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Research Article

GENERAL INFORMATION AND GEOLOGICAL STRUCTURE OF THE ANGREN ORE DISTRICT

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ABSTRACT
The Angren ore district is epithermal and is a large, weakly eroded ore-magmatic system, fixed from the surface by unique geochemical anomalies. Due to half a century of exploitation, the depth of mining of deposits is hundreds of meters, the content of the main useful component decreases with depth, and rich ores are exhausted. Identification of such objects is an urgent task, since they contain rich ores and a large-volume potential resource of poor metasomatic ores, acting as the main source of growth of reserves in mining areas, i.e. have an important metallogenic value.

Keywords: *Erosion, Anomaly, Deposits, Gold, Thrust, Silver, Minerals, Rock, Paragenesis, Process*

INTRODUCTION

The Kyzylalmasai deposit is located in the Akhangaran district of the Tashkent region, 70 km from Tashkent and 10 km from Angren.

The Angren gold extraction plant is located 5 km from the deposit and is connected to it by an asphalt road. The ore field area includes the North-West, Central, Mezhdurechye, Samarchuk and Chumau I and II sections of the deposit, as well as a number of gold-silver ore occurrences. The presence of ancient mine workings within the ore field was first noted in 1913 by V.N. Weber. The discovery of the Kyzylalmasai deposit is associated with the verification of the application of hydrogeologists I.I. Kim, P.S. Panchenko *et al.,* in 1959.

From 1959 to 1972, geological survey (Yu.Kh. Akhmedullin, A.A. Adelung, Yu.K. Lyashenko *et al.*), geophysical (B.I. Chisty, A.A. Volfovich *et al.*) and thematic (R.P. Badalova, M.O. Suleimanov *et al.*) works were carried out in the area. Prospecting and exploration works at the deposit began in 1963, and already in 1964 they moved to preliminary exploration, which was completed in 1971. As a result of the works of 1972-1974, industrial reserves of the Central section of the Main Ore-Bearing Zone were approved, and in 1974, reserves of categories C_1 and C_2 were approved at the Samarchuk and Chumauq I sections.

In 1975-1978, exploration work studied the deep horizons and flanks of the field. From 1975 to 1980, detailed exploration of the II stage was carried out in the Central area, and from 1980 - the III stage. By now, the assessment of the Central area has been fully completed, the Mezhdurechye area has been identified and assessed, the deep horizons of the Samarchuk area are being studied, the Chumauq I area has been fully developed, the Levoberezhnoye area (an independent object) is being assessed and developed, and the prospects of the Chumauq II area have been substantiated.

The southern part of the ore field is located in the foothill hilly-ridged zone with absolute marks of 1000-1300 m. The rest of the relief is mountainous, dissected, with steep slopes. Absolute marks reach 2000 m, and relative elevations are 150-300 m. The southern slope of the Chatkal Range, limited by the Angren River, is cut within the ore field by the right tributaries of the Angren River: Goshsay, Kyzylalmasay, Karabau. From the west, the ore field is limited by the Akcha-Vostochnaya River, and from the east - the Dukent River.

STUDY AREA

The Angren ore district of the Chatkal-Kurama region (Middle Tien Shan) is an integral part of a large gold-bearing province [6], in which large and unique gold deposits Muruntau, Charmitan, Kyzylalma, Kochbulak and others are localized from west to east (Fig. 1). The localization of these deposits, according to I.M. Golovanov [4], is subject to vertical metallogenic zoning, which is reflected in the different stratigraphic positions of the ore regions (from west to east): Central Kyzylkum $Є_1$-S_1, Almalyk D_1-C_2 Tien Shan and Angren C_3-P_1.

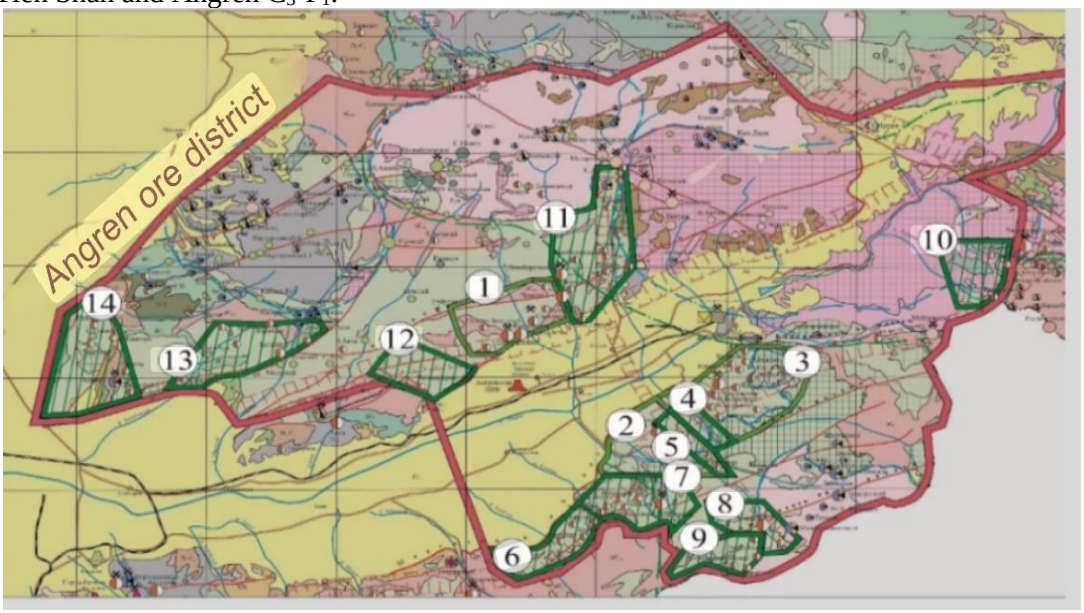

Fig. 1. Overview of the Angren ore district. 1-Kyzylalmasai, 2-Kochbulak, 3-Kairagach; prospective areas: 4-Nishbash, 5-Tokberdin, 6-Agatashlin, 7-Segenek-Guldaramin, 8-Uchkyz, 9-Kattakashkasay, 10-Kumkol, 11-Dukent, 12-Chilmayram, 13-Karabash, 14-Tashtepin.

The formation of the leading industrial gold ore deposits of Uzbekistan is spatially associated with the late Paleozoic regions of a subduction-collisional nature - the volcano-plutonic Middle Tien Shan, due to the subduction of the crust Turkestan paleocean under the Kazakhstan microcontinent and subsequent post-collisional processes, and the fold-thrust South Belt (R.I. Koneev, R. Seltmann, R.A. Khalmatov, 2018) with manifestations of local plume magmatism (F.I. Islamov, 1997).

MATERIALS AND METHODS

In the implementation of scientific work, using traditional geochemical methods, determining the material composition of samples by various analytical methods (spectral analysis, mass spectrometer ICP-MS), using the results of field and laboratory work, geological maps were created using ArcGIS software.
Despite the completely different history of development of these areas (R.Kh. Mirkamalov, F.K. Divaev, R.S. Seltmann, D.L. Konopelko, 2018), as well as the polygeneity and polychrony of the gold ore stage (F.I. Islamov, 1997), all industrial gold deposits exhibit a similar sequential series of mineralogical and geochemical parageneses (R.I. Koneev, 2006), which confirms the universality of the standard nature of the ore formation process and its belonging to fluid and magmatic systems, and some deviations are associated with the heterogeneity of the host strata and the pulsating nature of the polycyclicity and multi-stage ore process. Each geochemical type is present in all deposits, but only one is the main one, and the rest are impurities (A.A. Kremenetsky *et al.*).

The vertical geological, mineralogical-petrographic, geochemical zoning of ore-geochemical systems manifested in the region at micro levels is clearly recorded laterally from the west - hydrothermal plutogenic (closed systems) to the east - hydrothermal-volcanogenic type (open and semi-open systems), fitting into classical, idealized-abstracted models (V. Emmons, S.V. Grigoryan, L.N. Ovchinnikov, A.A. Kremenetsky, etc.). The main prerequisites indicating this are an increase in absolute altitude marks by 3-3.5 km, a change in stratigraphic levels (from Є-S to C_3-P-T_1), a decrease in the temperature of ore formations. Based on this, V.F. Skryabin [7] notes a fundamental difference in mineralogy, geochemistry, material composition of near-ore alterations, degree of sulfidity, increase in the role of vein bodies, decrease in the scale of objects, increase in gold content, etc.

The insufficient study of deep horizons of deposits to date does not allow this zoning to be clearly traced in its entirety, in a vertical section at micro levels, i.e. within specific deposits. In this regard, based on factual data, it can be assumed that the length of the total vertical ore column of the Chatkal-Kurama region is several kilometers. At the same time, according to H.N. Baimukhamedov, Yu.L. Gertman [2], near-ore metasomatites of the Revashte deposit characterize the uppermost interval of the hydrothermal column, characteristic of gold ore deposits of the Kurama subzone.

Fig. 2. Scheme of the main volcano-tectonic structures of the Angren ore region (based on materials by V.A. Arapov, [3])

Polygenic grabens: 1 – Shavaz-Dukent, 2 – Almalyk; subsidence troughs: 3 – Kamchik, 4 – Lashkerek; Valis-type calderas: 5 – Karabash, 6 – Chilten, 7 – Akshuran; resurgent: 8 – Babaytau-dor.

Based on the principles of the formational approach, volcanogenic complexes (C_{2-3}) are identified with volcanogenic formations. In particular, the rocks of the Minbulak complex (C_2mb) [3] correspond to the andesite-dacitic formation, the Balgala (C_2bl) – to the andesite, the Akchinsky (C_2ak) – to the dacite, the Karabau (C_3kb) – to the dacite-andesite, the Oyasaysky (P_1os) – to the liparite formation according to V.A. Arapov [1], or within the framework of the trachybasalt-trachyandesite-trachydacitic and trachyandesite-dacitic formations, according to T.N. Upper Paleozoic intrusive complexes have a number of characteristic features noted by T.Sh. Shayakubov, [8]; T.N. Ishbaev [5]:

The structure of the ore region is characterized by a complex geological structure, and the bulk of the rocks falls on the Caledonian and Hercynian structural stages.

The Caledonian structural stage is represented by sandy-shale deposits (S_1) and granitoids (S_2) breaking through them, volcanogenic formations (D_{1-2}), which in turn are covered by terrigenous-carbonate rocks (D_2-C_1). The Hercynian stage is composed of batholithic intrusions of granodiorite composition (C_2) and widespread volcanogenic complexes (C_{2-3}), as well as a complex of small porphyry intrusions, dike formations (C_3-P_1), in the rocks of which industrial medium and large deposits of Kochbulak, Kyzylalmasai, Kairagach and others are located, localized in volcano-tectonic structures: Shavaz-Dukent and Almalyk polygenic grabens and Lashkerek subsidence trough (Fig. 2).

RESULTS AND DISCUSSION

Genetically related to volcanism; intrusions belong to the hypo- and mesoabyssal facies of depth; the general sequence of intrusions in the Carboniferous is homodromic, and in the Permian it is antidromic; the composition of intrusive rocks is characterized by a sharp predominance of granodiorites, monzonites, gabbroids, with a subordinate role of granites and leucogranites, which is one of the characteristic features of the intraplate stage of magmatism, and this phenomenon itself appears to be a consequence of the influence of mantle fluids on residual foci of magmas of various compositions, located at different levels of the earth's crust.

In tectonic terms, the region is characterized by a complex block structure. Faults of early origin include northwestern and latitudinal ones, which intersect with discontinuous disturbances of northeastern strike. Northwestern faults are isolated. North-east trending faults are the most common, while meridional and submeridional faults are established along zones of regional tectonic fracturing of submeridional strike.

In the area of the Angren ore district (~2350 km^2), occupying the right and left banks of the Angren River, along with gold ore (Kyzylalma, Kochbulak, Kayragach, etc.), deposits and numerous ore occurrences are concentrated: alunite (Gushsay), lithium (Shavaz, Ashibuzuk), lead and zinc (Tashsay I, II, Kattasay), fluorite (Naugisken, Yangakly, Dzhanibek), silver (Lashkerek), uranium (Alatanga, Mazar, Dzhenichke). These are natural testing grounds for studying the evolution of a single hydrothermal column and creating on this basis a general scheme of the sequence of its formation and zonality of hydrothermal metasomatic ore formations of the period of late Paleozoic tectonomagmatic activation. Some of these deposits have been developed to date, others are involved in or are being prepared for operational exploration. Currently, among the gold ore deposits of the region, Kyzylalma and Kochbulak are being developed.

Significant gold reserves are concentrated within their boundaries, which is determined by the unique geological and structural conditions of the distribution of ore matter and its localization. These deposits, as a rule, are confined to the areas of development of middle-upper Carboniferous effusive rocks of dacite, dacite-andesite and andesite-dacite composition, located in depression volcanic structures, the rigid base and framing of which are represented by the so-called granitoid basement C_{2-3}.

The main feature of these deposits is the development of intensive wallrock metasomatism, superimposed on effusive and intrusive rocks, leading to the appearance of wallrock metasomatites of argillizite and beresite formations (S.M. Koloskova, R.I. Koneev, M.M. Pirnazarov, V.D. Tsoi, etc.). Despite the abundance of primary gold ore sources, the Angren ore region is characterized by low gold placer content. This is explained, first of all, by the weak erosion of the sources and the predominance of dusty and very fine gold in them, which, when carried out by lateral tributaries into the Angren River, is gradually released, dispersing in a thick layer of alluvium (Popenko, 2007).

In tectonics, the ore field is characterized by a two-tier structure. In the lower structural tier, Caledonian schists and granites are developed, broken through by Hercynian granitoids. In the upper structural tier, cover, extrusive vent, explosive, subvolcanic and volcanomict facies are developed. Its thickness varies from a few meters to 200-600 m.

Mineralized zones of the Kyzylalmasai deposit and ore field occurrences are controlled by the northwestern Kyzylalmasai, sublatitudinal Goshsay, northeastern Karabash faults and further, beyond the

Tuyachavul fault, by a northeastern-trending zone that can be traced to the Dukent River, where it submerges under Permian rhyolites. This system of mineralized faults fits into the tectonic dynamo pair of large left-lateral shifts of the limiting faults.

CONCLUSION

When the Kyzylalmasai fault approaches the Kyzkurgan zone on the northwestern flank, the former splits and fades. The described block (Kyzylalmasai) includes the area of development of almost all industrial ore accumulations. The left-bank block (the Karabau-Dukent interfluve), limited from the south by the Tuyachavul fault, can be traced to the Dukentsay River. Within its boundaries, on the left side of the Karabau River, in the northwestern contact of the Altyndyk extrusion, the Levoberezhnoye gold-silver ore occurrence is located.

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