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GEOLOGICAL CHARACTERISTICS OF THE ZIRABULAK ORE FIELD

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Abstract. *The article analyzes the results of previous studies of the Zirabulak ore field, and examines the data of recent years. The Zirabulak mining district covers the low-mountain uplifts of the Nurabad district of the same name in the southern part of Samarkand and, partially, Navoi regions. Geologically, it forms the northern flank of the Zeravshan-Alai structural-formation (metallogenic) zone, which is adjacent from the south to the Kuldzhuktau-Zeravshan regional zone of the west-northwestern strike. Based on the collected information and based on the geological conditions of ore content, stratigraphy, and magmatism of the region, the ore field deposits can be divided into two geological and industrial types: gold-quartz and gold-sulfide-quartz.*
Keywords*: Zirabulak ore field, stratigraphy, ore content, deposits, geological and industrial type, gold-quartz.*

Familiarity. The main aspects of the features of ore localization and regularities of gold mineralization placement in the leading deposits of the Zirabulak ore field and in the adjacent territories are covered in the studies of Baymukhamedov Kh.N., Khamrabaev I.Kh., Smirnova E.F., Sigalov B.I., Sadikova L.R., Sedelnikov L.V., Rakhimov A.D., Davlatov N.Kh. and many others.

Ore content. In the Zirabulak Mountains, gold ore objects of the following two geological and industrial types are common: gold-quartz and gold-sulfide-quartz. Figure 1 shows significant gold and uranium objects from the created database [1].

The early-stage gold-quartz formations are characterized by their contents (1.5-2.5 cu) and do not have a wide distribution range, which is generally associated with a weak near-ore alteration of rocks. Elements of sulfide formations are not very typical for this type, but there is a slight increase in arsenic. At the same time, the thinly dispersed nature of gold mineralization determines its high correlation even with a small content of lead, zinc, and other sulfides.

Primary gold halos on the deposits of the Sappen and Darait formations from samples taken from slightly modified shales from the surface are not rich and do not exceed 0.5 cu. However, with increasing intensity of calcification and depth, the content increases rapidly. Thus, geochemical samples from a depth of 0.5 m showed the gold content in quartz shales up to 2 cu. Geochemical survey scale 1: 50000 revealed six large area halos of gold with contents from 0.003 to cu.

The manifestations of the middle-stage gold-quartz formation are determined by the following criteria: proximity to the Zirabulak intrusive, high specialization in arsenic and a sharp excess of its content over the sulfide group, intense near-ore changes that record significant endogenous gold halos in terms of the intensity of petrophysical features, and maximum information content of geochemical features [1].

Here is a description of some representatives of this formation.

Daraitut ore occurrence, located in the northern part of the Zirabulak Mountains. Its area covers mainly deposits of the Sappa Formation and partly the Doraitu Formation, and also includes the Kichiksai granite massif.

The shales that make up the bulk are modified (chloritized, sericitized, and quartic).

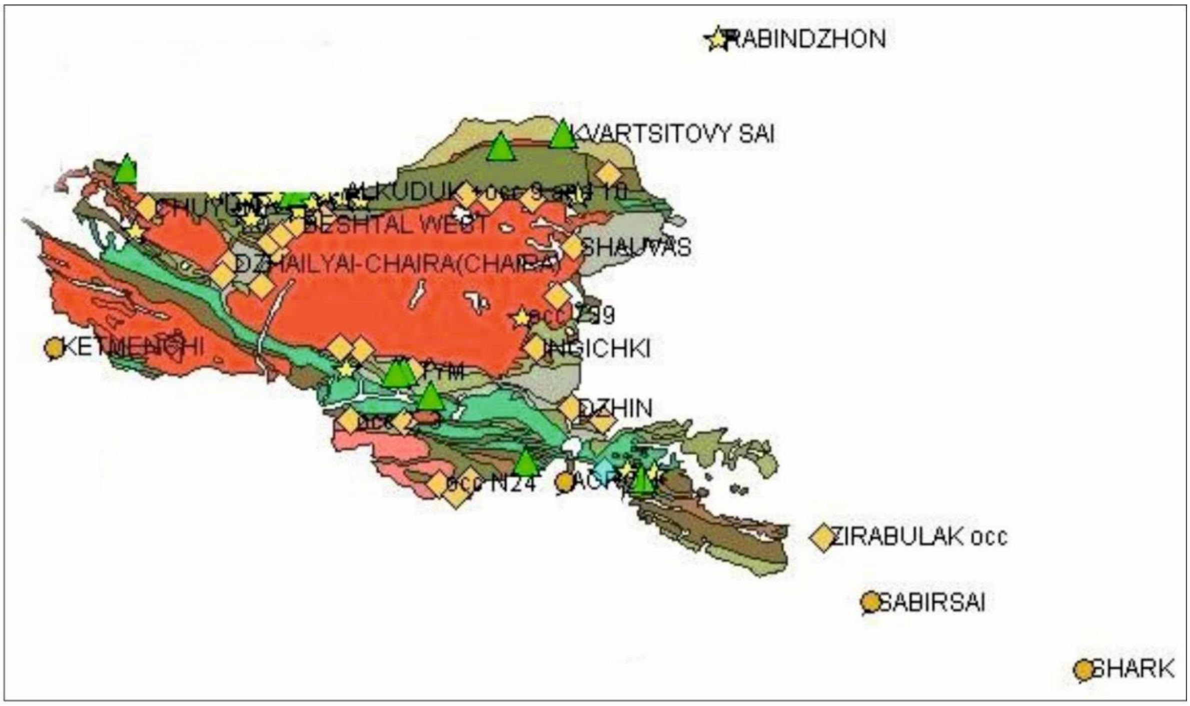

Figure 1. Gold and uranium objects of the Zirabulak mountains
(based on field materials by T.R. Saliev).

The Kutchi ore occurrence is located in the northeastern part of the Zirabulak Mountains and is composed of rocks from the Kattarmai Sappen formation. Shales are significantly altered: chloritized, sericitized, and quartzized.

The Ketmenchinskoe ore occurrence is located at the southwestern end of the Zirabulak massif. The site is located in the deposits of the Altyn-Aul formation and has gold halos at the western and eastern ends.

First of all, attention is drawn to the significant extent of mineralization distribution and possible high concentrations detected by geochemical halos.

Stratigraphy. *Ordovician system.* Deposits of this system called *the Altyaul Formation* are widespread in the Zirabulak Mountains. The formation consists of interbedded shales (carbonaceous-clayey, quartz-sericite-carbonaceous), siltstones, sandstones,granites, conglomerates with interbeds of limestones and effusive rocks. Their relationship to the underlying rocks is unknown. The apparent thickness is about 500 m [2].

The Silurian system. The rocks correspond to the Ordovician formations. At the base of the section, deposits of the Llandoverian stage called the Daraitu Formation are distinguished. The formation is composed mainly of carbonaceous-micaceous-clay shales with interbeds of siltstones, sandstones, gravelites, and limestones.

The Devonian system. The Lower Devonian formations are known as the Jajiraymakhal formation. In the area of the village. Altyaul, in the Beshtau Mountains, the section of the formation is represented by dark-colored massive and layered fine-grained dolomites and dolomitized limestones. The formation thickness is up to 600 m. The rocks correspond to the Silurian deposits.

The carboniferous system. Carboniferous formations occur in various stratigraphic horizons of the Lower Devonian sediments in a transgressive manner with erosion, azimuthal and angular unconformity. According to genetic and lithological features, they are divided into 2 formations: the lower - Tym (Tournaisian stage) and the upper - Tepalik formation of the middle-Upper Carboniferous.

The Tym formation is widespread. According to its lithological composition, it is divided into 2 units: the lower one, composed of substantially coarse-grained rocks with interbeds of siltstones and shales (200-300 m thick), and the upper one, represented by a rhythmic interbedding of shales and sandstones (180-300 m thick).

The Tepalik formation has limited development. It is characterized by a very diverse lithological composition: conglomerates, gravelites, sandstones siltstones, shales. It occurs with erosion in the Tym formation. At the base of the formation is a basal block-boulder conglomerate (up to 50 m thick). The entire formation is 450-500 m thick.

Mesocainozoic group. Mesozoic and Cenozoic formations are mainly represented by terrigenous and variegated Mi deposits of the Upper Cretaceous, Paleogene, Neogene, and anthropogenic periods. These deposits are developed in the foothill part of the Zirabulak uplift, being exposed in the form of narrow strips framing Paleozoic formations. The cretaceous deposits consist of conglomerates, sandstones, and gravelites with rare interbeds of clay up to 20-25 m thick. The total thickness of cretaceous deposits is up to 70-100 m.

Paleogene and Neogene deposits have a limited distribution and are represented by limestones, siltstones, sandstones, and marls. The thickness of the sediments vary from 4.0 to 50.0 m.

The Quaternary deposits are subdivided into 4 complexes (Nanai, Tashkent, Golodnostep, Syrdarya) and are representedby conglomerates, gravelites, and gravel. The maximum thickness of Quaternary deposits reaches 250 m.

Zaravshan-Turkestan (Katarmay) structural and formation zone. The Devonian system. Conventionally, the Lower Devonian (as well as the Protozoic according to Mikhailov, 2005) includes a thick (up to 4.5 km) volcanogenic-quartzite-shale stratum identified as the Katarmai formation. According to its composition, it is divided into 4 sub-formations (according to Korsakov, 1984; Korkin, 1970, etc.).

The lower (terrigenous-volcanogenic) zone is exposed in the core of the Katarmai anticline. It is composed of volcanogenic and siliceous rocks, micaceous-quartz shales, marbled and dolomitized limestones. Volcanogenic rocks belong to the olivine-basalt formation, and are everywhere transformed by greenstone. Shales are phyllite, phyllite, clayey, and sericite. Carbonate rocks are enriched in terrigenous material and occur in the form of lenses and interlayers.

The second sub-formation (terrigenous-carbonate) is exposed in the frame of the core of the Katarmai anticline. They occur mainly on rocks of the lower sub-formation. The lower part is essentially terrigenous-carbonate. It is composed of micaceous-quartz, often with albite, shales with numerous lens interlayers of limestones and dolomites.

The third subformation is volcanogenic-terrigenous and consists of alternating thin layers of agglomerate tuffs, sandstones, gravelites, siltstone-clay shales, as well as limestones and dolomites. Volcanogenic rocks are basalt, greenstone-transformed-the main ore-bearing environment.

The fourth-terrigenous subformation is exposed along the northern slope of the Ziaetda Mountains, and lies along the third subformation.

The age of the Katarmai formation is debatable, since limestones containing a diverse fauna of the Venlocian-Lower Devonian have mostly tectonic relationships with volcanites. Some researchers consider the age of the Katarmai formation to be Precambrian. According to V. S. Korsakov (1962), the rocks of the formation correspond to the Lower-Middle Devonian Flysch sequence known as the Sappenskaya Formation. The Sappen formation is composed of interbedded sericite-clay shales, sandstones, and siltstones with lenses and interlayers of limestones, dolomites, clay-siliceous shales, gravelites, fine-pebble conglomerates, and tuffites.

In the lower part of the formation, there is a rhythmic alternation of carbonate and terrigenous rocks. The formation thickness is -1.1 km.

Magmatism. The intrusive magmatism of the Zirabulak Mountains is mainly granitoid: granodiorite-adamellite-granite rocks are composed of about 370 square kilometers, which is *34.2%* of the total area of development of Paleozoic formations. The bulk ofintrusive bodies are located in the Zarafshan-Alai zone and are represented by potassium-sodium granitoids and effusives of moderate, acidic, and medium composition (fig. 2) [3].

In the volcanogenic trough (Zarafshan-Turkestan zone)**, intrusive** bodies are much smaller and are represented by hyperbasites, gabbroids, tonalites, and volcanites of the main composition.

The scheme of I. H. Khamrabaev (1958) includes the following age complexes of igneous rocks:

1. Ordovician-Lower Silurian volcanogenic
2. Silurian-Devonian volcanogenic
3. lower-middle carbon complex of basites and ultrabasites,
4. UpperCarboniferous-Lower Permian granitoid complex with intrusive phases: a) diorites, quartz diorites, b) granodiorites, c) granites, d) Alaskites.

A characteristic feature of all intrusive bodies is their subordination to the general folded structure of the region, the long axes of which extend in the latitudinal and west-north-western directions, and the placement of anticlinal folds in the cores. The shape of intrusions largely repeats the shape of folded structures, and when undulating the joints of folds, the surface of intrusive bodies experiences corresponding curvatures, copying all the mulds and domes of the host rocks (Ingichka region).

Thus, the location of granitoid intrusions is due to a sharply elongated belt shape, which determines the nature of near-fault bodies, and not batholiths embedded in the arched uplift. Intrusions are controlled by narrow linear blocks, sometimes occupying them entirely and, apparently, in this case, completely using interformational pre-carboniferous surfaces. Hence the importance of these surfaces for understanding the tectonic structure of the Central Zone.

Interformational breaks are quite clearly recorded from the relics of Middle Paleozoic deposits, which are almost always "pushed" under the complex of Lower Paleozoic deposits to the south. A characteristic feature of these disturbances is a sharp change in the effective density of blocks, almost similar to the zones of maximum linear gradients between the Paleozoic and Mesozoic complexes. The boundaries of rock differentiation by density only repeat the boundaries between formations if there is a sufficiently effective mass.

It follows from the above that the following large independent epochs are clearly distinguished in the geological development of the Zirabulak Mountains: the first of them is the

Caledonian, associated with the formation of folded meridional structures; the second is the Hercynian, due to the development of large discontinuous structures in the north - western direction and a wide manifestation of granitoid magmatism; the third covers the processes of Mesozoic and Cenozoic block tectogenesis.

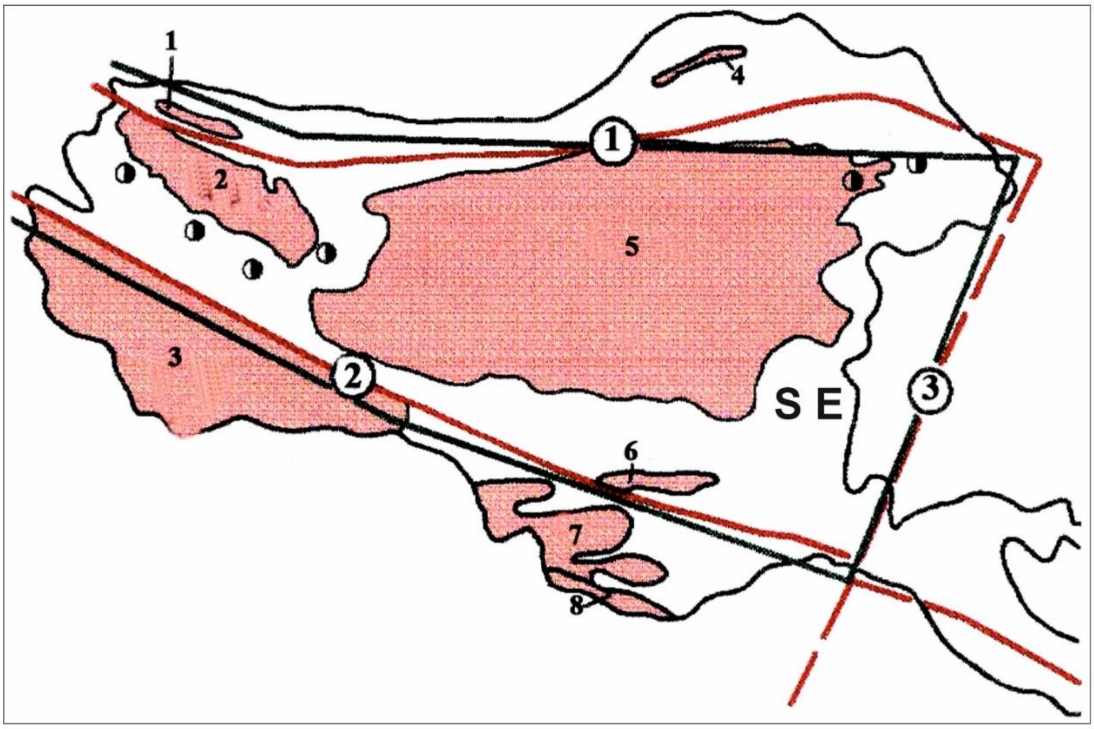

Figure 2. Granitoid massifs of the Zirabulak mountains (scheme by I.Kh. Khamrabaev) (based on field materials by T.R. Saliev).
l-Granitoid massifs (1-Dzhidalinsky, 2-Chirakzhurinsky, 3-Ketmenchinsky, 4-Kutchinsky, 5-Zirabulaksky, 6-Dzhalkyrsky, 7-Tymsky, 8-Karachakuduksky), ll-Faults (1-North Zirabulak, 2-Shimkhartau, 3-Zirabulak-Nurata).

Each of the epochs has some inheritance from the previous epoch only in the repetition of large secant structures that determine both the location of magmatic complexes in the Hercynian period and the location of endogenous minerals. The intensity of the latter is not the same in each epoch, just as the types of deposits and geological patterns of their location are significantly different for each epoch. At the same time, the structures formed by the Caledonian and Hercynian tectogenesis are of the greatest interest to us.

The early tectonomagmatic cycle is associated with the creation of a series of folded forms and their complicating breaks.

The middle cycle is associated with the introduction of granitoids and intense interformational movements.

The final cycle determines the number of dikes, multiple cross seams, and the folded area of the transverse direction.

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