

## PECULIARITIES OF PLACEMENT OF GOLD AND POLYMETALLIC MINING IN THE DEVON CARBONATES OF THE KARATAGATINSKY SQUARE OF THE ALMALYK ORE REGION

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### ANNOTATION

Today, in the Almalyk ore region, a number of gold occurrences are known in terrigenous-carbonate deposits in positions that are very favorable for the discovery of such types of deposits, and with the associated extraction of gold-containing fluxes for the metallurgical production of the Almalyk mining and metallurgical plant. This once again confirms the relevance of this work, dedicated to the allocation of gold mineralization of a new unconventional type, not only for the Almalyk ore region, but also for the territory of the entire Republic of Uzbekistan. The article presents the results of the work carried out in some countries to increase the country's mineral resources, but to increase our reserves of unconventional types of gold.

**Key words:** *terrigenous-carbonate deposits, gold, unconventional type, dolomite, limestone, ore-forming elements, silicification, dolomitization, argillization, sulfidization, polymetall*

### INTRODUCTION

Almalyk ore region is the most important region of non-ferrous metallurgy in Uzbekistan. There are stockwork copper-molybdenum, as well as polymetallic, gold and other deposits. The Almalyk Mining and Metallurgical Combine and the Kauldy mine operate on the basis of these deposits.

The urgency of the problem. Expansion of the mineral resource potential of the Republic of Uzbekistan is a problem of high urgency, the conceptual solution of which is largely associated with the discovery of new, unconventional types of ore deposits.

Despite a significant share of the increase in gold reserves that fall on large and unique deposits, the increase in gold reserves in the Almalyk ore region with a developed infrastructure of the mining industry is possible due to the discovery of small, compact deposits for low-volume production with an open pit mining in terrigenous-carbonate deposits.

New, unconventional for Uzbekistan types of gold ore (lower structural level), also known in the west of the United States, in Russia and other regions of the world, are represented by ores of hard-to-diagnose disseminated gold in terrigenous-carbonate deposits.

### METHODS

The work is based on materials collected by the author in the period 2011-2013 data of SE "East - Uzbekistan GSPE" were used. 8 geological sections were compiled, 8 prospecting, 112 mapping wells, 13 pits and 8 ditch were studied. For the ore zones of the sites, 50 geochemical samples were taken, 15 samples - crushes, from which monomineral samples were taken. Spectral and 24 mass spectral analyzes were carried out for minerals at the Central Laboratory.

When studying the material composition of ores and host rocks, a complex of modern methods of analysis was used (X-ray structural phase, local X-ray spectral, microprobe, neutron activation, spectral, including ICP - spectrometer). Below is a description of the main ore and vein minerals, paragenetic mineral associations (PMA) and some considerations on the mineralogenetic reconstruction of the ore formation process.

The Karatagatinskaya area is composed of sedimentary and igneous rocks. Dolomites with interlayers of limestones, sandstones and siltstones are widespread among the former. The latter are represented by quartz porphyries and granodiorite porphyries, as well as dikes of diabase porphyrites (lamphores).

Dolomites are the most widespread rocks. They can be attributed to the Karatagatinsky rhythm-form (according to I.V. Pleshchenko et al., 1983). Visually, it is black, dark gray, rarely fawn. According to the survey of thin sections, they are represented by dolomite of various grains (70-75%), calcite (5-20%) and fragments of quartz, feldspars, etc. (0-30%) and clay minerals (up to 10%).

Dolomite is represented by polytomorphic or fine-medium-grained segregations. Detritus varieties with fragments of radiolabels are sometimes noted. In some of the examined thin sections, dolomite forms polygonal grains of a bridge-like structure, which indicates the recrystallization of the primary rock.

Calcite forms thin veins, nests, less often individual grains in dolomite.

Fragments of minerals (quartz, feldspars, mica) and rocks (quartz porphyry, siliceous rocks) are unevenly distributed. In some areas, they make up to 30%, but on average their content does not exceed 5-10%.

Postmagmatic transformations in dolomites are poorly expressed. It is assumed that partial recrystallization, the appearance of ankerite veinlets, the development of hydromica (in direct contact with metasomatic quartz bodies), and the development of thin quartz veinlets are associated with the overlapping of gold ore mineralization.

Later processes caused the development of nests, clusters and veinlets of coarse barite, sometimes with disseminations of galena and chalcopyrite, as well as veins of white calcite, in the dolomites.

The geochemical features of dolomites according to mass spectral analysis of dolomite are characterized by low contents of most ore-forming elements (silver 0.48-1.7 g / t, copper 26-400, lead 170-670, zinc 89-310, gold 0.026-0.056 g / t).

Barium and strontium are present in increased amounts. As a result of the transformations of dolomites, an increase in silver, lead, bismuth, antimony, tin, molybdenum and gold was noted in them, with the simultaneous removal of barium and strontium. The complex of introduced elements indicates the polymetal nature of hydrothermal solutions. However, judging by the weak accumulation of elements, it can be assumed that dolomites are an unfavorable environment for their deposition.

Limestones (sandy and clayey) are sharply inferior in abundance to dolomites. Visually, they are light yellow, reddish, sometimes brownish in color.

Sandstones and siltstones form thin interlayers among dolomites. Visually, they have a light (pink, white, gray) color. Their composition is predominantly polymictic, less often substantially quartz. Cement is porous or contact, carbonate or clayey.

In the area of the Karatagatinsky massif, several paragenetic associations of different ages appeared (except for complexes of rock-forming minerals.)

Due to the fact that most of the manifestations of various associations are spatially separated, the sequence of their formation, in some cases, is assumed from indirect data. The following paragenetic associations of minerals are not distinguished:

1. lenses of fine-grained quartz ("quartzite") with gold and veins of gold-bearing quartz (productive association);
2. quartz veins with pyrite and chalcopyrite;
3. quartz - calcite - barite veinlets with polymetallic mineralization;
4. Calcite veins.

## RESULTS AND DISCUSSION

In carbonate rocks, the processes of marbleization, scanning, serpentinization, chloritization, hematization, ankeritization, and limonitization have been extensively developed. Marbles form fields in scale, developed over the bodies of intrusive and subvolcanic bodies, as well as in contacts with them.

Serpentinization and chloritization are most pronounced in the horizons of interbedded dolomites with sandstones and mudstones. This process is most intensively manifested in the zones of tectonic faults. Serpentinization often accompanies ankeritization and skarnification of rocks. Very often, polymetallic mineralization is associated with serpentinized rocks.

Ankeritization is noted in dolomites and limestones, sometimes together with calcite and quartz. Ankeritization develops mainly in the fracture valley, replacing carbonates. Lead limestones in areas of intense fracturing. The ore bodies in ankeritized carbonate rocks are high in lead, but they are not sustained and limited in size.

Limonitization and hematitization are very widespread in the area. Basically, these processes are widely manifested in cracked zones among carbonate rocks and in their contacts with intrusive bodies.

As a result of mineralogical studies, mapping of the outcrops of the Karatagatinsky ore field, outcrops and cores of deep wells (wells 125, 110, 126, 113, etc.), it was found that the contacts of carbonate rocks and carcass porphyry are brecciated, which are cemented in most of the micro-fine-grained chalcedony, opal and partly quartz, calcite, dolomite, sericite, chlorite, sulfide and hydrogoethite. The sulfide content ranges from 1 to 2% by weight. Sulfides are mainly represented by pyrite, less frequently by chalcopyrite, sphalerite, galena, and fahlores. In plan, these stratal deposits have a length (along the contact of rhyolites and carbonate rocks) up to 10 km, the thickness of the strata ranges from 1 m to 5 m. According to mineralogical and X-ray phase studies, these rocks are jaspers enriched in Cu, Au, Ag, Zn, Pb, As, and other elements (Table 1.). Gold is ultra-dispersed, as a result of the conducted studies, microprobe analysis of the chemical composition of the minerals gold, honey and zinc is associated with hydrogoethites (Table 2). According to the results of spectral and assay analysis, the main part of silicified rocks (jasperoids) where high gold content is observed is an increase, lead, zinc, arsenic and molybdenum, and zinc carbonate itself is not involved (Table 3). This data is confirmed by mass spectrometer analysis (ICP) (Table 4).

Table 1

Distribution of elements in fragments and cement of silicified eruptive breccias of contact of carbonate rocks (D2-D3) and quartz porphyry D1-2 (in ppm)

| Number | Cu   | Mo | Au | Ag  | Zn   | Pb   | As | Sb | Ti  |
|--------|------|----|----|-----|------|------|----|----|-----|
| 71     | 700  | 50 | 5  | 30  | 1000 | 1100 | 50 | 50 | 200 |
| 72     | 7000 | 50 | 10 | 30  | 1000 | 1100 | 50 | 70 | 500 |
| 73     | 200  | 15 | 2  | 1.5 | 200  | 700  | 15 | 5  | 200 |
| 74     | 15   | 2  | 3  | 0.5 | 6    | 50   | 2  | 2  | 20  |

As a result of the mineralogical, lithological-stratigraphic and geological-structural studies, gold ore occurrences in the terrigenous-carbonate rocks of the Karatagatinsky area are confined to certain stratified horizons. Gold occurrences are widely developed in the form of quartz veins consistent with layering, crosscutting veinlets and zones of metasomatic changes in interformational (contact) and intraformational zones. Their distribution showed structural and lithological control. Structural control is expressed in the confinement of the main mass of occurrences to the faults of sublatitudinal and submeridial striking, to the base of volcanic rocks of the Upper Paleozoic. Lithological control - all subconcordant occurrences are associated with lenses of calcareous quartz sandstones, dolomites and mudstones. Taking into account the stratiformity of the gold occurrences of the Almalyk ore region, the main factor in forecasting and searching for such objects, regardless of points of view on the genesis of these deposits, should be considered the lithological-stratigraphic control of mineralization, its confinement to certain formations and facies. Several prospecting and mapping wells were drilled in the Karatagatinskaya area, in addition, ditches and pits were drilled, which completely or partially crossed the carbonate strata.

In trenches, pits and mapping wells, gold concentrations have been revealed; they are associated with terrigenous - carbonate formations, with manifestations of polymetallic, pyrite mineralization, with zones of crushing, silicification, hematization, recrystallization of carbonates. Near-ore metasomatism in intensity is manifested from insignificant to intense within and between deposits, ore formations, which indicates the predominance of lithological control of mineralization. In some areas, the primary lithological composition is altered by silicification, dolomitization, argillization, sulfidization. Siliconization is manifested more noticeably and is directly related to gold, thus, the maximum number of recorded concentrations tends to the Karatagatinskaya and Kulatinskaya rhytmosvites, dolomites, to areas of interbedded greenish-gray, black, thin and medium-layered and altered limestones.

## CONCLUSIONS

The main purpose of the work was to study the features of the location and composition of gold and polymetallic mineralization in the Devonian terrigenous-carbonate rocks of the Almalyk ore region (Karatagatinskaya area).

1. Placement of gold mineralization is controlled by large regional faults, the localization of ore bodies is confined to shear faults; Gold mineralization in deposits is concentrated in hydrothermally altered (to quartzite-like appearance) carbonate rocks in silicification zones and in overlying volcanics.

2. The terrigenous-carbonate deposits of the Upper Devonian and Lower Carboniferous in the Almalyk ore region are characterized by increased gold content. Gold concentrations are confined to stagnant facies zones enriched in organic matter. A characteristic feature of the distribution of primary gold and mineralization in terrigenous-carbonate rocks is its finely dispersed organometallic character. Organic matter is a precipitant for gold and other elements. Under the influence of tectonic - magmatic activation and during the circulation of hydrothermal solutions, gold was epigenetically transformed and concentrated in the aforementioned structures.

3. Gold has features called microscopic gold "or invisible fine-grained". Polymetallic mineralization is confined to dolomites interbedded with limestones, marly dolomites, sandy limestones and dolomites and sandstones of the Kultinskaya, Karatagatinskaya and Almalyk formations near or in the contact zone with the Lower Devonian effusive rocks and is localized mainly in serpentization zones, mainly in zones crushing and brecciation zones.

4. Visually, in the field, it is difficult to identify areas favorable for the localization of gold mineralization without sampling. Gold in carbonate deposits is finely dispersed.

