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Research Article

GEOLOGICAL-GEOCHEMICAL AND GEOPHYSICAL CHARACTERISTICS OF THE KUDUK AND ARDAKSHAN SITES

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ABSTRACT
At present, the reserve of easily discovered deposits in Western Uzbekistan, including within the Malguzar Mountains, is practically exhausted, therefore the efforts of geologists, geochemists and geophysicists are aimed at searching for new deposits and ore occurrences in Paleozoic sediments. When carrying out prospecting works, a complex of prospecting methods is of great importance, implying a minimum set of forecasting and prospecting methods that reliably and in the shortest possible time ensure the discovery of a mineral. In this regard, a comprehensive study of the territory to identify new ore occurrences of gold is of paramount importance for strengthening the mineral resource base of Uzbekistan.

Keywords: *Gold, Mineralization, Geochemical Method, Geophysical Method, Kuduk Area, Ardakshan Area*

INTRODUCTION

Mineral resources of ore objects of the Malguzar mountains are represented by deposits and ore occurrences of gold and mercury, ore occurrences of titanium, copper, molybdenum, vanadium, tungsten, lead, zinc, uranium. The manifestations of ore mineralization of other types have an indicator value at the achieved level of knowledge (lithium, fluorine, antimony, bismuth, etc.). Here, in the eastern part of the Malguzar Mountains, there are more than 20 occurrences of gold (Kursak, Ismany, Ettkichu, Alchali, etc.), identified in the course of exploration, geochemical and geophysical works. In terms of gold content, the territory of the eastern part of the Malguzar Mountains was assessed as slightly gold-bearing. All manifestations of gold ore mineralization are controlled by faults striking west - northwest. A feature of these structures is that the rocks in the zones have undergone metasomatic changes. At the same time, the objects of the gold-quartz (gold-poor sulfide-quartz) formation are predominantly distributed within the Kattasay (Yulsay) and Lyaylyaguin (Bakhmal, Etytau) mineralized zones. Among them, the most promising is the East Bakhmal area, located in the western and, partially, in the central parts of the Laylyagun mineralized zone. In this regard, a comprehensive study of this area to identify new areas for gold is of paramount importance.

The purpose of this article is to identify the features of ore occurrences in the Kuduk and Ardakshan areas of the Laylyagun mineralized zone based on a set of prospecting methods (geological-geochemical and geophysical).

MATERIALS AND METHODS

The areas of the parts of the Lyaylyaguin mineralized zone have a complex tectonic structure and are zones of fold-ruptured dislocations with a series of reverse thrust faults. Based on the results of previously conducted geological exploration work in the study area, a large number of small scattered ore occurrences and points of gold mineralization were revealed.

It has been established that the fault zone of the Lyaylyagun upthrust-strike-slip fault (according to the data of M.M. Poskhov, V.A. Tabachkov, etc.) has a complex, frame-block or lenticular-block (mosaic) internal structure and belongs to the type of polyminal (multi-seam) structures. The general structural plan of the zone is presented as follows. A series of longitudinal tectonic faults corresponding to the general direction

of the fault and forming the basis of the structure, forms a series of longitudinal tectonic blocks (windows). Within each block, lithological rock varieties of different composition developed. Located inside tectonic windows, the lithological varieties of rocks in the form of lenses, plates (tectonic packets) are characterized by elements of collapse, increased fracturing and varying degrees of hydrothermal development. The general structural plan of the fault is complicated by transverse faults that limit longitudinal tectonic blocks. Tectonic blocks, similar in lithological composition, form the so-called geologically homogeneous blocks.

In general terms, this internal structural structure of the Lyailagun fault zone predetermines many geological phenomena favorable for ore formation. Including: numerous faults playing the role of ore-controlling structures; crushing and crushing zones; associated with discontinuous tectonics morphological features of faults and feathering cracks, transverse discontinuities; the presence of magmatic formations; hydrothermal alteration of rocks; variegated lithological composition of favorable ore-forming environment, which can be used as search (Janibekov, 2019)criteria.

The area of the Ardakshan site is 43.0 km^2, while the northeastern parts are overlain by Quaternary deposits (70%) up to 120 m thick. Paleozoic deposits are located in the northwestern part of the site under a Quaternary cover (loam and sandy loam) with a thickness of 4-3 m. The area of the site is composed of carbonate-terrigenous, terrigenous formations of the Landoverian Stage of the Lower Silurian, limestones of the Middle Carboniferous, dikes of basic and felsic composition.

Sediments of the Llandoverian Stage, the Lower Silurian of the Upper Substage occupy about two-thirds of the area and are represented mainly by hydromica-albite-quartz, hydromica-albite-quartz-sericite schists, feldspar-quartz siltstones with fragments of micro quartzite calcareous, sparse lint sandstones lenticular bodies, siliceous-quartz and quartz-feldspar sandstones.

The Ardakshan Formation ($S1ln_3ar$) is represented by siltstones and sandstone with shale interlayers. Uchkizlar Formation (S_1ln_3uk) - shales with interlayers of siltstones, sandstones, cross-bedded limestones and dolomites. middle substage (S_1ln_3pl). Papalaks Formation - schists with interlayers of siltstones, sandstones, limestones and dolomites. Ravat Formation (S_1ln_3rw) - shale siltstones, sandstones, gravity and conglomerates. Sedimentary rocks (limestones, dolomites with cherts) of the Late Devonian are broken by dikes of diabase porphyrites of the Upper Carboniferous.

The tectonic structure of the Ardakshan area is rather complex and is determined by a combination of placative and discontinuous structures. Plicative structures are represented by a significant number of small anticlinal and synclinal folds with a wingspan from one meter to one hundred meters; fracture tectonics is widely developed. The regional Ardakshan reverse-strike-slip fault is located here, which has a northwestern direction. Hydrothermal gold-silver mineralization is confined to brecciation zones accompanying fractures of the second and higher orders.

The Kuduk site located on the northern slope of the eastern part of the Malguzar mountains is 3-4 km east of the Uryuklin ore occurrence. The southern boundary of the site is the South Pshagarskanticline, in the north - outcrops of Paleozoic rocks.

The site is located in the zone of intersection of western north-western close faults with hidden transverse structures of the north-east and north-west directions. The geological and structural position of the Kudukarea is determined by the Lyaylyaguin upthrust strike-slip strike of the west-northwest strike; three subparallel tectonic faults with a thickness of 20-150 m are also identified.

The geological structure of the site is attended by Lower Silurian carbonate-siliceous-terrigenous deposits (siltstones, shales with interlayers of sandstones, gravel stones, platy cherts, limestones). In the north and south of the site, linear tectonic blocks are represented by Lower Silurian sedimentary-metamorphic shale

rocks with interlayers of sandstones and Upper Devonian limestones, dolomites with interlayers of cherts. Dyke-like bodies of diabase and gabbro-diabase are widely developed.

In the course of the study, a set of methods of field and laboratory research was used. The study of ore samples was carried out in polished sections (polished sections) using traditional methods of mineragraphy. The identification of ore and nonmetallic minerals was carried out in an optical microscope in reflected light on the basis of identifying the physical, morphological and optical properties of minerals, their textural and structural features, as well as the relationship of both individual ore and vein minerals and their associations.

Geophysical studies were summarized on the basis of laboratory data by the "East Uzbekistan Field Expedition" State Unitary Enterprises "Regional Geological Survey Expedition".

RESULTS AND DISCUSSION

Geochemical research. The complex geological structure of the Lyailagun fault zone largely characterizes the degree of distribution of geochemical elements and their relationship with various elements of the basic structure, and therefore, the concentrations of chemical elements and main groups of mineralization indicator elements in lithogeo-chemical dispersion halos are very uneven.

Lithogeo-chemical mapping was carried out in the environment of the "Surfer-8" graphic software package. The halos are delineated by the average content and the minimum anomalous content of chemical elements (Figure 1-5). When contouring the halos, different gradations were used depending on the geological and structural features of the area of work and the results of statistical analyzes.

Gold (Au). Abnormal gold halos were found mainly in 2 areas. In site No. 1, the minimum abnormal gold content is 0.05 g / t. Most of the geochemical halos are confined to the rocks of the Ardakshan Formation (siltstones, sandstones, gravel stones, shales). The area of one geochemical halo located in the south-west of the Leylyagun mineralized zone is about 3.1 km^2. In this area, there are halos with a gold content of more than 0.1 g / t. In site No. 2, gold halos are directed strictly to the northwest. In the south of the site, gold is confined to terrigenous rocks. The halos were identified by the minimum content of 0.05 g / t, the maximum content of 0.5 g / t (Likhachev, 1963**).**

Antimony (Sb) halos with anomalous contents of 40g / t n * 10-3 are located in the southwestern part of the area and make up 2 sq. Km. with contents 40-50n * 10-3. A large halo is observed in the south of the area. The contents of the primary geochemical anomalies are: the minimum anomalous content 0 in the interval 10, 20, 30, 40 maximum anomalous content 50 n * 10-3.

Lead (Pb). Lead halos of area No. 1 with a minimum anomalous content of 5g / t n * 10-3 are scattered throughout the territory. Two halos are located in terrigenous rocks closer to contact with carbonate rocks ranging in size from 0.2 to 0.3 km2. The main part of lead halos is developed in site No. 1 and are contoured with contents of 5 (minimum-anomalous contents), 50 g / t (maximum-anomalous contents). Lead halos correspond to gold halos and are elongated to the northeast according to the directions of the faults. The abnormal lead content in the Kuduk area is higher than the background content; in the background area, the content is 1,973.

Copper (Cu). Copper halos in the Ardakshan area with a minimum anomalous content of 0.5-10-3 g / t and a maximum anomalous content of 20-10-3 are widespread in wide halos located in terrigenous rocks closer to the contact with carbonate rocks. Four promising halos have been identified, ranging in size from 0.1 to 3 km2. The main part of honey halos is developed in the Ardakshan area and are contoured with grades of 3 (minimum anomalous content), 10 g / t (maximum anomalous content). The honey halos spatially fall within the gold halos and are elongated in the northwest direction corresponding to the strike of the faults.

Silver (Ag). Haloes Silver on Ardakshan with a minimum anomalous content of 0.01 10-3 g / t and a maximum anomalous content of 0.1 10-3 g / t are developed everywhere. The halos are located along the Ardakshan strike-slip in the form of chains in northwestern directions. Several small and large aureoles

have been identified,the presumable manifestations of aureoles are located in tectonic faults. Silver halos correspond to gold halos and are elongated to the northeast according to the directions of the faults.

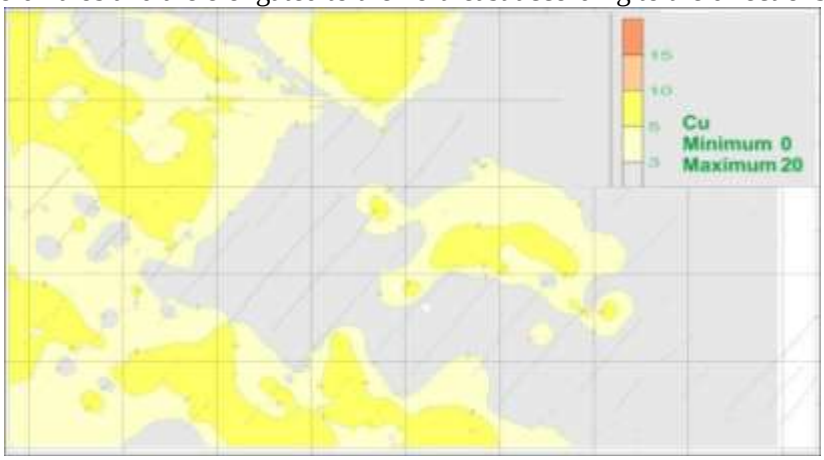

Figure 1: Scheme of geochemical aureoles (Cu) of copper in the Lyalaguin mineralized zone

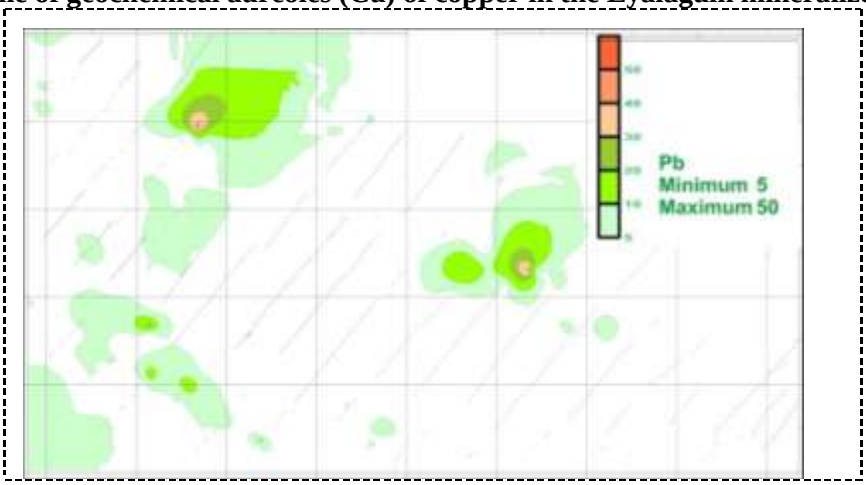

Figure 2: Scheme of geochemical aureoles (Pb) of lead in the Lyalaguin mineralized zone

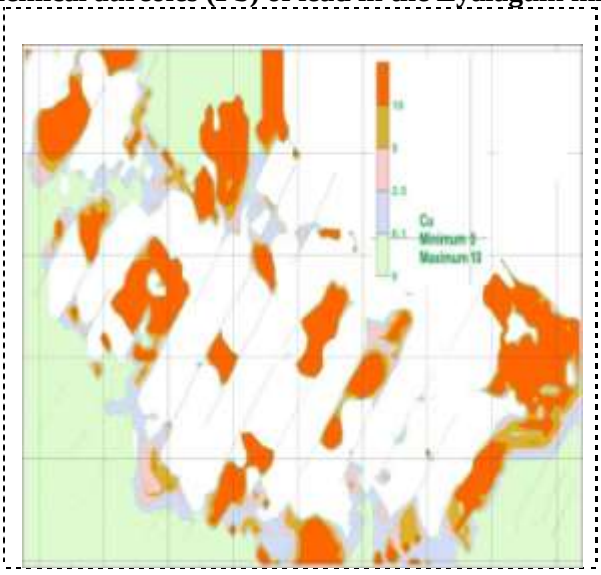

Figure 3: Scheme of geochemical aureoles (Cu) of copper in the Lyalaguin mineralized zone

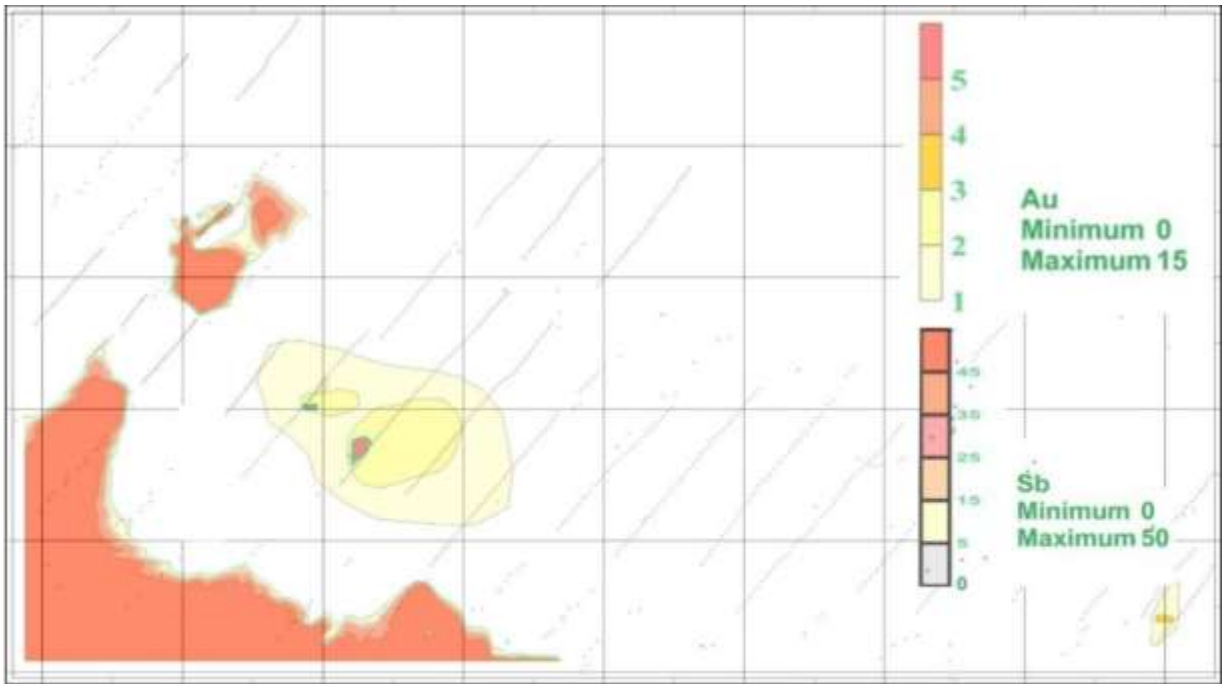

Figure 4: Scheme of geochemical aureoles (Au) of gold (Sb) antimony of the Lyalaguin mineralized zone

Geophysical research. In order to study the patterns of distribution of natural radioactivity in rocks and ores, the following types of work were carried out at the facility: gamma-ray logging (Gamma Logging), electric logging (KS + PS), in clinometry. The main goal of geophysical research in gold-bearing areas is to identify quartz veins and zones of intense silicification, ferruginization, which are characterized by low values of gamma activity. According to the data, the degree of silicification of rocks is characterized by the "silicification coefficient:

$K_{ok} = (I_f - Ia): I_f \cdot 100\%$,

where I_f is the intensity of gamma radiation from the host rocks,

I_a is the intensity of gamma radiation of the silicification zone,

K_{ok} - silicification coefficient. This coefficient has a conditional meaning and is expressed in the following figures: K_{ok} = 25-45% - intensely silicified rocks, $K_{ok} \geq 45\%$ - quartz vein (Akbarov, 2004).

The lithological dissection of rocks and the identification of radioactive anomalies in geophysical work were carried out by the "East Uzbekistan Field Expedition" State Unitary Enterprise "Regional Geological Survey Expedition" and are shown in Table 1.

Table 1 shows that according to the value of gamma activity, the rocks can be divided into 3 groups:

1) rocks characterized by relatively low values of natural radioactivity from 7 μR / h to 22 μR / h, these are Quaternary deposits, sandstones, limestones;

2) rocks with gamma activity from 14 μR / h to 30 μR / h - quartz veins, silicification zone, shale, crushing and limonitization zones, diabase, diabase porphyrites, gabbro, gabbro-diabase;

3) carbonaceous shale, graphitic shale characterized by high values of natural radioactivity from 25 μR / h to 40 μR / h.

For the most common rocks penetrated by wells, variation curves of the distribution of gamma activity were plotted. The variation curves have a simple shape (Figure 6 and Figure 7) (Ivankin, 1983; Ivankin, 1988).

Table 1: Natural radioactivity and electrical resistance of rocks

Name of breeds	Radioactivity mk R/h		Apparent resistance, Ohm.m	
	from to	Often meetings	from to	Frequent meetings
Quaternary deposits	7-21,7	-	-	50-300
Clay mica shale	14-16	14-24	70-140	50-150
Carbonaceous shale	25-38	15-26	120-220	-
Graphite shale	12-25	-	-	-
Siltstones	10-18,5	10-25	-	600-800
Sandstone	7-22	10-12	40-200	200-700
Siliceous sandstone	14-15,5	-	-	600-1000
Crushing and limonitization zones	12-26	15-18	2000-5000	100-300
Limestone	9-18	8-11	150 – 200	500 - 750
Siliconization zones	20-22	-	-	400-525
Vein quartz	14-25	6-11	500-2200	300-1000
Diabases, diabase porphyrites, gabbro, gabbro-diabase	10-29	8-14	80 - 600	500 - 800

The exception is the broad variation curve of silicified sandstone. Losses, which always occupy the same geological position, and quartz veins (silicification coefficient ≥ 45%) stand out confidently. It should be noted that the value of natural gamma-activity of rocks of the same composition is significantly influenced by a secondary change. So sericitization, potassium feldspar, increase the radioactivity of rocks, and silicification, chloritization, carbonatization, calcitization reduce it.

The rocks are not differentiated by the magnitude of the electrical resistance, because the limits of change in the resistance of all rocks are commensurate and do not depend on the type of rocks, but are due to a different degree of secondary changes, (Ivankin,1983) their fracturing and the presence of sulfide mineralization.

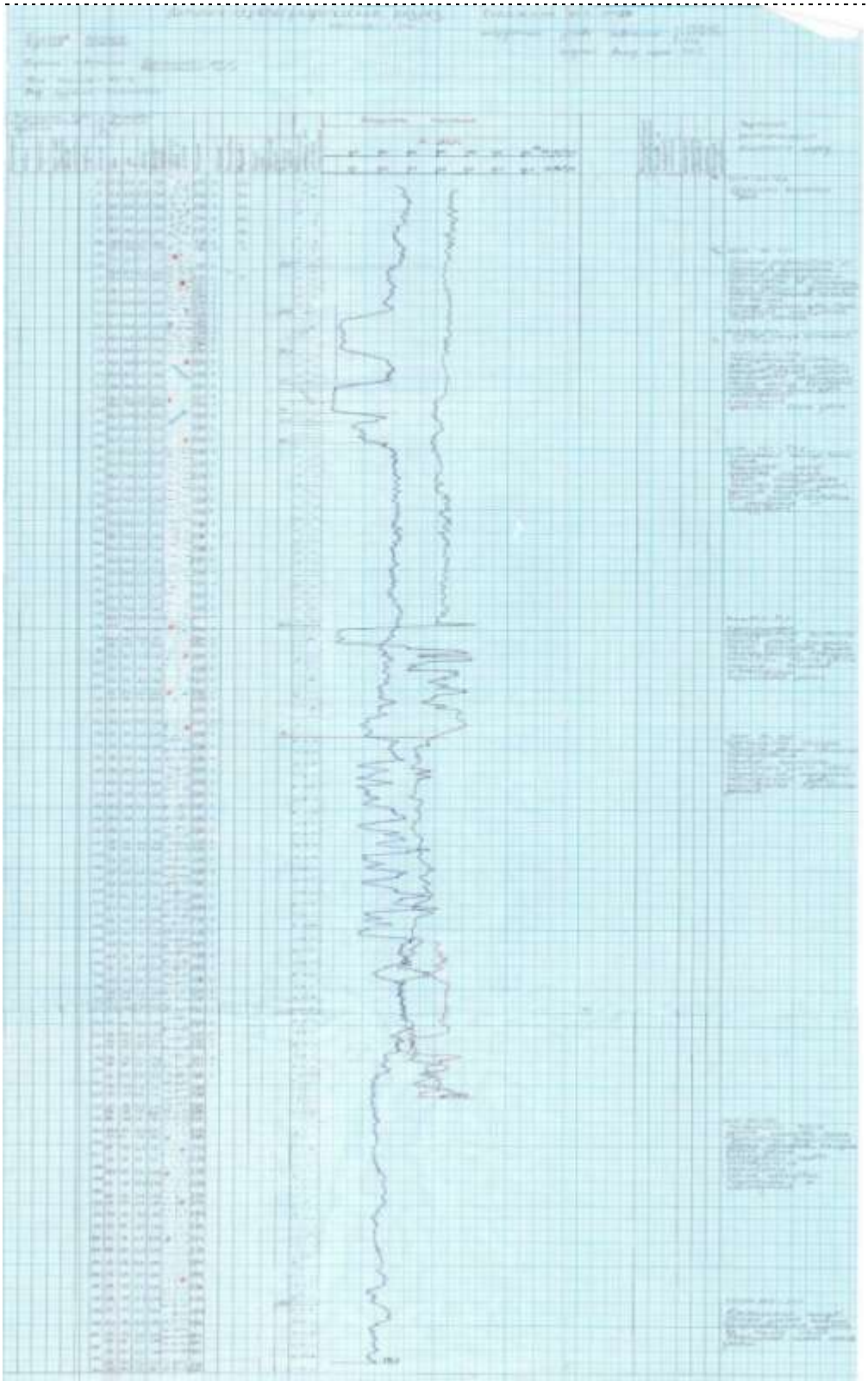

Figure 5: Passport well Pr-28 S-1

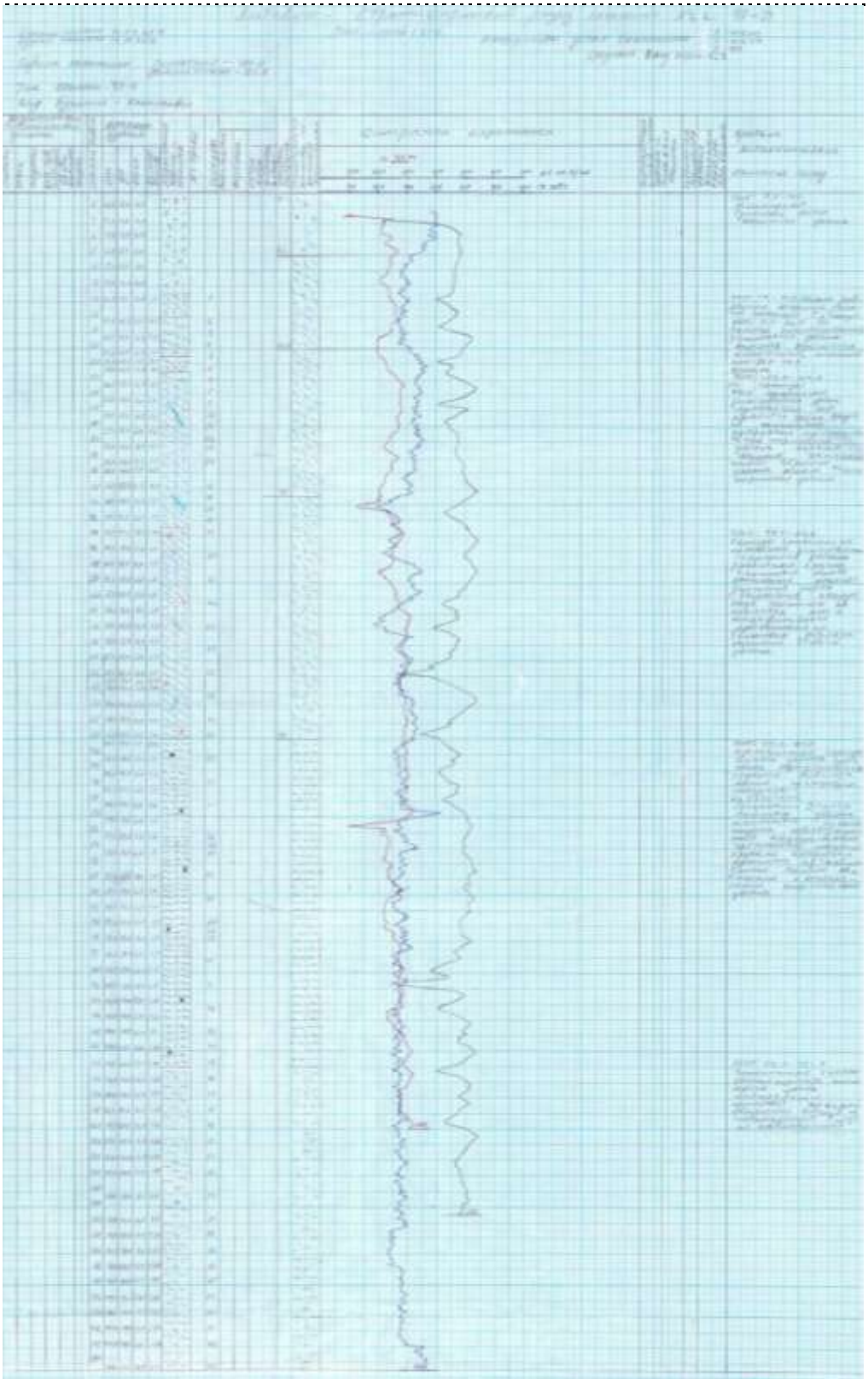

Figure 6: Passport of well Pr-28 S-2

CONCLUSION

The main prospecting structural and tectonic features for the Leylyagun mineralized zone is a highly permeable zone - the continuation of the Zargar and Karanchibulak faults and the Laylyaguin reverse fault, which determine the structural position of the identified ore occurrences and points of mineralization, and a pronounced system of close subparallel faults.

The results of geochemical studies have shown that all occurrences of gold are accompanied by a set of satellite elements (indicators) of gold. Silver, lead, zinc and copper are of prime importance. Less commonly, tungsten and antimony are present in association with gold. Together with gold, all these elements make up a productive association of scattering halos.

As a result of geological exploration at the Ardakshan site, 4 (ore zones No. 5,6,7,8) parallel ore zones were identified. The zones are striking north-west, the mapped length is from 400 to 600 m. In the contours of the mineralized zones, 10 ore-bearing zones have been identified. The gold content in the blocks outlined along the side of 0.6 g / t ranges from 1.03 to 0.7 g / t.

As a result of the work carried out in the Kuduk area, 4 contiguous linearly elongated mineralized zones were identified. Ore-bearing zones of northwestern strike, mostly steeply dipping.

According to the logging of geophysical studies, the allocation of quartz veins and zones of silicification, where quartz veins are clearly and unambiguously distinguished by negative HA anomalies in the zone of relatively low apparent electrical resistivity due to intensely altered and crushed rocks. The apparent electrical resistance of rocks exposed by wells varies over a wide range from 50 Ohm to 1000 Ohm.

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