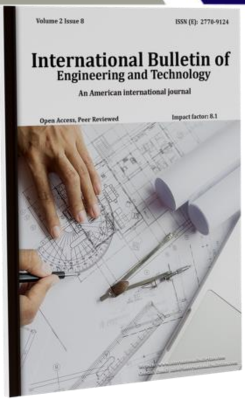

FEATURES OF THE DISTRIBUTION OF MAIN AND ACCOMPANYING ELEMENTS IN ORES AND MINERALIZED ZONES OF THE SHARYKTY ORE OCCURRENCE

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Abstract: Gold is the main valuable component of the ores of the Sharykty ore occurrence, in which it occurs mainly in the form of dispersed impurities in sulfide minerals and in the native state as part of the gold-sulfosalt association. The main amount of native gold is found in the ore oxidation zone. Based on the studies conducted, it was established that the main groups of associated elements are: for gold, the most stable search criteria are arsenic, antimony, silver and tellurium; The relationships of silver are more diverse - antimony, gold, tellurium, arsenic, zinc, lead and others.

The relationship in the formation of silver mineralization with quartz-carbonate-polysulfide and carbonate-sulfosalt associations was determined.

Key words: ore occurrences, Sharykty, minerals, gold, selenium, antimony, primary ores. oxidized ores, related elements.

The Sharykty ore occurrence is located in the metamorphosed formations of the Kosmanachinsky sequence (former Besapan formation) [6, 7]. The sequence is represented by shales of various compositions, siltstones, sandstones of black and dark gray color, phyllite-like shales of gray, greenish-gray color on the surface. The composition of the shales is: sericite-chlorite-carbon-quartz and sericite-carbon-quartz. The banding is determined by the alternation of thin layers of predominantly light quartz and darker sericite-chlorite composition. The dark layers are densely saturated with carbonaceous matter (CM). The combination of interlayers of different composition gives the rock a distinct texture [2].

The study of the distribution of main and accompanying elements in ores and mineralized zones is relevant, especially in new areas being explored. Tsoi V.D., Pirnazarov M.M., Koneev R.I., Karabaev M.S., Mirusmanov M.A., Razikov O.T., Khalmatov R., Koroleva et al. [4, 7, 8, 9, 10].

The research results showed that industrial concentrations of gold in most deposits are due to the development of several productive mineral associations, successively replacing each other in time and space.

Ore minerals in the heavy fractions of primary ores of the Sharykty ore occurrence mainly consist of pyrite. Chalcopyrite and arsenopyrite are found in isolated characters. In the total mass of the rock, sulfides account for up to 0.8-2%, i.e. are low-sulfide ores of the gold-sulfide geological-industrial type [1]. The resulting concentrates of ore minerals were used for the production of briquettes and other mineralogical and geochemical studies. The light fraction is dominated by fragments of schists of chlorite-sericite-quartz, carbon-siliceous composition, metasandstones and their silicified, chloritized varieties, quartz.

The main part of gold in endogenous ores is present in the form of dispersed inclusions in pyrite and arsenopyrite. In monomineral samples of pyrites from ore zones, spectral analysis reveals an admixture of gold (20-50 g/t) and silver (20-80 g/t). The gold content in arsenopyrite is up to 180 g/t, silver up to 60 g/t. In primary ores, native gold is rarely present, as part of a gold-sulfosalt association with chalcopyrite, sphalerite, pyrite, and silver tellurides (hessite, stuttzite). The shape of gold plates is lamellar, elongated, irregular. The gold particles discovered from this association by microprobe analysis are very small, 4-10 microns in size. Microprobe analysis of gold (electrum) from primary ores reveals increased contents of copper (2.14-5.46%) and selenium (0.86-2.16%) (Table No. 1).

The gold fineness of the primary ores is 592-622, which corresponds to electrum.

The main amount of native gold of the Sharykty ore occurrence is confined to zones of sulfide oxidation and the formation of secondary minerals, which is the result of the dissolution of fine and microscopic gold and its redeposition with the enlargement of segregations.

Native gold is associated with newly formed minerals (iron hydroxides), as well as in the voids of primary minerals (usually in quartz).

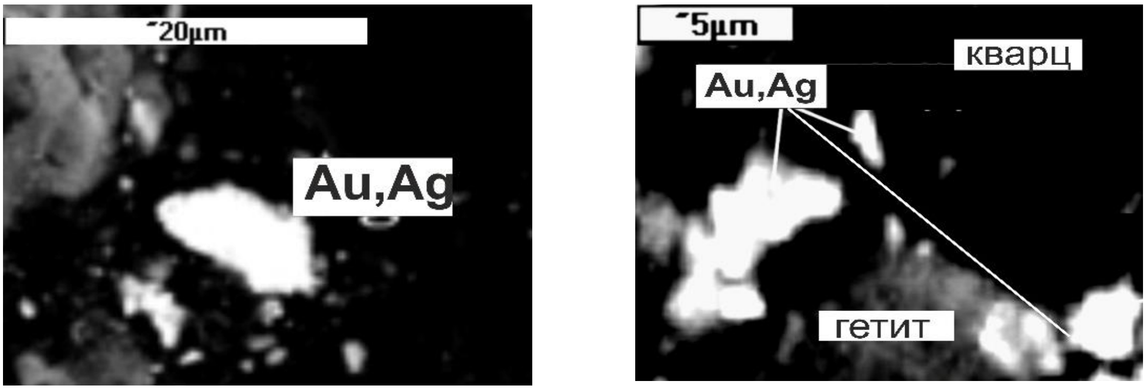

Fig. 1. Morphology and grain sizes of native gold in oxidized ores in association with iron hydroxides.

It forms round, lamellar, irregularly shaped grains, 2-35 microns in size, less often up to 40x125 microns. Gold deposits in oxidized ores sometimes have a porous structure, which is typical for gold in the oxidation zone.

In gold oxidized ores, gold forms a mixture with silver, with varying contents of both components. The fineness of gold from oxidized ores is 645 – 952. The iron content in them is increased (up to 0.76%), and copper content is reduced (up to 0.18%), compared to gold from primary ores. Gold from oxidized ores is characterized by the absence of selenium in its composition.

Table No. 1

Composition of native gold of the Sharykty ore occurrence according to microprobe analysis, from oxidized ores

No. p/p	Sample no.	Size (μm)	Contents of components, in%			
			Au	**Ag**	**Fe**	**Cu**
Shohetau						
1	20176	7	95,23	3,87	0,14	0,01
2	20177	12	72,50	26,95	0,63	0,08
3	20178	13	71,31	28,92	0,17	0,18
4	20278	18	70,10	29,44	0,03	0,03
5	20332	20	68,92	30,84	0,30	0,07
6	20341	15	66,96	32,09	0,76	0,12
7	20363	8	64,48	35,42	0,14	0,04

Native gold in the oxidation zone is fine-grained (up to 3-10 microns;). The fineness varies from 645 to 952.

Higher contents of the main and accompanying components are found in metasomatically altered and veined-silicified areas, confined to zones of rock crushing.

According to gamma activation and assay analysis, the gold content in ores is 0.9-4 g/t, silver - 0.3-1.3 g/t, in ores and mineralized zones (according to mass spectrometric analysis) - gold 0.008 -1.12 g/t, silver – 0.18-0.71 g/t. Higher concentrations are typical for selenium (59.5), gold (57.6), arsenic (56.4), and antimony (36).

In ores and mineralized zones, gold forms strong positive correlations with arsenic (0.66), antimony (0.65), silver and tellurium (0.46), which is reflected in Fig.2. Silver is characterized by positive correlations with antimony and gold (0.46-0.54) and arsenic, tellurium (0.32-0.37), as well as a group of polymetals (0.3), (Fig. 3).

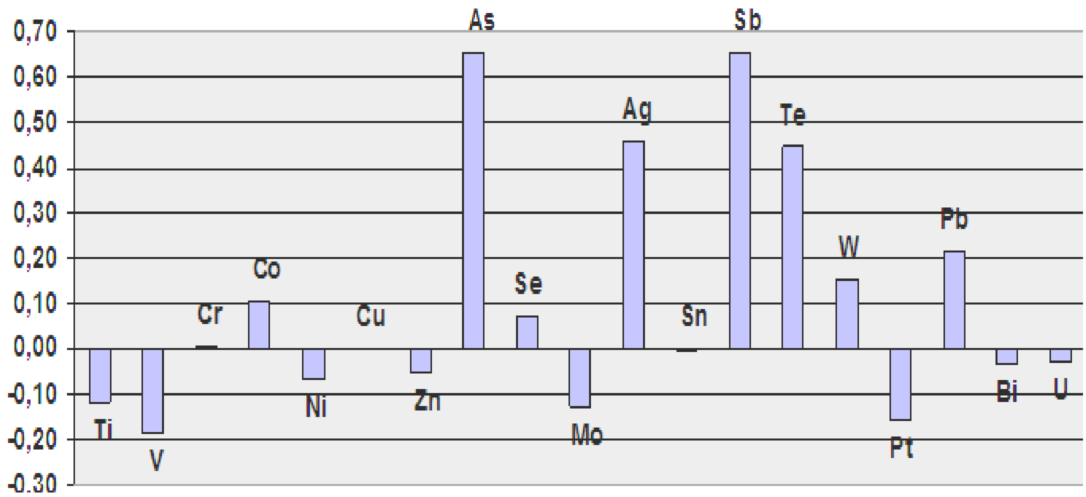

Fig. 2. Correlation connections gold

Table 1

Contents, average contents and degree of concentration of elements in samples of primary ores of the Sharykty ore occurrence according to mass spectrometric analysis

№	samples №	Place of capture	Au*	Cu	Zn	As	Se	Mo	Ag	Sn	Sb	Te	W	Pt	Au	Pb	Bi
1	50392	well ShK-16, int.52-54m	1,7	22,9	99,4	461	3,81	1,13	0,384	3,04	11,2	0,067	10,6	0,007	0,814	25,1	0,329
2	13317	well ShK-45, int.23-25m	1	27,6	59,8	295	4,8	3,06	0,28	3,45	8,92	0,047	8,34	0,006	0,584	12	0,266
3	50265	well ShK-13, int.112-114m	1,7	19,7	99,2	15,3	4,24	1,34	0,19	3,03	5,13	0,093	5,78	0,009	0,092	13,7	0,25
4	50264	well ShK-13, int.110-112m	1,6	14,7	70,4	19,1	0,24	1,8	0,219	2,39	4,91	0,06	9,47	0,006	0,046	9,11	0,199
5	50430	well ShK-16, int.128-130m	1,8	18,6	64,3	19,1	1,21	1,54	0,264	2,98	6,15	0,065	7,66	0,011	0,097	12,1	0,31
6	51223	well ShK-18, int.92-93m	1,4	15,7	82,4	19,4	3,64	1,44	0,31	2,34	5,31	0,072	34,4	0,013	0,237	24,3	0,178
7	50148	well ShK-15, int.132-134m	2,2	12,4	41,5	19,8	1,15	1,28	0,21	2,48	4,2	0,058	9,88	0,009	0,089	13,9	0,229
8	50525	well ShK-33, int.28-30m	1,6	15,4	76,2	33,2	3,93	1,17	0,30	2,37	7,35	0,108	51,8	0,014	0,231	19,1	0,234
9	50912	well ShK-14, int.150-152m	1,6	22,8	108	18,9	3,72	61,7	0,368	2,78	8,38	0,05	4,22	0,012	0,076	19,6	0,308
10	50482	well ShK-44, int.92-94m	1,5	19,5	99,8	19,1	2,91	1,16	0,264	2,64	1,96	0,086	5,37	0,011	0,026	25,5	0,411
11	50072	well ShK-41, int.140-142m	1,7	26,9	76,2	19,5	5,96	0,97	0,385	3,07	13,5	0,086	7,17	0,01	0,062	14,8	1,31
12	50604	well ShK-33, int.146-148m	1,5	18,4	58,4	95,8	5,36	0,89	0,291	2,5	6,43	0,086	3,7	0,01	0,545	13,1	0,25
13	50914	well ShK-14, int.152-154m	2	27,2	162	17,3	4,64	4,32	0,485	2,55	8,02	0,11	1,83	0,007	0,04	14,7	0,237
14	50147	well ShK-15, int.130-122m	0,8	44	50,7	34,4	2,32	0,84	0,698	1,97	20,4	0,321	4,02	0,004	1,11	32,9	0,3
15	50391	well ShK-16, int.50-52m	1	16,1	86,5	14	2,91	1,38	0,293	1,82	1,06	0,058	6,68	0,004	0,056	12,3	0,176
16	50265	well ShK-13, int.112-114m	0,6	14,7	91,1	9,4	2,24	2,53	0,605	2	2,41	0,078	2,25	0,013	0,049	13,6	0,155
17	50429	well ShK-16, int.126-128m	1,2	43,1	106	10,2	4,08	4,910	0,635	3,14	10,6	0,077	2,35	0,006	0,039	19,7	0,294
18	50911	well ShK-14, int.148-150m	0,6	23	101	44,8	0,18	2,84	0,258	2,99	5,03	0,064	4,03	0,004	0,082	15,2	0,216
Average content			0,97	0,97	85,16	64,74	3,19	5,24	0,36	2,64	7,28	0,09	9,98	0,01	0,24	17,26	0,31
Clarks			0,004	55	70	1,8	0,05	1,5	0,07	2	0,2	0,001	1,5	0,005	0,004	12,5	0,17
Concentration factor			241	2	1,2	36,0	63,7	3,5	5,1	1,3	36,4	88,1	6,7	1,7	59,4	1,4	1,8

Geochemical series of element accumulation intensity: Te-Se-Au-Sb-As-W-Ag-Mo-U-Bi-Pt-Pb-Zn-Sn-Cu

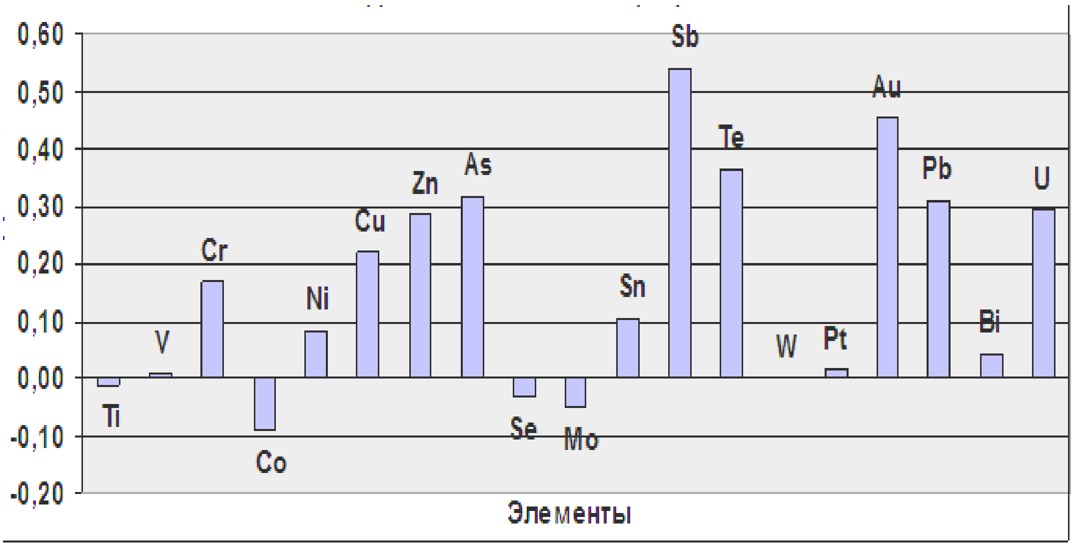

Fig. 3 Silver correlations

In order to identify changes in geochemical features, the nature of the distribution of elements in primary and oxidized ores and mineralized zones was studied.

In primary ores, the degree of concentration of the main and accompanying mineralization elements: tellurium (88), selenium (64), gold (59), arsenic (37), antimony (36), tungsten (6.7), silver (5), values of others elements are low (Table 2). Geochemical series of the intensity of accumulation of elements in primary ores: Te-Se-Au-As-Sb-W-Ag-Mo-U-Bi-Pt-Pb-Zn-Sn-Cu). In the distribution, gold forms strong positive correlations with arsenic, silver, antimony, tellurium, selenium (0.61-0.71) and copper, lead 0.48-0.55; (Fig. 3).

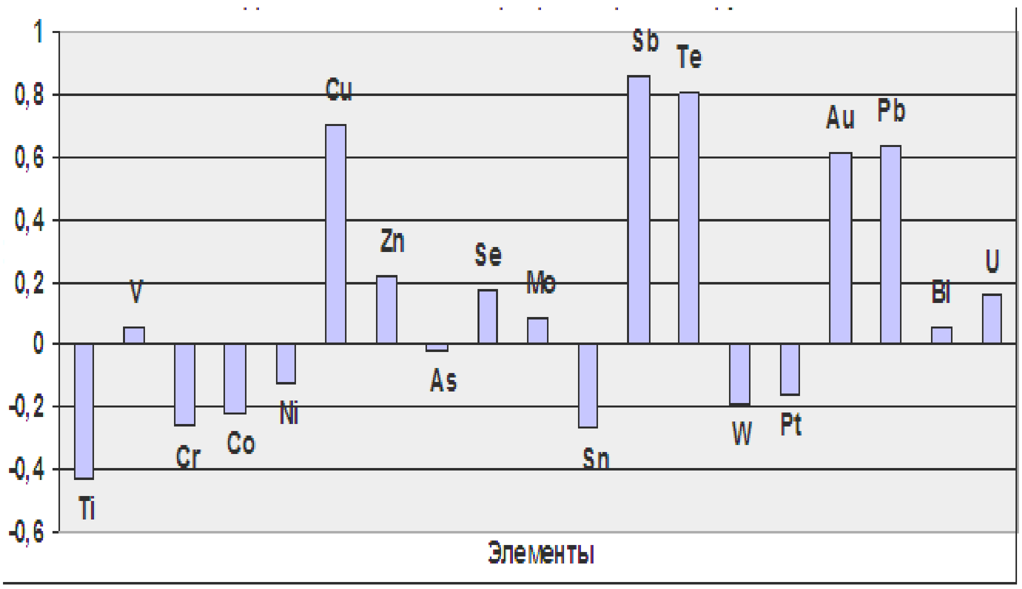

Fig. 4 Correlation connections of silver in primary ores

Table 2

Contents, average contents and degree of concentration of elements in samples of oxidized ores of the Sharykty ore occurrence according to mass spectrometric analysis

№	samples №	Place of capture	Au*	Ag*	Cu	Zn	As	Se	Mo	Ag	Sn	Sb	Te	W	Pt	Au	Pb	Bi
1	20207	K-22, int. 239.5-241m	1	0,5	18	146	74,2	0,76	3,62	0,25	2,44	18,2	0,09	2,7	0,007	0,167	18,3	0,298
2	20286	K-28, int.86.4-87.6m	1,2	0,3	47,6	118	37,5	5,22	4,71	0,265	3,07	6,33	0,115	1,44	0,006	0,143	19,8	0,306
3	21171	K-5a, int.146.8-147.9m	1,1	0,9	24,9	93,8	203	3,55	1,87	0,218	3,27	8,11	0,082	4,82	0,009	0,495	21,7	0,219
4	21416	K-6, int.39.2-40.3m	1,1	0,6	41	107	57	2,45	2,65	0,281	3,94	3,33	0,131	2,06	0,009	0,104	24,1	0,369
5	20359	K-14a, int.35.7-36.7m	1	0,5	27	134	27,6	6,41	3,93	0,445	3,34	5,05	0,065	2,24	0,007	0,075	18	0,231
6	21131	K-5a, int. 101.6-103m	1,4	1	24,9	46,1	266	4,59	3,29	0,19	3,08	13,2	0,078	5,91	0,011	0,434	16,4	0,329
7	21133	K-5a, int. 104-105m	1	1,2	27,1	44	247	1,6	3,76	0,231	3,69	21,4	0,078	5,04	0,013	0,879	30,1	0,479
8	20287	K-28, int.87.6-88.6m	1	0,5	36,6	85,1	18,7	1,05	3,9	0,239	2,65	7,81	0,157	1,82	0,011	0,039	21,9	0,321
9	20180	K-22, int.155.3-156.3m	1	0,9	17,4	61,4	397	3,45	2,54	0,205	2,2	6,53	0,07	3,73	0,013	0,317	11,9	0,204
10	20332	K-14a, int.4.0-5.2m	1,2	0,4	20,9	96,7	14,3	0,25	1,91	0,299	2,82	1,97	0,063	2,19	0,012	0,025	19,2	0,285
11	20300	K-28, int. 104.7-106 m	1,2	0,5	144	188	21,2	8,39	28,5	0,426	3,05	8,56	0,18	3,03	0,007	0,076	28,8	0,378
12	20363	K-14a, int. 39.5-40.5m	1	0,6	41,9	111	16,1	2,71	5,41	0,306	2,83	10,2	0,078	3,32	0,005	0,008	20	0,316
13	20341	K-14a, int.15.3-16.8m	1,5	0,5	14,7	91,1	9,4	2,24	2,53	0,605	2	2,41	0,078	2,25	0,013	0,049	13,6	0,155
14	21407	K-6, int.28.8-29.9m	1,1	0,3	24,4	81	10,6	3,72	1,94	0,427	2,92	1,63	0,094	2,99	0,018	0,023	21,6	0,255
15	20365	K-14a, int.41.5-42.7m	1,2	0,4	43,1	106	102	4,08	4,91	0,635	3,14	10,6	0,077	2,35	0,006	0,039	19,7	0,294
16	20177	K-22, int.152.4-153.3m	0,9	1,1	180	1215	369	2,45	2,58	0,277	2,85	8,95	0,071	5,16	0,006	0,316	14,4	0,24
17	20176	K-22, int.151.4-152.4m	1	0,5	23	101	44,8	0,18	2,84	0,258	2,99	5,03	0,064	4,03	0,004	0,082	15,2	0,216
18	20366	K-14a, int.42.7-44.1m	1,4	0,3	16,1	86,5	14	2,91	1,38	0,293	1,82	1,06	0,058	6,68	0,004	0,056	12,3	0,176
19	21132	K-5a, int. 103-104m	1	0,8	20,6	60,8	86,9	0,18	2,41	0,183	3,39	15,4	0,051	3,93	0,006	0,411	26	0,313
20	21420	K-6, int.44.2-45.7m	1,5	0,4	28,5	158	22,3	2,08	1,96	0,266	3,25	1,13	0,09	11,3	0,004	0,042	22,3	0,404
21	21172	K-5a, int.147.9-148.9m	1	1,1	24,4	101	224	2,91	2,18	0,209	2,5	9,95	0,071	26,5	0,006	0,572	25,3	0,325
22	20299	K-28, int. 103.5-105m	1,2	0,5	33,5	114	13,1	3,08	9,43	0,356	2,74	5,65	0,064	2,5	0,004	0,147	18,5	0,304
23	21409	K-6, int.30.9-31.9m	1	0,3	28,7	72,4	11,4	0,73	2,09	0,215	3,8	1,51	0,1	4,29	0,007	0,027	23,2	0,36
24	20178	K-22, int.153.3-154.3m	1	0,9	12,4	42,6	465	4,84	2,02	0,3	1,82	6,61	0,093	4,26	0,003	0,375	8,79	0,149
25	21130	K-5a, int.100.6-101.6m	1	1,3	17	37,6	224	2,46	2,56	0,175	2,5	10,4	0,053	12	0,006	0,792	15,1	0,339
26	20179	K-22, int.154.3-155.3m	1	1	14	47,7	640	2,01	2,73	0,349	2,19	9,22	0,147	6,69	0,008	0,634	11,5	0,179
Average content			1,12	0,67	36,60	136,4	135,6	2,86	4,14	0,30	2,86	7,70	0,09	5,12	0,01	0,24	19,14	0,29
Clarks			0,004	0,07	55	70	1,8	0,05	1,5	0,07	2	0,2	0,001	1,5	0,005	0,004	12,5	0,17
Concentration factor			279	9,5	0,7	2	75	57	2,8	4,5	1,4	39	89	3,4	1,6	61	1,5	1,7
Geochemical series of element accumulation intensity: Te-As-Au-Se-Sb-U-Ag-W-Mo-Zn-Bi-Pt-Pb-Sn-Cu																		

This geochemical series, as well as the existence of a strong positive correlation between gold and arsenic (0.7) and antimony (0.6), indicates the manifestation of the Au-As and Au-Te-Sb-Se geochemical association during the formation of endogenous mineralization of the Sharykty ore occurrence, corresponding to relatively low-temperature, near-surface levels of ore formation.

These features of the distribution of elements indicate a close geochemical connection of gold, in the processes of endogenous ore formation, with As, Ag, Sb, Te, Se, as well as Cu, Pb and the manifestation of gold-arsenic and gold-silver-selenide-sulfosalt associations in this area. A significant connection of gold with antimony, copper and lead indicates the manifestation of upper ore, more distant parts of the ore-forming system.

In oxidized ores, the highest degree of elemental concentration is typical for tellurium (89), arsenic (75), gold (61), selenium (57) and antimony (39), with smaller amounts of silver and uranium (5). The values of the remaining elements are not high (Table 1). The geochemical series of the intensity of accumulation of elements in oxidized ores has the following form: Te-As-Au-Se-Sb-U-Ag-W-Mo-Zn-Bi-Pt-Pb-Sn-Cu.

Here, compared to primary ores, the degree of gold concentration increases (61), which is associated with the geochemical properties of the element, namely, accumulation in the oxidation zone of the ores. The concentration levels of antimony and uranium also increase. The latter circumstance causes the formation of increased uranium contents in some part of the gold ore bodies.

Comparison of this geochemical series with those of other objects studied by us in the Auminzatau Mountains (Shokhetau, Karabugut, northwestern flank of the Peschanoe deposit, etc.) shows the significant role of uranium mineralization in the oxidized ores of the Sharykty ore occurrence.

Also, the main accompanying elements of gold in the oxidation zone are arsenic, selenium, antimony, tellurium and silver.

In the oxidation zone, gold forms a strong positive correlation with arsenic, silver, antimony (0.57-0.70) and tellurium (0.36). In the oxidation zone, gold has a significant positive relationship with tungsten (0.47), and connections with elements of the group of polymetals present in primary ores disappear. This is apparently due to the accumulation of tungsten and the removal of lead, zinc, and copper from the oxidation zone.

The main groups of associated elements are analyzed: for gold, the most stable search criteria are arsenic, antimony, silver and tellurium; The relationships of silver are more diverse - antimony, gold, tellurium, arsenic, zinc, lead and others. This indicates a greater connection in the formation of silver mineralization with quartz-carbonate-polysulfide and carbonate-sulfosalt associations.

Thus, it has been established that stable geochemical signs of gold mineralization in this area are halos of arsenic, silver, antimony, selenium and tellurium, which form significant correlations in both endogenous and exogenous ore formation.

The indicated features of the distribution of the main and accompanying elements were identified according to mass spectrometric analysis (SE “Central Laboratory” Ministry of Mining Industry and Geology of the Republic of Uzbekistan). In order to determine the reliability of the results obtained, their comparative analysis was carried out with the data (on the same samples) of the Daugyztau State Survey. It is noted that the nature of the distribution

IBET | Volume 4, Issue 11, November

of elements is basically the same, which indicates the reliability of the results obtained and the conclusions drawn.

In both oxidized and primary ores, the content of rare earth elements is below their clarke value.

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