. It often forms monomineral secretions in quartz, and occasionally, splices with quartz in the form of spherical, with a complex subgraphic structure and thin-spongy forms. The morphology of the gold minerals indicates that their crystallization took place in a viscous (gel-like) medium.

The halogen minerals of silver and their dependence on climatic conditions. It is known that the halogen minerals of silver are the most characteristic for regions with a dry climate in the present or in the past. For example, the deposits of South America, where silver halides occur in significant clusters (especially in Chile's deposits). Ores with kerargirite are abundant in many dry areas of the western United States (New Mexico, Arizona, Utah, Nevada, etc.).

In the CIS, there are deposits with silver halides in the oxidation zone in the Altai, whose climate in the past was drier than at the present time. In the steppe part of Kazakhstan, silver halide minerals are found in the fields of Maikain, Dzhezkazgan, Dzhelambet and Beschoku. The climatic conditions of

Central Kazakhstan are characterized by relative dryness. In addition, a significant part of the territory of Central Kazakhstan is a drainage area in which salt lakes are very widespread. Reflection of climatic conditions is the composition of groundwater of Kazakhstan deposits. So chlorine, is a particularly characteristic component of the waters of the deposits, which are blocked by the newest deposits, and the waters circulating in the latter, judging from the literary data, sometimes represent real salt brines.

Thus, the connection between the formation of halide silver minerals and the climate reflects an increased content of halide elements in the waters of dry regions. In the deposits of Europe, silver halides are rare or absent altogether. Similarly, they are not reliably detected in the Northern and Middle Urals, the Caucasus and Transbaikalia.

It should be emphasized that, according to available data, kerargyrite is the most common of silver halides, embolisms and bromargyrite are less common, and even less often is iodargyrite. Of these, the latter was found in significant quantities only in Chile and in the dry regions of the west of the USA, ie, in regions with the highest concentration of halide elements in solutions. In deposits where the oxidation zone was formed under conditions of a more humid climate, only kerargyrite is usually represented from silver halides. The reason for this should be considered an insignificant content of iodine and bromine in the waters of the humid climate regions. Although the amount of chlorine in the waters of the same areas is insignificant, it is many times greater than the content of bromine and iodine, and in some cases may be sufficient to settlement/depositing appreciable amounts of silver.

Obviously, the presence of bromide and, especially, iodide silver in the oxidation zone, is the most reliable proof of its formation under dry and hot climate conditions. In conditions of a dry but cold climate, the prerequisites for the formation of silver halides are much less favorable.

Sources of halogen elements and silver. Different opinions were expressed on the sources of chlorine and other halogen elements in natural waters. Some researchers suggest that the sources of chlorine are weathering rocks, while others suggest the formation of silver halide minerals in connection with the action of sea water on ore bodies.

Based on our own observations and published data, the authors believe that the idea of the role of sea water for the formation of silver halides does not have significant confirmation in the known mineral deposits of this group. High concentration of chlorine in the underground waters of the deposits of Kazakhstan reflects the climatic conditions of this region. Sources of chlorides and other salts contained in groundwater are weathering rocks.

Sources of silver, fixed in halogen minerals, in a significant part undoubtedly is native silver. This was noted by a number of authors (V.I. Vernadsky and others). P.P. Pilipenko (1915) pointed out that the formation of kerargirite in the Altai deposits is associated with a change in native silver, electrum and silver-bearing sulphides of black ore. The possibility of formation of halogen minerals of silver in connection with the weathering of sulfide minerals was also noted by Ya.V. Samoilov (1906), Browns (1904), and others.

Observations for the steppe part of Kazakhstan allow us to conclude that along with native silver and silver-bearing sulfides, native gold is a significant source of silver for halide minerals in natural conditions. An example of a deposit in which the formation of silver halides as a result of hypergenic gold changes is traced is Maikain. The formation of silver halide minerals during the weathering of silver-bearing sulfides is traced in Dzhezkazgan.

As is known, in some types of pyrite deposits, silver halide compounds in high amounts are observed in the sulfur-bearing horizons in the bottoms of the oxidation zone (Maikain, Blava, and Rio Tinto). It was found that in Maikain, a part of the halides in the sulfur-bearing horizon arose as a result of the replacement of argentite formed from the descending solutions. It is possible that this process has a wider meaning. It can also be assumed that along with argentite in the sulfur-bearing horizons, native silver is formed, which is also replaced by halides.

The linear crust of weathering of hydromica-kaolinite type within the Arkharlinsky ore field. In all likelihood, it is the remains of the lower zones of the normal profile of the pre-Late Cretaceous weathering crust (the zone of disintegration). Due to changes in the hydrogeological and climatic conditions in different periods of the platform stage of the region's development, the vertical levels of the desalination zones were repeatedly replaced by sediment zones, which led to the secondary gold concentration of ore bodies at several levels.

Composition of minerals according to micro-X-ray spectral analysis (mass%)

№ row	№ fig.	№ analysis	Elements, weight %											Mineral formula		Mineral name
			Au	Ag	Cl	J	Br	Cu	Fe	O	S	Zn	Mg	Empirical	Idealized	
1	1	1		99,35		–	–	–	–	–	–	–	0,65			Native gold
2	//	2	–	72,06	20,62	3,40	3,25		–	–	–	–	–	$Ag_{2.02}(Cl_{1.77}Br_{0.12}J_{0.08})_{1.97}$	$Ag(Cl_{0.9}Br_{0.06}J_{0.04})_{1.0}$	Chlorargyrite
3	//	3	–	65,69	0,65	24,22	9,13		–	–	0,31		–	$Ag_{2.61}(J_{0.82}Br_{0.49}Cl_{0.08})_{1.39}$	$Ag_{1,88}(Cl_{0,06}Br_{0.35}J_{0,59})_{1.0}$	Iodine- bromide
4	//	4	96.62	2.44	0.63	–	0.30		–	–	–	–	–			High-grade gold admixed with silver chlorodibromide
5	2	1	–	77,24	12,04	–	10,72		–	–	–	–	–	$Ag_{1.80}(Cl_{0.86}Br_{0.34})_{1.2}$	$Ag_{1.50}(Cl_{0.71}Br_{0.29})_{1.0}$ или $Ag_3(Cl_{1.42}Br_{0.58})_2$	Bromine-bearing chlorargyrite
6	//	2	–	96.56	1.04	–	2.40		–	–	–	–	–			Native silver with silver's bromide and chloride
7	//	3	–	52,45	–	46,68	0,28		0,58	–	–	–	–	$Ag_{1.71}(J_{1.28}Br_{0.01})_{1.29}$	$Ag_{1.32}J_{1.0}$	Iodyrite
8	3	1	–	99.17	–	–	–		–	–	–	–	0.83			Native silver
9	//	2	–	51,73	–	47,43	–		0,41	–	–	–	–	$Ag_{1.12}J_{0.88}$	$Ag_{1.28}J_{1.0}$	Iodyrite
10	5	1	85.27	14.73	–	–	–		–	–	–	–	–			Moderately-high grade god
11	//	2	–	99,23	–	–	–		–	-	–	–	0,77			Native silver
12	//	3	–	47,80	–	52,20	–		–	–	–	–	–	$Ag_{1.04}J_{0.96}$	$Ag_{1.08}J_{1.0}$	Iodyrite
13	6	1	64.48	35.52	–	–	–	–	–	–	–	–	–			Electrum
14	//	2	–	82.82	–	–	–	–	5,44	10,04	0,51	–	–			Silver admixed with iron oxide
15	//	3	96.82	3.18	–	–	–	–	–	–	–	–	–			High-grade Gold
16	4	1		65,61	–	–	–	18,39	–	–	16,0			$Ag_{1.3}Cu0.62S_{1.07}$	$(Ag_{1.35}Cu_{0.65})_2S$	Mckinstryite
17	//	2	–	48,79	–	1,85	–	18,80	10,05	5,84	13,75	–	–	$Ag_{1.15}Cu_{0.75}S_{1.1}$	$(Ag_{1.2}Cu_{0.80})_2S$	Mckinstryitew/ Fe oxide
18	//	3		56.33	–	41.52	–	0.64	1.52	–	–	–	–	$Ag_{1.23}J_{0.77}$	$Ag_{1.60}J_{1.0}$	Iodyrite
19	//	18	93,09	5,88	–	–	–	–	1,03	–	–	–	–			High-grade Gold
20	//	19	–	90,23		–	–	–	3,45	6,32		–	–			Silver w/Fe hydroxides
21	//	20	63.70	36.30		–	–	–	–	–	–	–	–			Electrum
22	//	21	46,94	53,06		–	–	–	–	–	–	–	–			Electrum
23	//	22	92,20	7,80		–	–	–	–	–	–	–	–			High-grade Gold
24	//	23				–	–	–	0.42	–	33.30	66.28	–	$Zn_{1.48}Fe_{0.01}S_{1.51}$	$(Zn_{0.99}Fe_{0.01})_1S$	Sphalerite
25	//	24				–	–	76.10	0.52	–	23.29	–	–	$Cu_{1.86}Fe_{0.01}S_{1.13}$	$(Cu_{1.65}Fe_{0.}01)_{1.66}S$	Geerite

Analysts: Plekhova K.R., Levin V.L.; Kotelnikov P.E.

The vertical sweep of the zone, enriched with hypergenic gold and silver, reaches a depth of 100–110 m from the modern surface. The content of silver is from 200-450 to 3632.9 g/t.

Newly formed hypergenic gold on the deposit associates with hematite, limonite, jarosite, malachite, azurite and other minerals of the oxidation zone. It should be emphasized that hypergenic gold has a variety of morphological types: 1) quite often there are tent-shaped/paw-shaped dendrites dendrites of a branch-shaped shape, with axes diverging at right angles; 2) star-shaped dendrites, consisting of separate zonal tables, indicating the stage of hypergenic mineral formation and various degrees of gold enrichment of individual portions of solutions; 3) dust-like gold in association with limonite and jarosite in a quartz matrix; 4) rounded zone formations like the Liesegang rings, probably formed as a result of their periodic deposition from gel solutions with the participation of electrochemical processes. In addition, fine-grained gold is adsorbed by hypergenic minerals of iron and manganese. It is especially noteworthy that in cases like this, in the course of enrichment with gold, jarosite changes its color from ochreous-yellow to golden-yellow [9].

As a result of detailed microscopic and microprobe studies of the ores of the oxidation zone of the Arkharli deposit, various silver halides and splices of electrum with native silver were first established, which are of fundamental importance in the restoration of hypergenic mineral formation processes (table).

Figures 1–7 show native gold and silver and silver halides in close intergrowths. Most of the grains found are zoned and consist mainly of various halides of silver and native silver with an admixture of iodine, bromine and chlorine halides. The chemical composition of the minerals described below is determined on the microprobe JCXA-733. The images are performed in the back-scattered electron mode.

Chlorargyrite is found in the zonal, in the center of which there is native silver with micro inclusions of native gold around which a hem of chlorargiritedevelops with a flucan of iodobromite (figure 1).

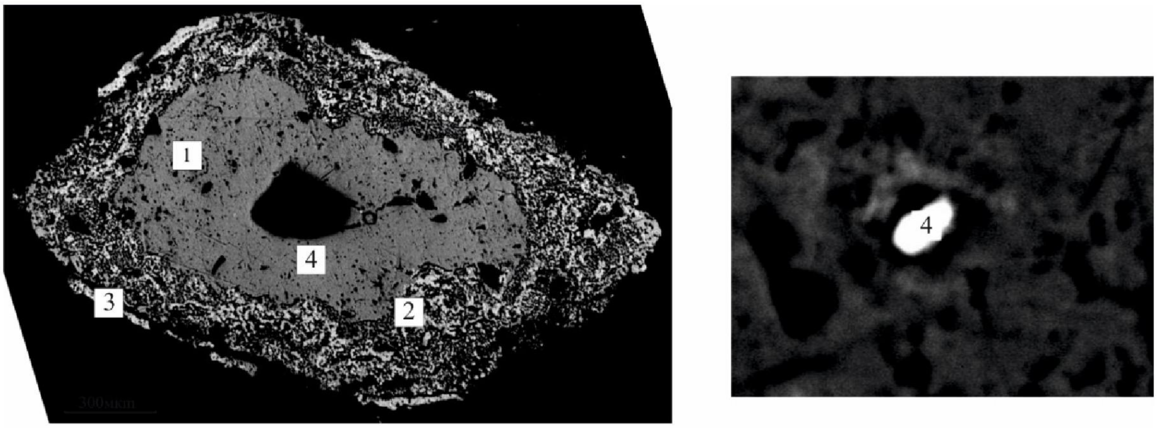

Figure 1 – Zone attachment consisting in a center of native silver with gold inclusion (1 and 4), a hem of chlorargyrite (2) with a flucan of iodobromite (3). On the right is an enlarged fragment of Figure 1 with the inclusion of gold in native silver. 4500. Analysts Levin V.L., Kotelnikov P.E.

Iodobromite – in the zonal attachment develops as a thin flucan around the hem of chlorargirite (figure 1).

Embolitis – in the zonal attachment, forms the basis around which a thin hem of iodirite develops. A fine-grained porous native silver was found in the embolite (figure 2).

Iodirite – develops in the form of thin hems in the zonal attachments, around the embolus, porous native silver, makinstriata (figures 2–4).

Mackinstriate is a silver and copper sulphide also in the development zone, in which the central part of the community is of the same formation, around which a cracked makinstriate with an iodine admixture is framed by a flucan of iodirite (figure 4).

Native gold and silver. Native silver is found in zone urgent materials with silver halides and usually the last of thin hem around silver (figure 1). Porous silver inclusions are found in the embolus (figure 2). Also found porous silver, framed by a porous flucan of iodirite (figure 3). In addition, it is possible to observe native silver of two generations: light yellow AgI and fouling it through a fine-grained porous

AgII (figure 5). Also, native silver was noted in the splices with electrum (figure 6). Native gold is in a subordinate amount, small inclusions found in native silver (figure 1, 5, 6). Gold of high quality. In addition, with native silver in the intergrowths, an electrum was found (figure 6).

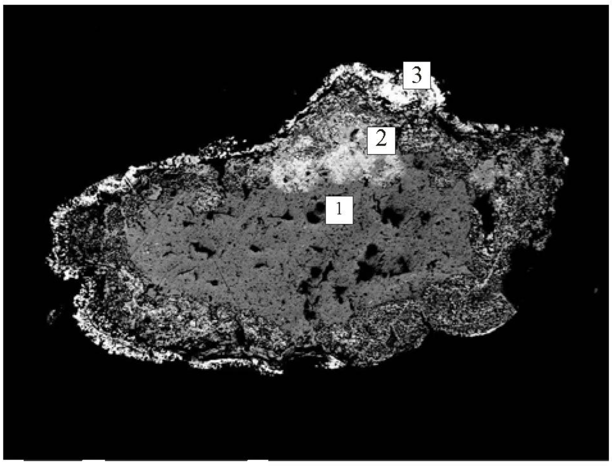

Figure 2 –
Zone attachment, in the central part of which the embolus (1) with developing around a thin hem of iodirite (3).
2 – porous inclusion of native silver. Uv. 220.
Analysts Levin V.L., Kotelnikov P.E.

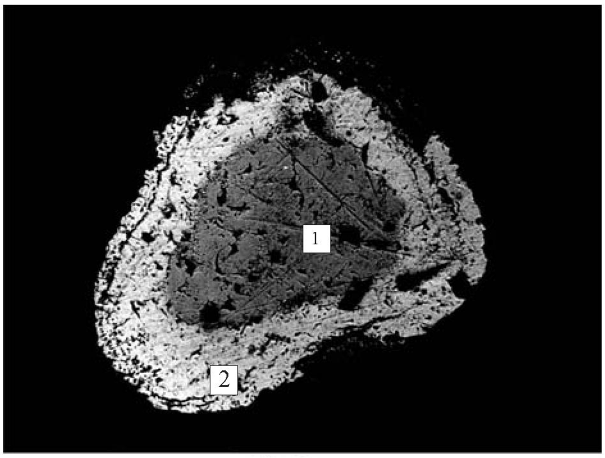

Figure 3 – Porous native silver (1) with a hem of aggregated porous iodirite (2).
Uv. 550.
Analysts Levin V.L., Kotelnikov P.E.

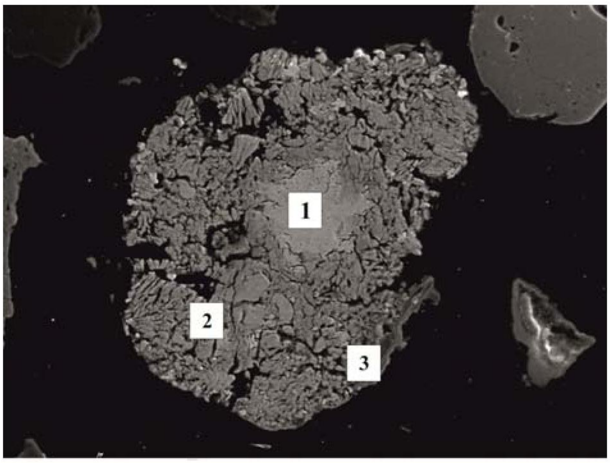

Figure 4 – Zone attachment, in the central part of the mackinstriate (1), around – a wide hem of the makinsstriatus with an admixture of iodine (2) with a thin flucan of iodirite (3). Uv. 560.Analysts Levin V.L., Kotelnikov P.E.

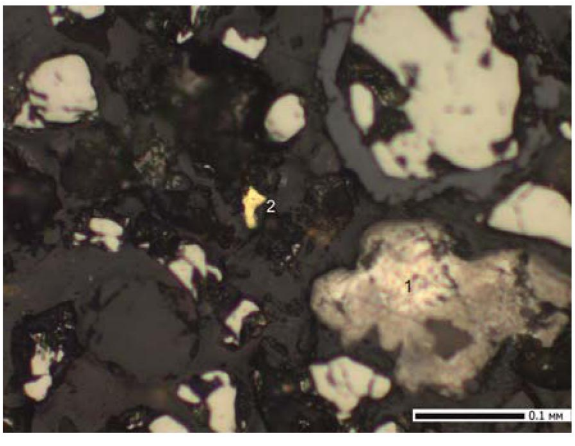

Figure 5 – Light yellow AgI (1), overgrown with porous AgII.
2 – yellow - high-grade gold. Uv. 200.
Analysts Levin V.L., Kotelnikov P.E.

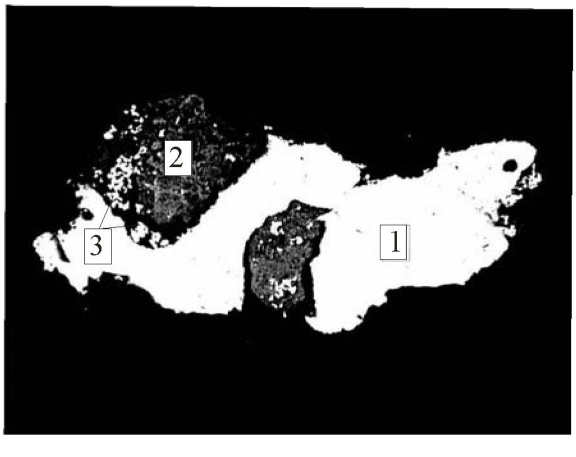

Figure 6 – Electrum swarm (1) and native silver (2) with fine inclusions of high-grade gold (3). Uv. 500.
Analysts Levin V.L., Kotelnikov P.E.

As a result of detailed microscopic studies of the ores of the oxidation zone of the Arkharli deposit, various halogen minerals of silver are established in association with native silver and gold, which are of fundamental importance in the revivification of processes of hypergenic mineral formation. The silver halides are present in the form of zonal intergrowths, in which they are represented by thin hems of iodine, bromine and chlorine differing in composition, alternating or settling around native silver, often with small inclusions of gold. The close paragenesis of gold, silver and silver halides indicates the hypergenic nature of gold.

In the oxidation zone, there are also hypergenic copper sulfides (covellite, chalcocite, bornite), hematite and iron hydroxides (goethite, hydrogoethite). Cowellin basically forms rims, microprotrusions and the finest secretions in chalcopyrite, partially or completely replacing the latter. Chalcosine is less common than covellite, but usually associates closely with it. Sometimes it replaces sphalerite and bornite, forming rims and penetrating into the latter along the weakened zones.

On the basis of the foregoing, it follows that in the paleozone of the oxidation of the Arkharli deposit there were favorable conditions for the dissolution of gold and silver, and then migrating them with acidic solutions to the lower horizons of the weathering crust with further precipitation at the appropriate geochemical barriers. The main condition for the appearance of gold and silver solubilizing reagents is the presence of pyrite, the main source of H_2SO_4 and Fe_2 (SO4) 3, and chlorine in the percolates along with the surface waters. As S.S. Smirnov points out [10], chloride migration of gold is the most reliable and an increase in the conditions for such a transfer is more likely due to the presence in the ore material of MnO2 and the increased acidity of the transport solutions. Under the same conditions, silver is precipitated from silver sulfate in the form of hardly soluble chlorides, bromides and iodites. However, it is impossible to exclude the possibility of migration of gold and silver in colloidal solutions.

A detailed study of the features of the formation of hypergenic gold and silver in the oxidation zone has not only theoretical but also applied significance. It is necessary for deciphering the behavior of gold and silver in carrier solutions and determining the physico-chemical parameters of the latter. It will also be useful in solving practical problems for developing new technologies for extracting gold and silver.

Conclusions.

1. The presence of silver halides, especially silver bromides and iodides in the oxidation zone of the Arkharli deposit, is the most reliable proof of its formation in dry and hot climates.

2. The formation of native gold in the hypergenesis zone is associated with gold-enriched sulfate-chloride waters, which, as they filter into the deeper horizons of the oxidation zone, become less oxidative and, under the action of various reducing agents, break down with the formation of native gold.

3. Based on the data on silver halides of the oxidation zone of the Arkharli deposit and based on the results of other researchers in studying the zones of oxidation of gold-sulfide deposits, it can be stated unequivocally that the source of silver in the halide minerals is native silver and gold, as well as silver-containing sulfides.

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АРХАРЛЫ КЕНОРЫНЫ (ОҢТҮСТІК-ЖОҢҒАР) АЛТЫН-КҮМІС АЛҚАБЫНЫҢ ГИПЕРГЕНЕЗ АЙМАҒЫНДАҒЫ ГАЛОГЕНДЕРІ

Аннотация. Архарлы кен орнының тотығу аймағындағы алтын күмістің галогены анықталды және зерттелді, олар күміс және алтынмен тығыз байланыста. Түпнұсқалық күміс, алтын және күміс сульфидтері галогендік минералдарға арналған күміс қайнар көздер болып табылады, бұл олардың бірлескен аймақтық агрегацияларымен дәлелденеді. Күміс галогендік минералдары арасында хлораргирит, йодобромит, эмболит, иодирит анықталды. Алтынның гипергендік құбылысына алтын, күміс және күміс галогендерінің жақын парагенезімен белгіленеді. Архарлы кен орнының құрғақ және ыстық климатпен тотығуының палеозонында қолайлы жағдайында алтын мен күмісті ыдыратуға, қышқыл ерітінділермен олардың қоныс аударуына және олардың тиісті хлоридтерді, бромидтер мен йодтарды ерітетін геохимиялық тосқауылдарда одан әрі жауын-шашынның болуына әкелгендігі әбден мүмкін.
Түйін сөздер: алтын, күміс, Архарлы, гипногенді, кенорын.

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ГАЛОГЕНИДЫ СЕРЕБРА В ЗОНЕ ГИПЕРГЕНЕЗА ЗОЛОТО-СЕРЕБРЯНОГО МЕСТОРОЖДЕНИЯ АРХАРЛЫ (ЮЖНАЯ ЖОНГАРИЯ)

Аннотация. Выявлены и изучены галоидные минералы серебра в зоне окисления месторождения Архарлы, находящиеся в тесных срастаниях с самородным серебром и золотом. Самородное серебро, золото и серебросодержащие сульфиды являются источниками серебра для галоидных минералов, о чем свидетельствуют их совместные зональные сростки. Среди галоидных минералов серебра в тонких каймах определеных лораргирит, иодобромит, эмболит, иодирит. На гипергенный характер золота указывает тесный парагенезис золота, серебра и галогенидов серебра. Существовавшие благоприятные условия в палеозоне окисления месторождения Архарлы с сухим и жарким климатом привели к растворению золота и серебра, их миграции кислыми растворами и дальнейшим их осаждением в соответствующих геохимических барьерах, при которых возникла возможность высаживания трудно растворимых хлоридов, бромидов и иодитов.
Ключевые слова: золото, самородное серебро, Архарлы, гипергенный, месторождение.