JGRPD

ISSN : 3032-131X

https://doi.org/10.61796/jgrpd.v1i7.1130

MINERALOGICAL AND PETROGRAPHIC COMPOSITION OF ORE-BEARING ROCKS IN THE CHOLCHARATOV PROSPECTIVE AREA AND THEIR SIGNIFICANCE IN THE LOCALIZATION OF MINERALIZATION (SOUTH BUKANTOV)

O.O. Kholdorov
Researcher of the geological control department, State institution "Institute of Mineral Resources", Uzbekistan
Email: orifjonxoldorov97@gmail.com

F.S. Tilovov
Researcher of the geochemical research department, State institution "Institute of Mineral Resources", Uzbekistan

N.A. Berkinov
Researcher of the digital mapping department, State institution "Institute of Mineral Resources", Uzbekistan

Received: June 22, 2024; Accepted: June 29, 2024; Published: July 21, 2024;

Abstract: Objective: This study investigates the mineralogical and petrographic composition of ore-bearing rocks in the Cholcharatov prospective area (South Bukantov) to elucidate their role in the localization and formation of mineralization. **Method:** Comprehensive mineralogical and petrographic analyses were conducted on ore-bearing rocks, with a focus on identifying the composition, structure, and mineral associations within the region. Particular attention was given to carbon-containing shales and their interactions with adjacent lithological units, such as quartzites. **Results:** The primary ore-bearing rocks in the Cholcharatov area were identified as carbon-containing shales, hosting significant sulfide mineralization. The mineralization predominantly occurs within the carbonaceous shales and is intensified in zones of contact with quartzites. These findings highlight the critical role of lithological and structural controls in localizing ore deposits. **Novelty:** This study provides new insights into the mineralogical and petrographic characteristics of the Cholcharatov area, emphasizing the significance of carbonaceous shales in hosting sulfide mineralization. The research contributes to the broader understanding of ore deposit formation mechanisms and offers a refined model for targeting mineralization in similar geological settings.

Keywords: Kokpatas Suite, Cholcharatov Square, Altyntau Intructure, Metasomate, Sericite, Aleurolite, Quartzite

Introduction

The study of the mineralogical composition and petrography of ore-bearing rocks plays an important role in understanding the processes of formation and distribution of mineralization in a region. This is particularly relevant in new prospective areas such as the Cholcharatov region (Bukantov South), which has significant geological potential. This research aims to identify the types of rocks, dominant minerals, and the mineralization characteristics contained in the ore-bearing rocks in the region. Understanding these geological factors is essential for directing mineral resource exploration efficiently. Thus, this study contributes to the development of geological models for more focused exploration [1].

The ore-bearing rocks in the Cholcharatov region are largely dominated by carbonaceous shales, which are known to have great potential for hosting sulfide mineralization. Mineralization in this rock is often enhanced by interactions with other lithologies, such as quartzite. The influence of tectonic processes, metamorphism, and hydrothermal activity also plays an important role in the formation of mineralization in the region. The combination of these geological conditions creates an environment that is very favorable for the formation of ore deposits. This study aims to describe the relationship between the characteristics of ore-bearing rocks and the distribution of mineralization in a local context [2].

Previous research in the surrounding area has shown a close relationship between carbonate shale and sulfide mineralization, but specific data for the Cholcharatov region is still limited. Therefore, this research will not only fill the data gap but also provide new insights into the process of mineral deposit formation in the area. The approach used involves detailed mineralogical and petrographic analysis, which provides information about the microscopic structure and mineral composition of the rock. The results of this research are expected to provide a scientific basis for mineral exploration in the Bukantov Selatan region. Thus, this research has important implications for both geology and practical applications in the field of mineral resource exploration [3].

Methods

The research employed a detailed methodological approach to analyze the mineralogical and petrographic composition of ore-bearing rocks in the Cholcharatov area. Fieldwork involved the systematic collection of rock samples from key lithological units, with an emphasis on carbon-containing shales and their contact zones with quartzites. Laboratory analyses included thin-section petrography to examine microstructural features and identify mineral compositions, as well as X-ray diffraction (XRD) to determine crystalline phases. Additionally, geochemical assays were conducted to quantify the concentration of sulfide minerals and assess their distribution patterns within the rock matrix. This comprehensive approach enabled the identification of the geological processes influencing mineralization and provided insights into the structural and lithological controls of ore deposit formation.

Results and Discussion

Determining the composition of ore-bearing primary rocks in areas with developed mineralization, including formations that have undergone varying degrees of change under the influence of hydrothermal processes or contact metamorphism, is one of the main tasks of scientific geological research. Because certain rocks serve as markers of specific geological processes, some ore-bearing rocks can be used as exploration criteria [4]. For this reason, the study of the mineralogical and petrographic composition of mineral minerals and ore-bearing rocks in the territory of the Cholcharatov prospective field, located in the Southern Bukantov ore field, which is one of the main areas of the mining industry of our republic, is of practical importance in the field of geology. The Cholcharatov field is located within the Southern Tien Shan orogenic belt, in the northern-western part of the Golden Intructure in the South Bukantau Mountains, to the north of the central Kyzylkum gold and uranium ore province [5]. In the geological structure of the territory, the deposits of the Kokpatas suite of the Upper Proterozoic age are represented by the Altyntau granitic intrusive, which carries them shieldedly, as well as the wolf and quaternary deposits with the formation of coverings on them. The genus of the Kokpatas suite is divided into four paches in the Khojaakhmat anticlinal and the Cholcharatov synclinal, the paches are sometimes folded in accordance with each other. They are composed of metaterrigenous rocks, silicon quartzite, dolomite, carbon shale, plagioclase-micaceous shale, and amphibole shale (Fig. 1).

The Cholcharatov area is bordered by the Altyntau granitic intructural massif to the south, the mesa-kinasoid sedimentary rocks to the north and northwest, to the west by the Cholcharatov light and the so-called uplift, which is formed in the Aitim light zone (Fig. 2).

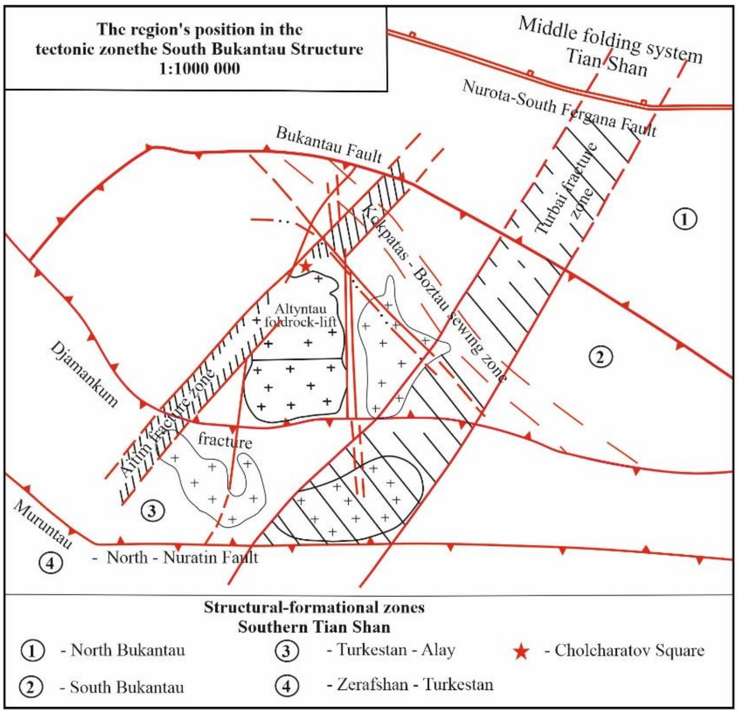

Fig. 2. Schematic map of the tectonic-structural location of the territory of Southern Bukantov at a scale of 1:1,000,000 (Kotunov A.Ya. et al. 1976).

Formations of the Altyntau intrusive complex (C_3-P_1) in the region formed in the Hercynian tectonomagmatic cycle and are divided into the following age groups [3,4].

The first stage (γδ C_3-P_1) developed in the form of a large number of small bodies on an area of up to 1 km. In the area, biotite granodiorites and adamellites are characterized by a melanocratic appearance, while dark colors in the rock are represented by biotite. The contacts of the second and third stage rocks are clearly visible, often in the form of apophysis. The altered part of the contact is very poorly visible.

The second stage (γ-γδ C_3-P_1) is widespread in the region and is the main stage of intrusive formation. The second phase consists of biotite granites and ademillites, the structure is medium and large-grained, the texture is often porphyritic. It is sometimes observed that the third phase of biotyl granites gradually transitions into dihedral granites, indicating that the formation processes of the second and third phases are close to each other.

The rocks of the third stage (γ C_3-P_1) can be found in all parts of the Altyntau intrusion in the form of small bodies up to several square kilometers. The third phase consists mainly of two-square granites, the structure of which is medium and sometimes fine-grained.

Deposits of the Kokpatas Formation, consisting of metamorphic rocks, are widespread in the Cholcharatau Mountains, located in the northwestern part of the Altyntau Intructure in Southern Bukantau. The suite deposits are composed of shales, sandstones, and siltstones of various compositions, as well as partially in the upper part of the area of carbonate and fillite rocks of gray, greenish-grey color. The results of their microscopic examination are presented below. The information presented in the article is based on the results of research using a modern high-precision “Nikon ECLIPSE LV100N POL” microscope on transparent shelves made of enclosing rocks.

Slanes. Based on the composition of the shales distributed in the area it is composed of albite-chlorite-feldspar-quartz-sericite minerals. The structure is lepidogranoblast, the texture is shale, sometimes linear, striated, and vein-like. Vascular pathways it has a diverse composition, characterized by a significant content of feldspar-quartz, mica-carbon, and ceresite minerals (fig. 3) [6]. The striped texture of the rock is primarily composed of quartz layers. The quartz granules are not wrapped open, they are firmly attached to each other. The grain size ranges from 0.01 to 0.25 mm. In cross-sectional nickels, quartz exhibits cloud-like attenuation, with a shelf content of 50-70%.

Plagioclase is rarely observed in the layers that make up the striped texture, forming prismatically elongated crystals. The size of the crystal grains is 0.25 mm, in the shelf it is 1-5%. It is common in combination with seresite, biotite, and carbonaceous inclusions.

Sericite partially altered, sometimes chloritized. In crossing nickels, it has a high interference color. On the biotite shelf, all mica grains appear brown, with a grain size of 0.01-0.1 mm, sometimes (biotite) up to 2 mm. The content of mica group minerals in the shelf is 10-20%.

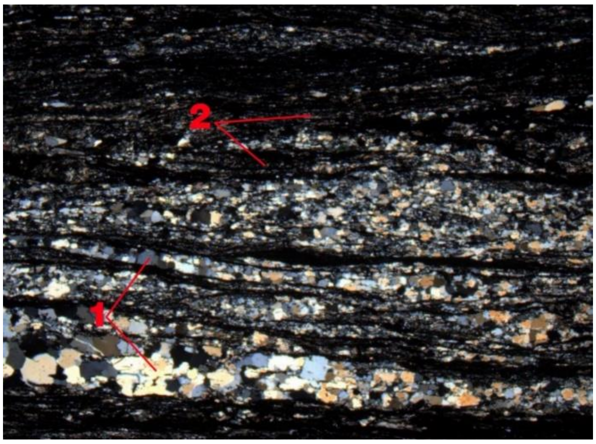

Fig. 3, shelf №. 3, K. 40^{x}, X in nickels, 1-quartz; 2-cericite.

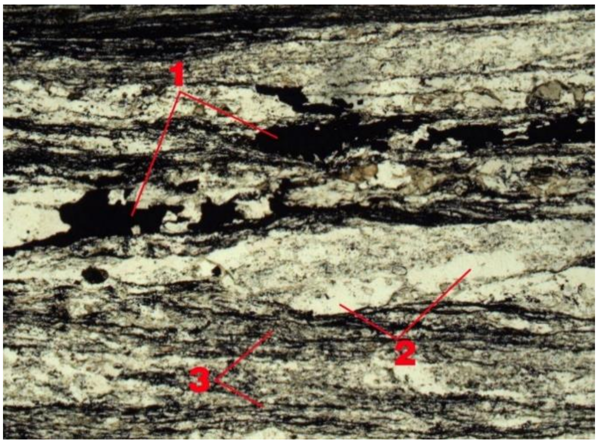

Fig. 4, shelf №. 4, K. 200^{x}, X in nickels, 1-ore minerals; 2-quartz; 3-sericite.

Ore minerals (iron hydroxide) <0.01-0.2 mm are common in the shales (Fig. 4), and the amount of ore mineralization reaches 2-3%.

Granular sulfide mineralization is observed throughout the entire volume of the shales, especially in carbon-enriched subshells (Fig. 5). Pyrite has idiomorphic granular sizes up to 0.5-0.7 mm, crystallizing in cubic synchronization, sometimes extending in the direction of formation of shales, and diffusing in separate spots up to 1.5 mm in size. Carbon-siliceous shales are widespread in the Cholcharatov area, forming strata among the rocks of the Kokpatas Formation. The rocks are macroscopically black in color, have a relatively dense structure, and have shell-like cracks in the massif. They exhibit areas of vein and lens-shaped quartz formation.

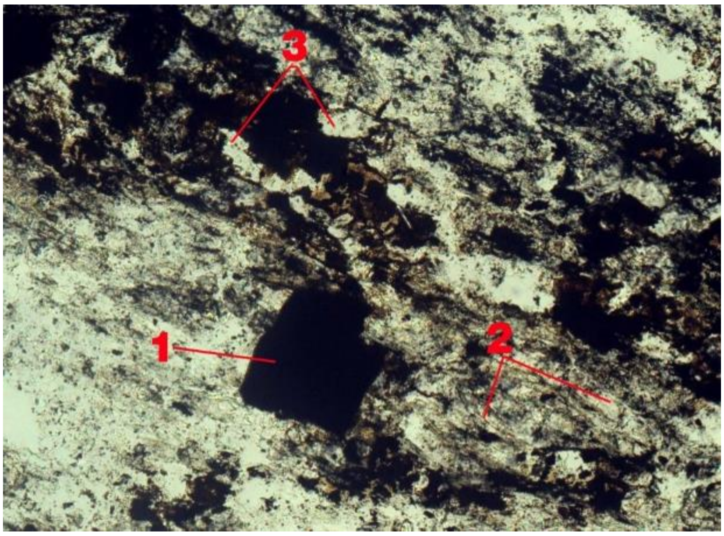

Fig. 5, shelf № 15, K. 100^x, in nickels, 1 - pyrite; 2-cericite; 3- quartz

Quarsite. The structure is gronablasty, the texture is massive, partially linear, and nest-like. Quartz is primarily observed in the rock with large and medium grains. The grains are unwrapped in an open form, and in intersecting nickels they extinguish in a wave-like form. The grain size ranges from 0.01 mm to 0.2 mm. The quartz content in the rock is 92-95%. Iron hydroxide impurities in the rock accumulate in the form of lines stretched subparallel to each other. Iron hydroxide is often found in combination with carbonates. The size of iron hydroxide is <0.01-0.1 mm. The iron hydroxide content in the rock is 1-2%, while the carbonate content is less than 1% (Fig. 6).

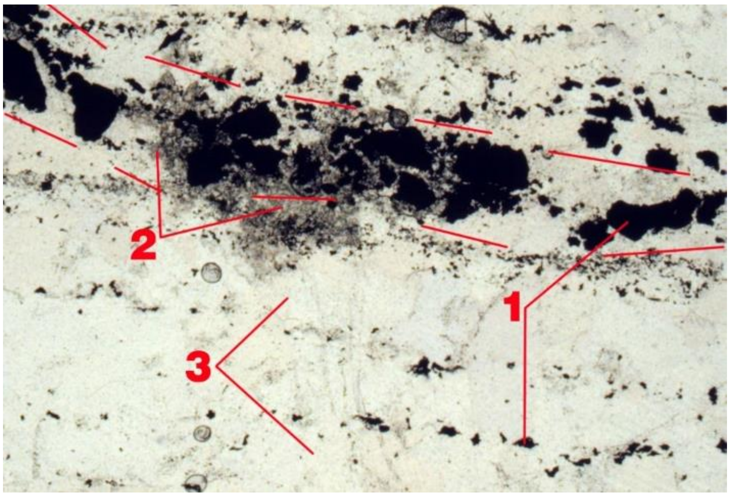

Fig. 6, shelf №. 5 K. 40^x, || in nickels, 1-getite; 2-carbonate; 3-quartz

Aleurolite. The structure is lepidogranoblastic, aleurolithic, the texture is massive, sometimes linear. The rock is composed of fine-grained quartz and plagioclase minerals, the grains of which are firmly attached to each other. The size of the crystals of the colorless quartz crystals is <0.01-0.1 mm. In intersecting nickels, quartz exhibits cloud-like attenuation. Quartz constitutes 80% of the rock. Plagioclase has an elongated-prismatic form, with double plagioclase observed in intersecting nickels (Fig. 7). The grain size ranges from <0.01 - 0.05 to 0.1 mm, the plagioclase content in the shelf reaches 1-7%, the structure of which is hypidiomorphic with a prismatic texture. Sericite, as a product of transformation, forms evenly distributed, often interdirected lines in the rock. The grain size is 0.01-0.05 mm, the amount of sericite in the shelf is very low and reaches 1-5%. Crystalline grains containing tourmaline crystals from accessory minerals are hypidiomorphic in shape, with a size of 0.01-0.02 mm, characterized by pseudo-damping (Fig. 8).

Carbon-containing inclusions are observed in the cavities together with iron hydroxide.

Ore mineralization in the shelf was formed by the formation of growths in combination with iron hydroxides, grain size <0.01-0.1 mm. formed in the spaces between the crystalline grains. Ore mineralization reaches 1-5% in the shelves.

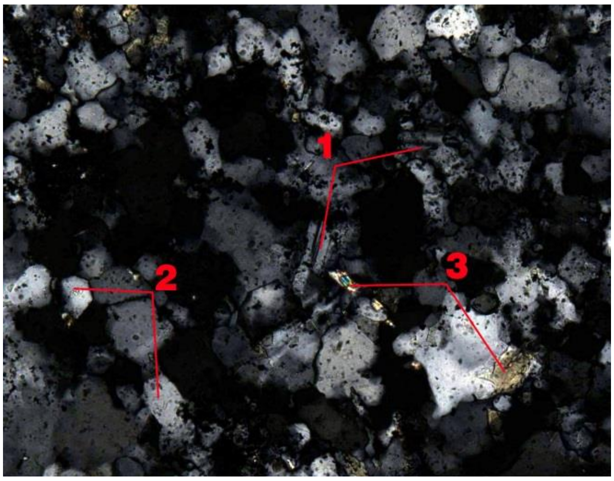

Fig. 7, shelf №. 7, K 200x, X nickels, 1-plagioclase; 2-quartz; 3-sericite

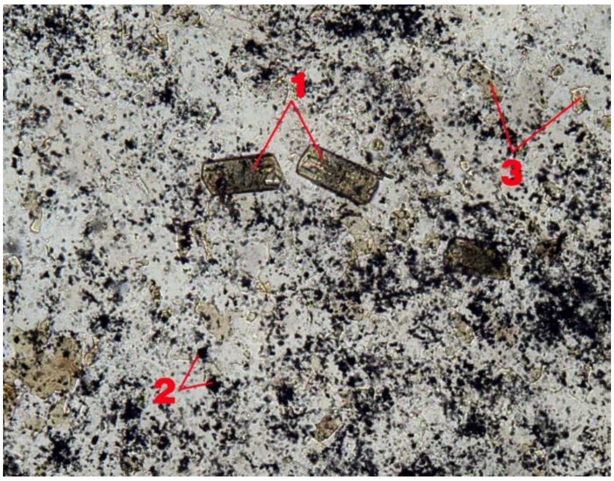

Fig. 8, shelf №. 2, 200x, || nickels, 1-turmaline; 2-ore minerals; 3-biotite.

Metasomatitis. The structure is lepidogranoblast, the texture is shale, linear, and nest-like. The rock is primarily represented by quartz deposits, nested iron hydroxide deposits, and carbonate-sericite deposits. In the shelf, quartz is colorless, not clearly shaped, the edges of the crystalline grains in the open state are not smoothed, the grain size is 0.01-0.3 mm, it has a cloud-like attenuation at two nickels, and the quartz content in the rock is 40-50%. Sericite is evenly distributed in the rock, often mutually oriented, with carbon and carbon substances combining to form large clusters of sericite. The crystal grain size is <0.01-0.1 mm. The amount of sericite in the shelf reaches up to 25% (Fig. 9).

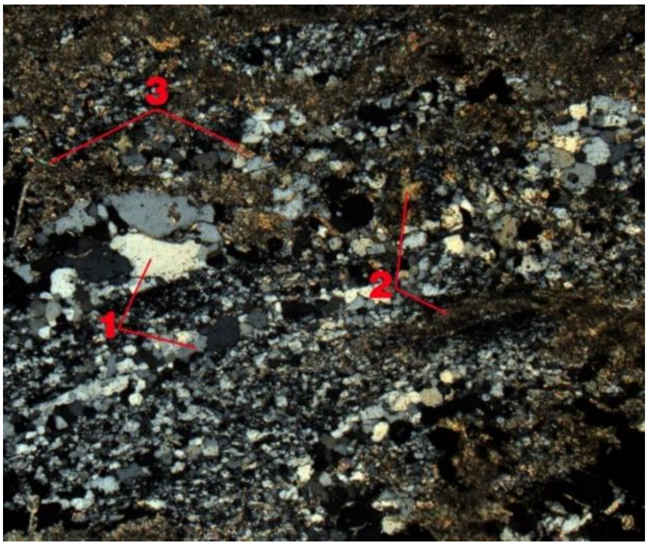

Fig. 9, shelf №. 7, K 40x, X nickels, 1-quartz; 2-carbonate; 3-sericite.

Carbonate minerals exhibit a bright pearly interference. It is often accompanied by iron hydroxide. Together with sericitis, they form layers, the vessels are formed in the form of lenses up to 1.5 mm thick. The vessels sometimes cross the layers perpendicularly. The grain size is 0.1-0.5 mm. The amount of carbonate minerals in the shelf reaches up to 25%. Chlorite is grayish-green in combination with iron hydroxide. The size of chlorite grains is 0.0n - 0.2 mm. Ore mineralization is represented by iron hydroxide (geotite) in the form of cellular accumulations in the cavities. Iron hydroxide often fills vessels and cracks in the rock. The grain size is 0.0n-0.2 mm. Ore mineralization in the shelf is <1-2%.

The formation of mineralization in the study area depends on the material composition of the ore-bearing rocks and their physicochemical properties. The localization of sulfide mineralization in different rocks is diverse, with fine-lensed inclusions in the chlorite-sericite shale horizons, in quartz minerals - sometimes in the form of droplets, in carbonaceous shales - in relatively large quantities, forming broad leaflets in different directions.

The characteristics of the localization of ore mineralization are clearly evident when comparing the rocks of the study area:

The enveloping layers, uncovered as a result of mountain ditches passing through the central part of the area, are primarily of a tuphogenic nature quartz-feldspar sandstones, as well as metaterrigenous formations and carbon-bearing shales of the same composition. This patch extends in a northwesterly direction and lies at an angle of 45-70° to the northeast.

A latitudinal zone has been formed along the crushed metaterrigenous rocks and a package of carbon-containing shales, and the most favorable factor for the penetration and placement of hydrothermal fluids in fractured rocks has emerged (Fig. 10a). In the total mass of rocks, spotted sulfide mineralization is clearly manifested macroscopically, the majority of which is pyrite. The involvement of sulfide minerals in the structure of this ore mineralization occurred as a result of metasomatic changes in the berezite-listwinite formation during regional propilithization and the final hydrothermal stage of their mineral formation.

Intensive crushing of these rocks in the fault zone can be clearly observed in the walls of canals in the Cholcharatau area (Fig. 10b). In fractures and quartz veins at their intersection, small pyrite-arsenopyrite sulfide mineralization clusters are observed in the form of chains. The characteristics of the localization of the identified sulfide mineralization are well expressed in the fragments of rocks in the channel, in the part limited by cracks of 10-30 sm in the channel, the sulfides form stains, while in the extreme parts of the rocks, they form chain-like clusters.

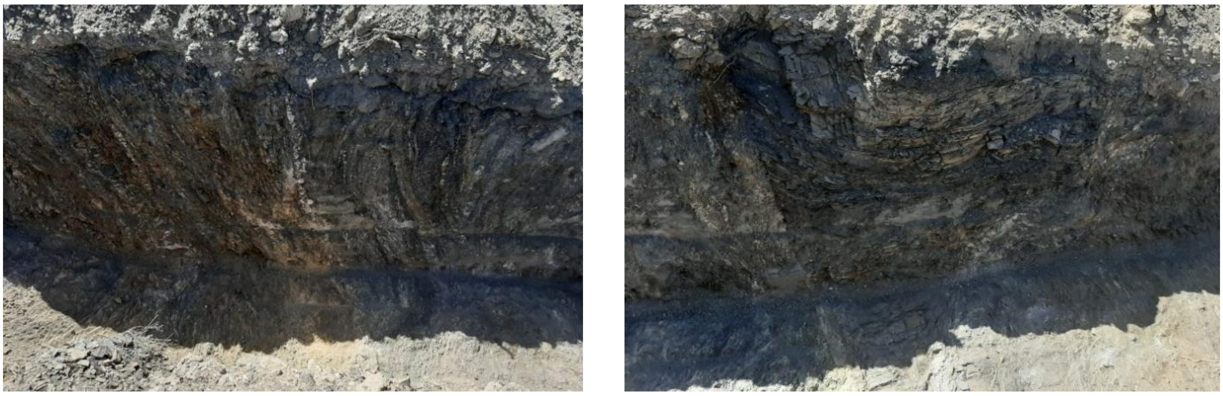

Fig. 10. a) quartz veins located along cracks in carbon-bearing shales.b) is a separate fractured zone in carbonaceous shales.

The southern part of the study area consists mainly of feldspar-chlorite-sericite shales, plagioclase-siliceous shales, and plagioclase-amphibole shales. The rocks of this part of the field also intersect with the fault zone in the latitudinal direction. Compared to the core, rock fragmentation is much weaker. It is more often observed in the form of individual iron-bearing cracks, sometimes with quartz veins forming in the central part, distributed in the sublatitudinal direction, lying at an angle of 40-50° to the north.

To study the relationship between rock fracturing and ore content, the amount of vascular mineralization in rocks of different lithological composition was calculated along the excavation.

As a result, 6-7 to 10-15 quartz-carbonate-sulfide veins were recorded per meter of meta-terrigenous rocks and carbonaceous shales (Fig. 11a).

In feldspar-chlorite-sericite-containing shales, plagioclase-siliceous shales, plagioclase-amphibole shales, and quartzite deposits, ore veins are observed relatively rarely, up to 2-3, and mainly along the rock layering surface (Fig. 11b).

Fig. 11. The relationship between the degree of rock fracturing and their ore content. a) a separate fractured zone in shales (with quartz veins), b) quartzites with massive texture.

These observations allow us to establish that the physical and mechanical structure of rocks plays a significant role in the formation of fractures under the influence of tectonic movements. Due to its relatively rigid and homogeneous structure, quartzites in tectonically active zones are less prone to fracturing, less sulfide, and consequently less mineralized [7].

Meta-terrigenous rocks and carbon-bearing shales have a relatively massive, homogeneous, and brittle structure. Fragile carbonaceous shales and meta-aleurolites under the influence of tectonic movements form a zone of deep fracturing and high permeability, which is a factor in the formation and placement of the main and only mineralization in the area.

Conclusion

Fundamental Finding: This study establishes that the deposits of the Kokpatas Suite, primarily composed of metamorphosed shales, metasomatites, and alerulites, represent the main ore-bearing rocks in the Cholcharatov area. The presence of highly fractured meta-terrigenous rocks and carbonaceous shales significantly enhances the permeability and serves as a critical control for mineralization. **Implication:** These findings underscore the importance of lithological and structural characteristics in localizing ore deposits, providing a valuable framework for exploration in geologically similar regions. **Limitation:** However, the study is limited to a specific geographical scope and does not extensively consider the role of broader regional tectonics and hydrothermal dynamics. **Future Research:** Further investigations are recommended to integrate regional geological and geophysical data, including isotopic studies and fluid inclusion analyses, to better understand the genesis and evolution of mineralization in the area.

References

[1] T. Mustafa, T. Mirza, dan S. Kalaitzidis, “Genesis of Sulfide Mineralization in the Gallala Area Kurdistan Region, Iraq: Constraints from Major and Trace Elements of Sulfide Ore Mineralization and their Host Rocks,” *Iraqi Geol. J.*, vol. 56, no. 2F, hlm. 1–22, Des 2023, doi: 10.46717/igj.56.2f.1ms-2023-12-7.

[2] L. Yan, N. Fengjun, S. Xiang, S. Peng, Z. Xiaoyong, dan Y. Zhaobin, “Geochemical

Characteristics and Tectonic Setting of the Ore-bearing Granite Conglomerate of the Western Qinglong Uranium Ore Field in the Shigaizi Region and its Relationship with Uranium Mineralization," *Geol. Ore Depos.*, vol. 64, no. 3, hlm. 144–161, Jun 2022, doi: 10.1134/s1075701522030084.

[3] P. Zhang, "A review of gold exploration in the Tulasi Area, Xinjiang Uygur Autonomous Region, China," *Miner. Depos. Res. Meet. Glob. Chall.*, hlm. 1555–1555, 2005, doi: 10.1007/3-540-27946-6_396.

[4] I. Yu. Melekestseva, V. V. Zaykov, P. Nimis, G. A. Tret'yakov, dan S. G. Tessalina, "Cu–(Ni–Co–Au)-bearing massive sulfide deposits associated with mafic–ultramafic rocks of the Main Urals Fault, South Urals: Geological structures, ore textural and mineralogical features, comparison with modern analogs," *Ore Geol. Rev.*, vol. 52, hlm. 18–36, Agu 2013, doi: 10.1016/j.oregeorev.2012.03.005.

[5] S. Yin, C. Ma, J. Xu, J. Fu, dan X.-N. Zhang, "The role of crystal mush in porphyry systems: A case study from the Baishiya ore field, East Kunlun orogenic belt, northern Qinghai-Tibet plateau," *Ore Geol. Rev.*, vol. 146, hlm. 104962, Jul 2022, doi: 10.1016/j.oregeorev.2022.104962.

[6] J. Ramos, "Review of: 'Exploration of Quartz, Feldspar, and Mica Minerals Using Geophysical Resistivity, Self-Potential, and Natural Electrical Field Techniques,'" Mei 2024, doi: 10.32388/hwa8qu.

[7] H. Gong, J. Li, D. Di, N. Li, dan Z. Zhang, "Influence of less active initiator on the living performance of atom transfer radical polymerization and the structure of the synthesized grafted copolymer," *RSC Adv.*, vol. 5, no. 25, hlm. 19117–19127, 2015, doi: 10.1039/c4ra15190a.