UDC 553.441
DOI 10.52171/2076-0515_2024_16_02_103_108

Chemical Composition of Native Gold Element from the Gosha Deposit

G.S. Guseinov, Sh.A. Abasova

Azerbaijan State University of Oil and Industry (Azadlig ave. 16/21, Baku, AZ 1010, Azerbaijan)

For correspondence:
Abasova Shams / e-mail: abasovashems82@gmail.com

Abstract

The chemical composition (fineness, impurity elements) of native gold element from this deposit is considered. It has been established that the fineness of gold varies from 650 to 990%, averaging 810%, corresponding to high-grade gold. Impurity elements in the composition of native gold element have also been studied. Their presence in gold is established by special distribution patterns. There is a relatively high cotent of Te (0.02-0.05); Sb (0.06-0.08) and Bi (0.03-0.04). It is explained by the fact that silver under certain conditions, forming compounds with Sb, Bi and Te, falls out of solutions, as a result of which gold becomes high-grade (910-980%).

Keywords: fineness, histograms, impurity elements, modal value.

Received *17.11.2023*
Revised *11.06.2024*
Accepted *21.06.2024*

For citation:
Guseynov G.S., Abasova Sh.A.
[Chemical Composition of Native Gold Element from the Gosha Deposit]
Herald of the Azerbaijan Engineering Academy, 2024, vol. 16, № 2, pp. 103-108 *(in English)*

Qoşa yatağında sərbəst qızılın kimyəvi tərkibi

Q.S. Hüseynov, Ş.Ə. Abasova

Azərbaycan Dövlət Neft və Sənaye Universiteti (Azadlıq prospekti 16/21, Bakı AZ1010, Azərbaycan)

Xülasə

Məqalədə sərbəst qızılın kimyəvi tərkibinə (əyarlığı, element qatışıqları) baxılmışdır. Müəyyən olunmuşdur ki, qızılın əyarlığı 650-990% arasında dəyişir, orta əyarlıq 810% təşkil edir və yüksək əyarlı qızıla uyğun gəlir. Sərbəst qızılın tərkibində iştirak edən element-qatışıqları lazer rentgen-spektral üsulla öyrənilmişdir. Sərbəst qızılın tərkibində aşağıdakı element qatışıqlarının olması müəyyən edilmişdir (%): Cu (0,008-0,01), Fe (0,01-0,02), Pb (0,003-0,004), Zn (0,001-0,002), Te (0,02-0,05), Sb (0,06-0,08), Bi (0,03-0,04). Qeyd edilən element qatışıqlarının (Te, Sb, Bi) miqdarı nisbətən yüksəkdir. Bu Qoşa yatağında qızılın əyarlığına öz təsirini göstərmişdir.

Açar sözlər: əyarlıq, histoqramlar, element-qatışıqları, modal dəyər.

Химический состав самородного золота Гошинского месторождения

Г.С. Гусейнов, Ш.А. Абасова

Азербайджанский государственный университет нефти и промышленности (пр. Азадлыг, 16/21, Баку, AZ1010, Азербайджан)

Аннотация

Рассмотрен химический состав (пробность, элементы примеси) самородного золота Гошинского месторождения. Установлено, что пробность золота варьирует от 650 до 990‰ и составляет в среднем 810%, что соответствует высокопробному золоту. Также изучены элементы-примеси в составе самородного золота. Присутствие их в золоте устанавливается по особенностям распределения. Отмечается относительно повышенное содержание Te (0,02-0,05); Sb (0,06-0,08) и Bi (0,03-0,04). Серебро в определенных условиях, образуя соединения с Sb, Bi и Te, выпадает из растворов, в результате золото становится высокопробным (910-980‰).

Ключевые слова: пробность, гистограмма, элементы-примеси, модальное значение.

Introduction

The Gosha deposit is located in the extreme northwestern part of the Shamkir uplift of the Lok-Garabagh structural formation zone of the Lesser Caucasus. It is a typical representative of volcanogenic deposits with progressive ore formation and is associated with a continuous basalt-andesite-dacite-rhyolite formation, localized in the dome of the volcanic structure. A.A. Aliyev, E.S. Suleymanov, V.M. Babazade, A.A. Isaev, M.D. Bayramov, G.A. Veliyev, G.S.Guseinov and others dealt with the issues of geology, ore formation and gold content of the deposit in different years.

The geological structure of the deposit includes basaltic andesites, tuffs, tuff breccias and tuff conglomerates of the early Bajocian and a sequence of quartz plagio porphyries of late Bajocian age (Fig. 1).

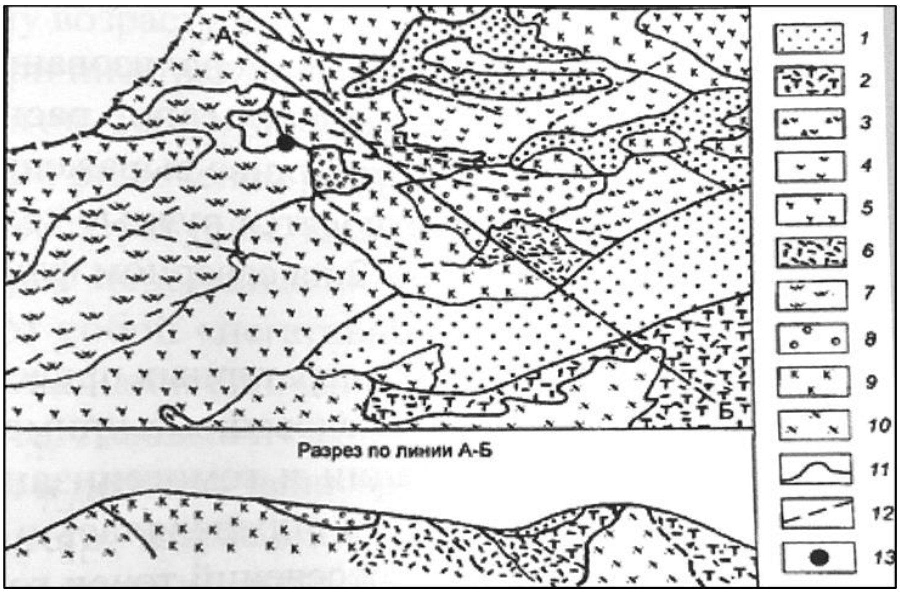

Figure 1 – Schematic geological map of the Gosha deposit

1- modern deposits; 2- Upper Bajocian substage, rhyodacite tuffs; 3- Early Bajocian substage, andesite lava breccia tuffs; 4- Early Bajocian subvolcanic basalt-andesites; 5-Late Bajocian subvolcanic rhyodacites; 6-lavas of Late Bajocian rhyodacites; 7-pyritized secondary quartzites formed due to Late Bajocian rhyodacites; 8- hornfelsed rocks; 9- hydrothermally altered; 10- quartz-plagioporphyr; 11- geological boundaries; 12- tectonic disturbances; 13. Gosha deposit.

As is known [2], the Gosha deposit itself is confined to the junction of two differently directed faults of different ages of origin, extent and orientation, expressed on the surface as a zone of increased disturbance, containing Middle Jurassic subvolcanic, Late Jurassic intrusive bodies and dike formations. The main ones are linear magma-controlling faults of early Jurassic origin and have a northwestern (pan-Caucasian) strike. They can be traced along the axial strip of the Ahmedabad-Gosha anticline, which has an asymmetric structure - the northern wing is steep 57 (up to 45º) compared to the southern one, which has a dip angle of approximately 20º. Frequent undulations of the anticline hinge are accompanied by the formation of brachystructures (anticlinal and synclinal), complicating the structure of the Ahmedabad-Gosha volcano-tectonic uplift. The presence of a fault zone is clearly recorded from geological, geophysical and geomorphological data.

In tectonic terms, the deposit is associated with the second-order Gosha-Ityrkalansk anticline, occupying the western part of the Ahmedabad-Gosha anticline, in the zone of conjunction with the homonymous deep fault and systems of fractures of submeridional and sublatitudinal directions. All fracture disturbances are represented by a brecciation zone of veinosity, accompanied by pyritization and kaolinization.

The main ore-forming mineral is pyrite. In subordinate quantities, there are chalcopyrite, sphalerite, and dull ores. Secondary minerals include native gold, arsenopyrite, tetradymite, petzite, chalcedony, and others. Among vein minerals, quartz and calcite are encountered. The main minerals of supergene ores are goethite, hydrogoethite, bornite, covellite, etc. Quartz-pyrite, quartz-gold-telluride, and quartz-goethite-hydrogoethite stages of mineral formation are distinguished.

The authors, based on factual materials collected during research at the described deposit, have established the chemical composition (fineness, impurity elements) of native gold using analytical data. The fineness of gold and detailed study of its chemical composition allow the identification of its genetic characteristics, which can be used as predictive indicators at various stages of gold deposit research.

To investigate this matter, a specific amount of gold nuggets from samples - nugget fragments of primary and oxidized ores, was analyzed. The analysis results are presented in Table 1.

Table 1 – Composition of individual gold grains according to microprobe analysis

№	**Au**	**Ag**	**Te**	**Sum**
1	94,3	5,6	0,01	99,91
2	91,4	8,6	0,02	100,02
3	88,6	11,3	0,03	99,93
4	98,9	1,1	0	100,00
5	74,9	25,0	0,02	99,92
6	86,8	13,1	0,01	99,91
7	84,7	15,3	0	100,00
8	65,8	34,1	0,02	99,92
9	86,7	13,7	0	100,00
10	89,4	10,5	0,03	99,93
11	86,8	13,2	0,02	100,02
12	95,2	4,80	0	100,00

It follows from the table that the fineness of gold varies from 650 to 990‰, averaging 810‰, and the modal value falls in the range of 800-850‰, corresponding to high fineness gold according to the classification of N.V. Petrovskaya [5]. In individual grains of gold (analyzes 1,2,4,12) a high fineness of 910-980 is observed. These gold grains were taken from the oxidation zone, where, under the influence of thermal processes, they lost all kinds of impurity elements and became high-fine [5].

In general, the gold fineness in this deposit ranges from 650-900‰. As is known [1], one of the reasons for fluctuations in gold fineness is the condition of ore formation. Thus, starting from the deeper horizons of the deposit, with decreasing depth of deposition, the silver content in native gold naturally increases and at the same time the gold purity decreases, i.e. As a rule, the fineness of gold increases with depth. We established this pattern based on a comparison of data from different horizons of the described deposit. Thus, on the lower horizon (1502 m), where quartz-pyrite ores were formed, gold is found in early pyrite in a finely dispersed state and, as a rule, has a high fineness (960-980‰). Quartz-gold ores of the telluride stages of mineralization, being productive in gold (horizon 1654 m), are characterized by a lower fineness (800-880‰).

Based on the data obtained, histograms of the gold sample distribution were constructed, confirming the above (Fig. 2.)

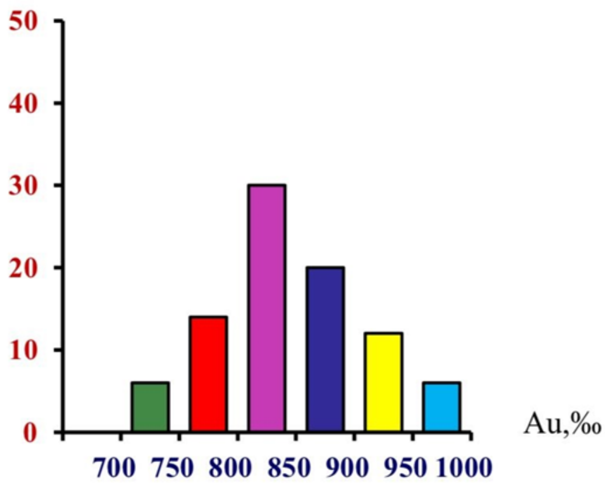

Figure 2 – Histogram of gold sample distribution from the Gosha deposit according to atomic absorption spectrometry data
(The abscissa axis is the gold sample: the ordinate axis is the frequency of occurrence in ‰ rel)

As you can see in the histogram (Fig. 2), the lower fineness of gold (700-750 ‰) is 6%, and the maximum (800-850 ‰) is 30%. Gold with a fineness of 800-850‰, according to the classification of N.V. Petrovskaya [5], corresponds to a high fineness.

It should be emphasized that the given properties of native gold from the Gosha deposit are typomorphic for gold-bearing parageneses formed in shallow depths of the volcanic region of the Lok-Garabagh structural-formational zone of the Lesser Caucasus [6].

Impurity elements. As a rule, native gold is deposited at the end of each ore stage and contains microinclusions of previously released ore minerals, enriching them with elements. Along with mechanical ones, structural elements of impurities included in the crystal lattice of gold itself are also noted. Their presence in gold is usually determined by distribution features. This determines the topomorphic significance of impurity elements as indicators of geochemical and mineral types of deposits and the regional geochemical situation. Most of the impurities are distributed unevenly in native gold and are associated with the presence of microscopic and submicroscopic mineral inclusions in gold grains - lithophile elements Fe, As, Pb, Bi, Te, S, uniform distribution in gold grains of Hg, Cu, Pd, and also possibly Sb, Cd, Pt. They form limited solid solutions with gold.

Impurity elements in the composition of native gold at this deposit were determined by emission spectral microanalysis using the method of I.P. Lantsev. [3,4] It has been established that native gold quartz - gold - telluride stage contains the following impurity elements (%): Cu (0.008-0.01), Fe (0.01-0.22), Pb (0.003-0.004), Zn (0.001 0.002), Te (0.02-0.05), Sb (0.06-0.08), Bi (0.03-0.04), As (0.002 0.003). At the same time, such impurity elements as Te, Sb and Bi are characterized by relatively high contents, which apparently influenced the fineness. This is apparently explained by the fact that silver under certain conditions, forming compounds with antimony, bismuth and tellurium, falls out of solutions, and hydrotherms depleted in silver deposit high-grade gold.

The composition and content of impurity elements in native gold are shown in Figure 3.

In some cases, the composition and content of impurity elements can serve as additional indicators when deciding on the stages and stages of the ore formation process, on the depth of gold deposition, as well as when choosing optimal schemes for its extraction and refining.

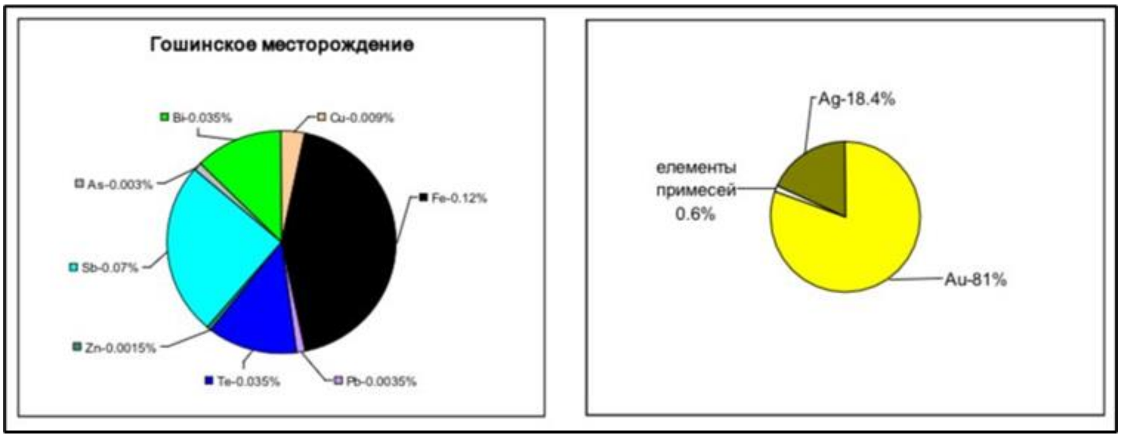

Figure 3 – Composition and content of impurity elements in native gold from the Gosha deposit

Conclusion

The established fineness of native gold allows us to obtain additional information to clarify the conditions for the formation of the Gosha deposit.

The results of the analysis showed that the increased contents of impurity elements (Te, Sat, Bi) included in the native gold of the studied deposit are in shallow conditions.

Conflict of Interest

The authors declare no conflict of interest.

REFERENCES

1. **Grishin V.M., Kosyak E.A.** On the reasons for fluctuations in gold fineness. In: Geol, Geochemistry and mineralogy of gold mining areas and deposits of Kazakhstan, 1988, issue, 1, pp. 113-122. *(in Russian)*
2. **Mansurov M.I.** Geological and structural conditions for the formation of the Goshin gold deposit. Auto. Ph.D., dis., 2004, 18 p. *(in Russian)*
3. **Lantsev I.P., Denisova L.K**. Impurity elements in gold. *(in Russian)*
4. **Lantsev I.P., Nikolaeva L.A. Badalova R.P. and others.** On the issue of the distribution of impurity elements in native gold from various deposits. Proceedings of INIGRI, 1971, issue, 96, pp. 110-117. *(in Russian)*
5. **Petrovskaya N.V.** On the typomorphism of native gold. // In the book. Problems of geology, mineralogy and petrology. M.: Publishing house Nauka, 1969, vol. 2, p. 260-285 *(in Russian)*
6. **Huseynov G.S. Mammedov I.A**. The Use of Typomorphic Features of Native Gold for the Solution of Geological Exploration. *Herald of the Azerbaijan Engineering Academy* 2022, vol. 14, no. 3, pp. 123-130. *(in Russian)*