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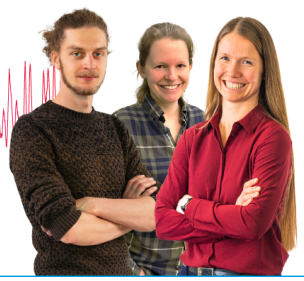
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Kosmogeological Studies of Koytash Intrusive of Malguzar Mountains

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Abstract. The article discusses the possibilities of cosmogeological research on the Koitash intrusion of the Malguzar Mountains. Materials were analyzed, and major regional-scale ore-bearing structures such as faults, tectonic wedge structures, strike-slip faults, and ring structures were identified. Using remote sensing images, it was possible to observe zones of regional fracturing of a meridional strike and identify color anomalies that may indicate the presence of certain geological formations or mineral ores. Forecast intervals are most often located on the border of low and high field values, which is associated with the peculiarities of the geological structure and metallogenesis of the region. Research shows that special importance in metallogenesis is given to zones of regional fracturing and their intersections with faults and zones of other strikes. These intersections determine the position in the area of ore nodes. Graben-limiting faults, located on the arches of dome-type ring structures, are of great metallogenic significance. These faults, intersecting with regional fracturing zones of the deposit's meridional strike and ore occurrence, are localized precisely in these areas.

Keywords: Malguzar mountain, multispectral images, GIS technologies, Koytash mountain, Kirsch method.

04 August 2025 08:22:38

INTRODUCTION

It is known that remote sensing during regional and detailed geological exploration work carried out on areas uniformly and well studied by traditional methods allows for interpreting the material accumulated over the area and its generalization on a space photograph. Converting the distance basis using GIS technologies into a discrete form allows you to consider and organize the spatial position of each elementary cell of the named documents or their layers, compare and conduct a multivariate analysis of these map elements, and determine the position of each map layer relative to the geological factors responsible for solving the geological task. Drilling and geophysics data are used as independent map layers, and the obtained data is used in forecast constructions [1.

When analyzing materials in modern GIS technologies, the overlay method is more often used, including integrating data located in different thematic layers of a vector (raster) map. Overlay promotes spatial unification and allows you to integrate data on faults, structural and material complexes of different genesis, composition, and age, on ring structures and other cosmogeological objects of a point, linear, areal nature, and according to data from traditional methods. Finally, the final results are visualized. The multi-layer card type allows you to treat multiple cards as one. Thematic layers allow you to analyze maps in high detail.

Another way to automate decoding is to create coloristic (composite) images based on multispectral images. The method brings a large amount of information, individual elements of which, as our work has shown, contribute to the decoding of basaltoids, iron-bearing rocks, and rocks that contrast with the background of the surrounding complexes [2-3].

Synthesis (creating a composite image) simplifies the original image and converting it into conventional colors that identify specific objects. This is the simplest transformation, in which the process of obtaining and studying images is carried out interactively and contributes to the transition of interpretation to automation, ensuring the

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transition from analog forms of providing materials to digital ones, which are the basis of GIS technologies [1-4, 13].

METHODS AND MATERIALS

Koytash intrusion covers the western part of the Koytash Mountains in the central part of the Northern Nuratau ridge. It is administratively located in the Gallyaaral district of the Jizzakh region (Fig. 1, Fig. 2.).

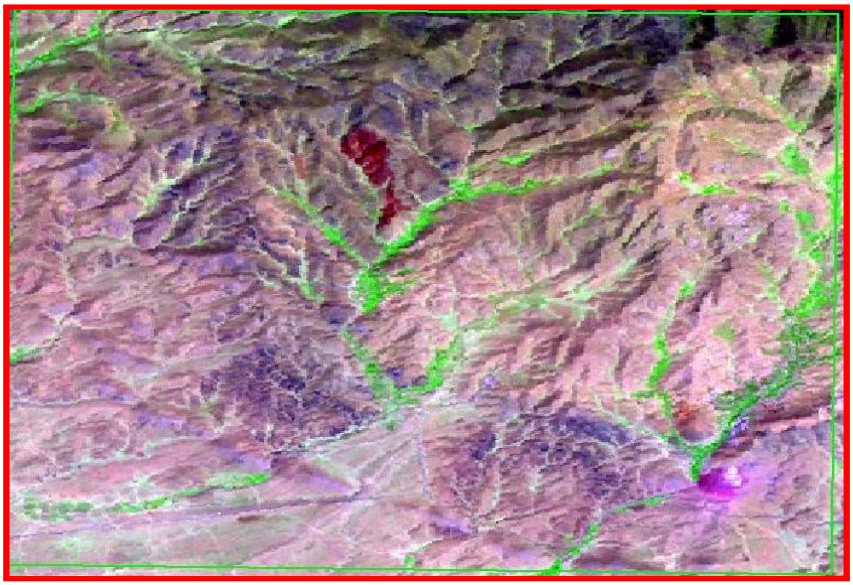


FIGURE 1. Area of conducting advanced cosmogeological.

The interpretation and analysis of aerospace information were carried out visually and using computer processing using generally accepted methods and techniques set out in the basic provisions for the organization and production of specialized aerospace geological work, methodological recommendations developed in the State Committee for Geology, and consists of three major stages of research: [1].

1. Preliminary interpretation of space survey materials;
2. Field interpretation or field certification work;
3. Post-field interpretation or integration of preliminary and field data with geological and geophysical materials.

The work was based on the task of creating remote sensing cosmogeological maps at a scale of 1:200,000, identifying forecast areas using an automated method and integrating the results of cosmogeological research with geophysical and geochemical data on the Koytash intrusion and deciphering satellite imagery materials of various types and scales. In the process of deciphering materials from space images, the methods of Kirsch, Sobel, and principal component analysis.

1. The Kirsch method is an operator with masks, each of which is oriented in a direction. Achieved by rotating the base operator. The image of the reference territory clearly shows linear, concentric, arcuate, and isometric structures located within the folded structure, intramountain depressions, and foothill plains. Their contours can be traced as black, white, sometimes paired lines of varying lengths. The densest network of lineaments is observed within the outcrops of the Paleozoic basement in conditions of open and semi-closed surfaces, and their sparseness is noticeable in flat areas. As you move away from the mountains, the clarity decreases. The number of detected structural units sharply decreases (Fig. 2). The "Sobel" method is an improved version of the "Kirsch" method. Still, the choice of indexation coefficient value is more successful, and structural inhomogeneities in the images appear more contrasting, especially in closed areas [2].

04 August 2025 08:22:38

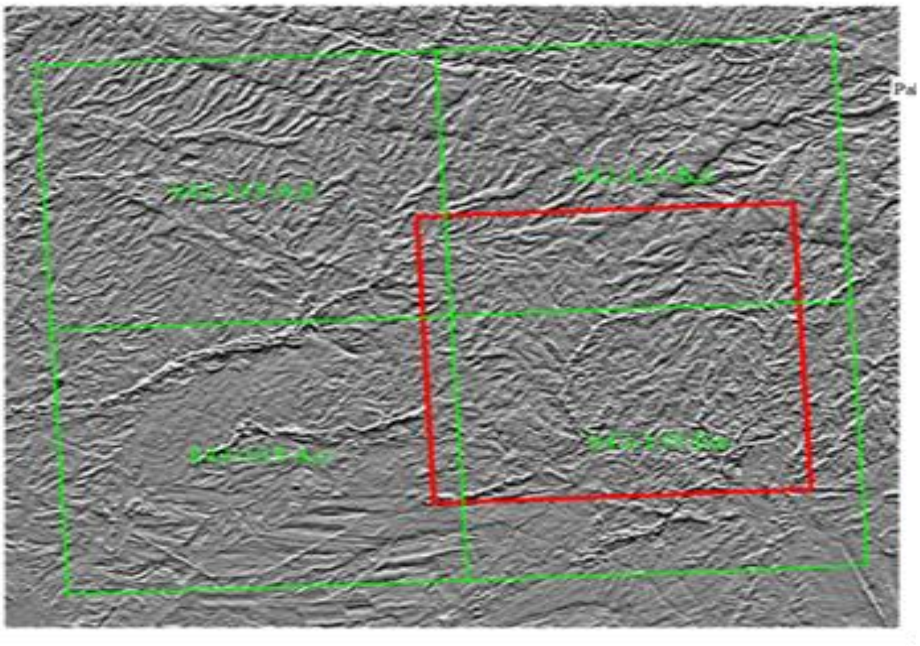


FIGURE 2. Kirsch method.

- This method allows you to fix explosive objects away from folded structures. In the processed image (Fig. 4);
- The contours of different-sized concentric structures and their internal structure are especially clearly visible. Surface and hidden faults are expressed as paired white and black lines.

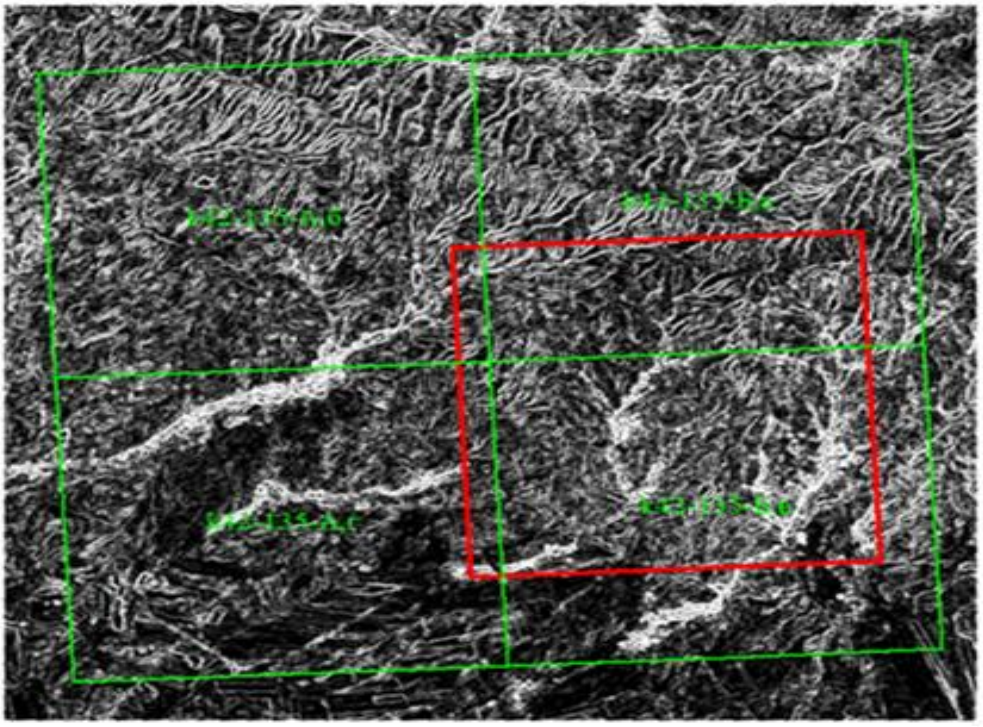


FIGURE 3. Sobel method.

04 August 2025 08:22:38

The image of a deep fault is very interesting: it is not a continuous line, as was drawn earlier, but a narrow zone of short echelon-like intertwined lines, often not intersecting with each other, both in width and length of the zone.

Principal component analysis (Principal Component Analiz is a method for analyzing multispectral correlated data. The concept of correlated data means that as the brightness value of pixels in one spectral channel increases, the brightness values in other spectral channels also increase. An example of a two-dimensional space of spectral features: as the value in the first channel increases, the value in the second increases; this means a high correlation between these channels (fig. 4). [3].

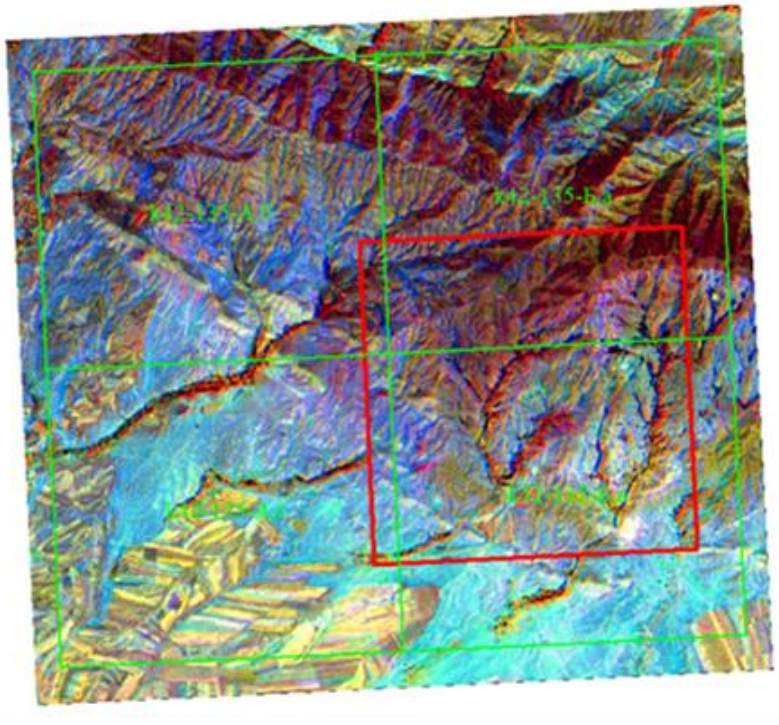


FIGURE 4. XRD method.

It can be seen that the area of distribution of values is located at an angle to the axes of the graph, so none of these axes displays the entire range of object values. This means that the image will be deprived of colors when synthesizing a color image. For example, all vegetation types will be depicted in similar, indistinguishable shades of color. This arrangement of brightness values is typical for most natural objects (vegetation, soils, and rocks).

RESULTS AND DISCUSSION

Cosmogeological studies were conducted using materials from space surveys Landsat 7, Aster, Qui with k Bird using software products ENVI, ERDAS based on GIS technologies [4].

The assigned tasks were:

- space survey materials have been prepared for the territory of the southern and western exocontact Koytash intrusion in the Northern Nuratau Mountains scale 1:25000 for an area of 100 km^2;

- cosmogeological schemes of a scale of 1:25000 were created for an area of 1,00 km^2 within part of the nomenclature sheets K-42-135-B-a, K-42-135-B-b, K-42-135-B-v interpretation of multispectral digital satellite images of various types and scales using modern software products ArcGIS 9.2, ENVI 4.7, Global Mapper based on GIS technologies;

- an analysis of the remote basis was carried out - a cosmogeological map at a scale of 1:25000 of the Koytash intrusion and adjacent territories, including cosmophotogeological maps of different scales compiled for individual areas of this area [5, 6-9].

04 August 2025 08:22:38

The distance bases reflect the main ore-concentrating structures of the regional scale, including faults, tectonic wedge-shaped structures, strike-slip faults, SDCs, ring structures, as well as zones of regional fracturing of meridional strike and color anomalies that are absent on geological maps (Fig. 5).

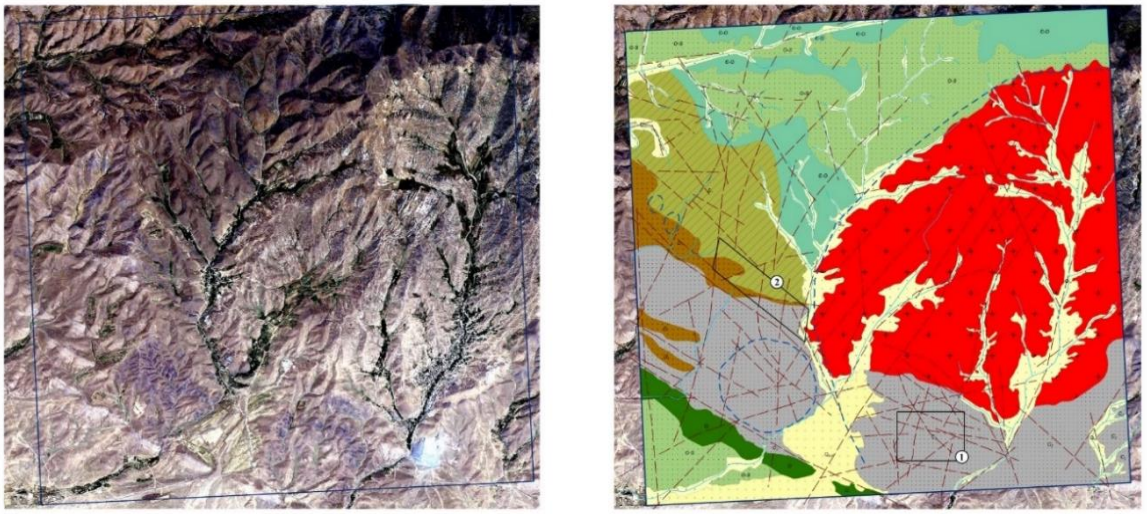


FIGURE 5. Cosmogeological scheme – remote basis of Koytash ore field.

Interpretation of the interpretation results was carried out using special techniques - digital processing of fault networks for metallogenic and structural analysis; channel ratio technique; identification of intersection points of cosmogeological structures; identification of wedge-shaped structures, blocks, block-separating, and barrier faults; ring structures; fracture zones; and other objects of possible localization of mineralization [10-13].

In the placement of endogenous deposits, an important role is given to transform through barriers, rift-like disturbances, and zones of increased fracturing. Cosmogeological studies conducted earlier by the authors of the report within Uzbekistan have established the importance of the localization of mineralization of various types of the most ancient (from our point of view) disturbances - zones of regional fracturing of the meridional strike of various hierarchical levels and their location with a certain step (distance between zones of a certain rank). They are given an ore-concentrating character. Regional fracturing zones (RFZ) of meridional strike. Non-amplitude (low-amplitude) faults of a cross-cutting nature for the Koytash intrusion represent zones of concentration of parallel faults and can be organized into zones of different hierarchies (widths). The faults that make up the ZRT are diaclases, often without displacements. ZRTs are channels for the migration and concentration of fluid flows and quartz veins. The development of cracking occurs most often when compressive stresses change to shear stresses, with the formation of slightly open cavities along the shear, favorable for the localization of mineralization.

Wedge-shaped (pyramidal) blocks are identified and formed by geological surfaces converging in plan and section, and they arise as a result of the interaction of faults, faults, and ring structures [14-17].

Higher basicity magmatism is supposed to be associated with increased iron group element content. Increased pyrite content oxidized due to weathering processes is reflected in composite images as red color anomalies. Iron oxide, in the general spectrum of individual multispectral channels, is displayed in blue, clay - in red, and quartz - in green. Filtering algorithms (combinations of channels) allow you to adjust and enhance brightness, helping to visualize the interpretation of various rock changes. In the version of the survey channel synthesis used in work, the anomalies are predominantly red and bright pink in color and are associated with the development of basic rocks (gabbroids) or manifestations of ferruginization processes (jarosite) in diorite porphyrites. Was a lamprophyre dike noted within the anomaly? (diorite porphyrites, ferruginous, with jarosite) with a thickness of 1,2 m of submeridional strike, which may have caused the color anomaly. Mapping anomalies, if they are caused by the manifestation of oxidation and ferruginization processes, guides search efforts. If gabbroids cause them, then the study of anomalies can help solve the problem of the connection between placer gold and gabbroids [18-20].

Important ore-concentrating elements of remote foundations. In the work area, ring structures of igneous origin develop, the position and size of which are reflected remotely. Ore-concentrating significance is attached to graben-bounding faults formed on the arches of ring structures and especially to the intersection points of graben-bounding

04 August 2025 08:22:38

faults with zones of regional fracturing of meridional strike, which determined the nodal nature of the placement of mineralization. The near-fault position of grabens is generally characteristic of rifting processes. [21].

Faults are the main elements of the remote search basis. The number of faults on a remote basis exceeds that shown on the geological map. This is explained by the insufficient use of aerospace survey materials in geological surveying. So, on the maps, faults of the northeastern and northwestern strikes are recorded, but there are no faults of the meridional and latitudinal strikes. Another trace of tectonic disturbances is established based on interpretation and geological data..

The decipherable signs of faults (the main elements of aerospace geological maps) are diverse, and regional structures rather than local ones control all of them. The deeper the deformations are in the earth's crust, the more dispersed they reach the surface and can only be noted in photographs of a high level of generalization (more often expressed as zones of regional fracturing). Therefore, in most cases, meridional faults are absent on geological maps compiled without MDS.

The totality of results obtained by deciphering remote sensing materials, expressed as remote sensing foundations (structural-tectonic maps), is based on objective material-space photographs, which are their dominant feature.

CONCLUSION

Forecast intervals are commonly situated at the boundary between low and high field values. This positioning is predominantly influenced by the geological structures and metallogenic processes of the region. The zones of regional fracturing, particularly their intersections with faults and other strike zones, play a crucial role in determining the locations of ore nodes within the area. These intersections are significant as they indicate potential concentrations of mineral resources. Emphasis is placed on graben-bounding faults situated along the arches of dome-shaped ring structures. The metallogenic importance of these faults becomes evident at their intersections with zones of regional fracturing that follow a meridional strike. It is at these intersections that deposits and ore occurrences tend to be localized. To conduct comprehensive geological studies, utilizing mineralogically important (forecast) intervals highlighted on fault grid maps and satellite images is recommended. These intervals will enhance the efficiency and effectiveness of geological exploration and development processes.

04 August 2025 08:22:38

REFERENCES

1. Abdullaev, A., Khaliyorov, K., Shanazarov, S., Ziyayeva, P., Ruziyev, I., & Muminov, M. Ore-containing data of lyalyagun mineralized zone of malguzar mountains. In E3S Web of Conferences, Vol. 401, EDP Sciences. (2023).
2. Aerospace methods of geological research. Under. ed. A.V. Pertsova. St. Petersburg Publishing house of St. Petersburg cart factory VSEGEI, 2000, 316 p. (MPR of Russia, Federal State Unitary Enterprise "Aerogeology", State Unitary Enterprise "NIIKAM").
3. Methodological recommendations for cosmophotogeological mapping on the territory of Uzbekistan. (Tashkent, 1983).
4. Methodological recommendations for the use of space survey materials during regional geological survey work, (Moscow, 1985).
5. Gibson, P. Introductory remote sensing principles and concepts. Routledge. (2013).
6. Methods of remote sensing of the Earth for solving natural resource problems. Directory. Chief editors: A.F. Morozov , A.V. Pertsov . St. Petersburg VSEGEI Publishing House. (2004).
7. Ince, F. Digital image processing systems and remote sensing. International Journal of Remote Sensing, 4(1), 129-148. (1983).
8. Algazi, R. Digital Handling and Processing of Remote Sensing Data. An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques. (1972).
9. A. Nikitin., N.Mezhelovsky. Three-dimensional digital geological mapping: principles and computer programs for drawing up new generation maps. Vestnik, Moscow Univ.
10. "Safety Rules for Geological Exploration Works", XK-10-96-11, (Tashkent, 2011).
11. Lurie, I., & Kosikov, A. Theory and practice of digital image processing/remote sensing and geographic information systems. Ed. AM Berlyant.-M. Science World, 9. (2003).
12. Seitmuratova, E. Y., Goryaeva, V. S., Saidasheva, F. F., Arshamov, Y. K., Baratov, R. T., Dautbekov, D. O., ... & Karimbekov, T. K. The Current State of Research on Secondary Quartzites of the Northern Segment of the

Jungar-Balkhash Folded System and Their Au Mineralization (Central Kazakhstan). Minerals, 13(6), 813. (2023).
13. I.Ruziev., L.Samiev., D.Mustafoyeva., S.Nortaev., S.Yakhshiev. Geographic Information System for changing the level of soil salinity in Jizzakh province, Uzbekistan. In E3S Web of Conferences, Vol. 371. EDP Sciences. (2023).
14. Ganiev, I., Shukurov, A., & Qodirov, S. Main features of the magmatism of Chatkal-Kurama region of Tien Shan. In AIP Conference Proceedings, Vol. 2432, AIP Publishing LLC. (2022). DOI:10.1063/5.0090316
15. Instructions for compiling and preparing for publication sheets of the State Geological Map of the Russian Federation at a scale of 1:1,000,000 (third generation). St. Petersburg VSEGEI Publishing House, (2003).
16. Feldman, S. C., Pelletier, R. E., Walser, E., Smoot, J. C., & Ahl, D. A prototype for pipeline routing using remotely sensed data and geographic information system analysis. Remote sensing of environment, 53(2), 123-131. (1995).
17. Safonova, I., Seltmann, R., Kröner, A., Gladkochub, D., Schulmann, K., Xiao, W., Sun, M. A new concept of continental construction in the Central Asian Orogenic Belt. Episodes Journal of International Geoscience, 34(3), 186-196. (2011).
18. Shadlun, T. N. Ore textures as indicators of formation conditions of mineral paragenesis in different types of stratiform lead-zinc deposits. In Ore Genesis: The State of the Art (pp. 607-624). Berlin, Heidelberg: Springer Berlin Heidelberg. (1982).
19. Ishbaev, K. D., Shukurov, A. K., & Kosbergenov, K. M. Lamprophyres and mineralization of the koytash ore field (Southern Tien Shan). LITHOSPHERE (Russia), 20(2), 231-253. (2020).
20. Khaliyorov, K., Khoshjanova, K., Atabaeva, N., Karamatova, G., Ruziev, I., & Nurjanov, S. Distribution of copper in intermediate rocks of Shaugaz-Kandyrsay interfluve (Eastern Almalyk). In E3S Web of Conferences (Vol. 401, p. 01003). EDP Sciences. (2023).

04 August 2025 08:22:38