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SEARCH AND PREDICTION CRITERIA FOR THE DISCOVERY OF PROMISING AREAS WITHIN THE MUROVDAG - AGHDAM UPLIFT (LESSER CAUCASUS PART OF AZERBAIJAN)

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Abstract

The search and prediction criteria for the discovery of promising areas for endogenous mineralization within the Murovdag-Aghdam uplift were considered in the article. It was determined that the location of ore deposits and occurrences in the regional plan is subject to the location of the main tectonic elements in the general structure of the region and the presence of deep faults demarcating separate blocks. The prospect of discovering copper-gold-pyrite, copper-polymetallic, copper-porphyry, copper-pyrite and other types of deposits and occurrences within the Murovdag and Agdam uplifts is characterized by the extensive development of products of Jurassic volcanism, and these mineralizations are genetically and spatially related to sour differentiates. The deposits and occurrences of the region are adapted to horst blocks, characterized by strong shear-faults, permeability of hydrothermal solutions, development of thick volcanogenic series rocks, presence of volcanic centers, volcano-dome structures and vent structures. Mineralizations are spatially located in the endo- and exotopic of intrusive complexes, in the contact zone between their separate phases, and in intensively fractured gabbro-diorite, quartz diorite massifs, and in the dyke mass associated with the intrusive. Mineralizations are spatially located in the endo- and exocontact of intrusive complexes, in the contact zone between their separate phases, and in intensively fractured gabbro-diorite, quartz diorite massifs and in the dyke mass associated with the intrusive.

It was determined that the analysis of the morphostructural features of the region, the genetic or paragenetic relationship of mineralization with igneous rocks, paleogeographical and geomorphological analyses, the development and selection of search-preticted criteria, signs and methods of mineralization, and all regularities that have affected the spatial location of deposits should be taken into account for the metallogenic prediction of ore regions, areas and deposits and the assessment of potential mineralization.

Keywords: *Murovdag and Aghdam, ore regions, prospective areas, regularity, localization, prospecting, assessment, criteria*

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Introduction. Prediction of mineralization of large regions, separate geological zones and junctions is considered an important scientific issue in the theory of formation conditions and placement patterns of ore deposits. Prediction of ore deposits of different genesis is carried out on the basis of complex criteria. The structure of separate regions in the regional plan and the specificity of geological development and the genetic characteristics of mineral deposits are brought to the fore here.

The division of geological prediction into regional, large-scale and local types is widely used. Metallogenic provinces and zones, ore regions and junctions are taken as the main object during regional scale prediction, ore fields (deposits) during large-scale prediction, and ore masses and ore columns during the local predictions [6, 7, 12].

The scientific-methodical basis of the development of a typical search-prediction model of geological objects is considered to be the principle of general similarity, taking into account the general regularity of the formation of different types of mineral deposits. According to modern ideas, the prospecting model is formed from the interaction and combination of geological elements of the ore-bearing space. Such elements determine the geological conditions of the localization of the search object, include geological signs, search factors, signs and other indicators that reflect the degree of occurrence and presence of the mineralization process [5, 9, 14]. Industrial-genetic type characteristics are distinguished based on them, which help to determine the search method system of the deposit. More precisely, search-prediction models answer the question of under what geological conditions ore substances are accumulated and by what signs they are assessed [6,11,15].

Research results and discussion. The analysis of materials on non-ferrous and noble metal systems in the Lok-Karabakh mature island arc shows that the ore-magmatic system develops on a single principle with the sour rocks of the Late Jurassic-Early Cretaceous magmatism and has an asymmetric zonal structure. They are highly metallic and promising for noble and non-ferrous metals, and are located in certain areas of island arc volcanism, forming a general zonation.

We have taken ore-magmatic systems represented by copper-porphyry, copper-polymetallic, copper-pyrite and gold-bearing deposits of Murovdag and Mehmana ore regions as a standard-type research object. These deposits belong to different genetic and ore formation types, which are close to each other in many cases according to their mineral composition, but differ according to the petrochemical properties of igneous rocks. This is explained by the different sources of magma-determining system and mineralization of copper, lead, zinc and gold [2,14].

Complex geological-geophysical, geomorphological and geochemical methods were used on the results of decoding of space and aerial photographs on a scale of 1:200,000 to determine the structural and metallogenic properties of the ore-magmatic systems and perform prediction works in the Murovdag and Agdam anticlinoriums, and the following interpretation works were carried out: 1) structural-geological decoding of different generalization-level space images in order to detect lineaments and annular structures; 2) decoding of aerial and space images on a scale of 1: 200,000 over the entire territory; 3) decoding of different more interesting areas of the region from structural and metallogenic point of view; 4) complex analysis and comparison of the decoding results of space and aerial images with the preliminary data of previous geological-planning, prediction, metallogenic and other large-scale geological maps and geological-geophysical studies [2, 20].

As a result of the decoding, it was determined that faults and their different extent zones, annular structures and intrusive masses are quite reliable and completely deciphered in space images, while the degree of reliability during decoding of lithological-structural complexes is relatively low. Faults are reflected in space images as elongated, sometimes discontinuous, straight-line or narrow photoanomalies that are weakly curved in plan [2].

Recently, it has been observed that the spectrometry of satellite data such as Landsat and ASTER has been used in the spatial determination of the prospects for the discovery of ore deposits within the ore regions and fields and mineral indicators in geological situations, as well as in the detection of promising areas for mineralization characterized by hydrothermal-metasomatic alterations [1, 18].

Murovdag ore region is characterized by extensive development of copper-porphyry, copper-pyrite and copper-polymetallic ores and their respective alterations. The possibility of discovering hydrothermal-metasomatic alterations based on remote sensing data creates ample opportunities for effective geological research in this area [1,18,25]. Hydrothermal alterations are considered an important source of information in mineral exploration and prediction. From this point of view, discover and research of alteration zones in the territory of Murovdag ore region was carried out using remote sounding data. Alteration components were identified based on their diagnostic spectral bands within the principal components [18, 25]. Alteration zones determined by remote sensing, geological prospecting and field inspections have been accurately analyzed. The results show that K-spars are represented by kaolinization, sericitization, silicification, pyrophyllitization based on OH alterations. Such alterations are considered typical for copper-porphyry, gold-copper-porphyry deposits. Fe^{2+}(Fe^{3+}) alterations are seen mainly as a result of pyritization. This is considered as an indicator of polymetallic deposits in the area [21, 25].

The distribution of hydrothermally altered clay minerals, especially alunite, illite and kaolinite in the study area shows strong hydrothermal activity here. The presence of alteration types such as K-spathization, profilitization and silicification confirms indirectly that hydrothermal activity in the study area occurred at medium and low temperatures [25].

Hydrothermal-metasomatic alterations (quartzization, pyritization, kaolinization, sericitization, etc.) of the surrounding rocks are observed along the tectonic structures found within the Murovdag ore region. The more intensive concentration of Au, Cu, Mo, Pb, Zn and other epithermal minerals, which are related to these alterations, occurred under the influence of solfataric processes with post-magmatic activity of acidic volcanites and granitoids and closely genetically related to Late Bajocian mid-basic and acidic rocks and also postmagmatic activity of plagiogranite and gabbro-granodiorite intrusives [14].

Obtaining stereoscopic images of tectonic structural elements is possible based on the analysis of correct and accurate stereoscopic images [2]. In order to detect new linear and annular structures in the tectonic structure of the research area, it is important to classify the structural elements in the region and determine the extension directions. Stereoscopic images allow to carry out work accurately up to a scale of approximately 1:35,000. The biggest advantage of stereoscopic images is the tracking and detection of structural elements and hydrothermal alteration zones in an area of 3600 km^2. From this point of view, the structural elements of the region: faults, caldera-type structures, linear and annular structures, different lithological units and compositions, which were studied using geomorphological elements on the surface of the Earth by obtaining photogeological data from stereoscopic images, are also mapped [14,18] (Fig. 1).

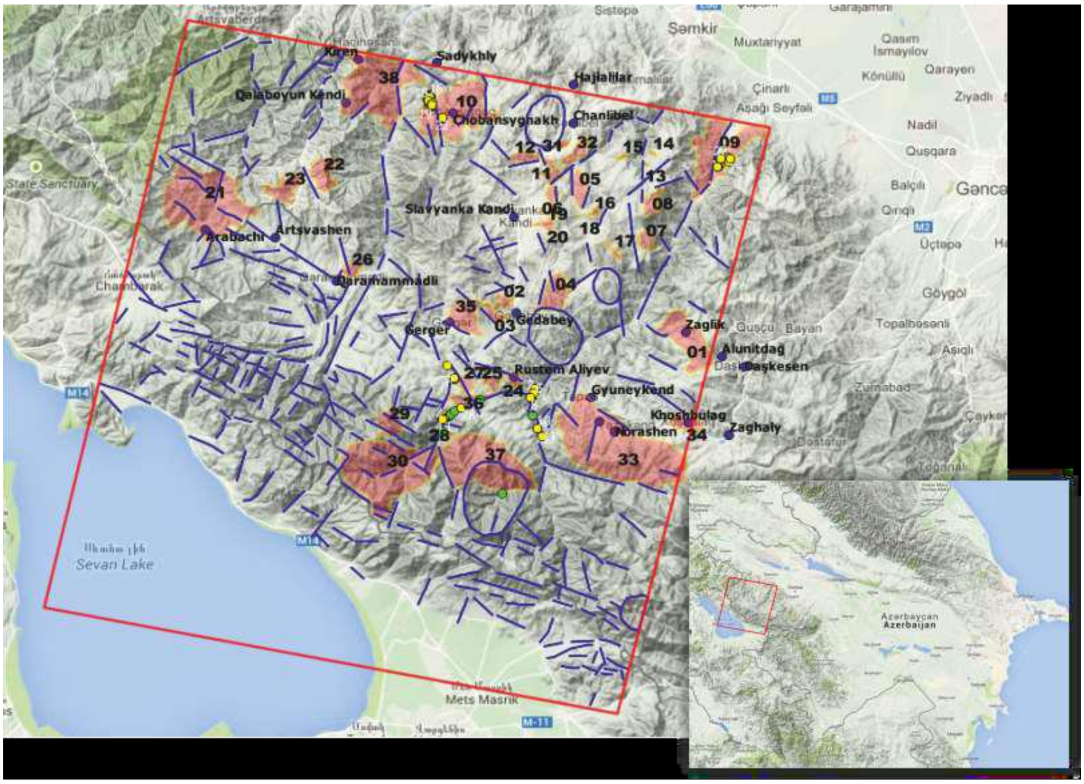

Figure 1. Topographic view and location map of potential areas for prospecting ore minerals according to ASTER satellite data in Gadabey-Murovdag ore regions

Structural, magmatic, stratigraphic and lithological-facies factors are considered more important among several factors of arrangement and localization of endogenous ore deposits in the Murovdag and Mehmana uplifts and in the Lok-Karabakh metallogenic zone as a whole [3].

Structural factors are determined by the regularity of the location of ore fields, deposits and occurrences in the Murovdag and Mehmana ore regions, the location of the main tectonic elements in the general structural plan of these ore regions at the regional level, and at the same time the presence of depth faults that limit separate tectonic blocks. The Murovdag anticlinorium is characterized by an internal block structure consisting of ascending and descending blocks and is demarcated by depth faults. Most of the deposits and occurrences within the ore-magmatic system are adapted to horst blocks and are characterized by intense –shear faulting, hydrothermal permeability, extensive development of thick volcanogenic rocks, and the presence of volcanic centers, volcano-dome structures, stratovolcanoes and vent structures [4].

The role of structural factors in the arrangement and localization of different types of mineralization occur in different ways. Fault and rupture-type fracture systems played an important role in the formation of copper-porphyry deposits and occurrences (Goshgarchay, Goshgardag, Demirli, Agdara, etc.) in the abovementioned ore regions, which are distinguished by their complex characteristics, and intensive impregnated-veinlet sulphide mineralization was adapted to these fracture systems. The use of geophysical data suggests that the spatial arrangement and localization of endogenous mineralization in the region is related to the structural elements of the deep structure. The interpretation of the geological-geophysical materials shows that the less important ore-controlling structural elements of the Lesser Caucasus mega anticlinotium can be attributed to the uplift and faulting zones of its well-expressed ground surface in the relief. A number of copper-polymetallic, copper-porphyry, copper-gold-pyrite, copper-pyrite, etc. types of endogenous ore deposits and occurrences are adapted to the local uplift of ground. Such structural regularity provides a geological basis for the demarcation of known deposits and occurrences and the identification of new prospective ore regions and fields [3,13,14].

A general regularity reflected in the arrangement of ore fields and deposits related to the uplift part of the ground, which occurred by structural elements and intrusive complexes related to the surface foundation, is determined in the tectono-magmatic arrangement of copper-porphyry ore deposits. At this time, it is natural that the copper-porphyry deposits and occurrences adapt spatially to the ore region where magmatism is intensively developed. Copper-porphyry deposits are usually associated with medium-acidic intrusive complexes and dyke belts [3,11,17].

It is clearly observed that the endogenous mineralization and magmatic processes within the Murovdag and Aghdam uplifts are related to long-term depth fault, or rather fault zones. This situation is first of all reflected in the adaptation of a number of endogenous mineralization areas to the Caucasian fault and folding structures [3]. According to the researchers, the role of transverse structural elements in the anti-Caucasus direction is not insignificant for determining a general regularity in the location of endogenous ore deposits and occurrences [11,17]. The Delidag-Gadabey near-meridional magma- and ore-controlling lineament zone is considered one of such structures and played an important role in the location of copper-porphyry deposits and occurrences of the Lesser Caucasus and in the localization of mineralization. According to V.M.Babazade and others' information [2,3], the lineament zone observed in near-meridional direction, which is naturally close to the Delidag-Gadabey lineament zone, has a positive role in the location of the intrusive massif of the same name (Janyatag) in the Mehmana ore region. This lineament zone in the ore-magmatic system controls directly the location of the abovementioned intrusive massif, as well as the copper-porphyry, copper-polymetallic, sulfur-pyrite, copper-gold-pyrite, etc. genetic deposits and occurrences related to this massif.

The Tartar-Khachinchay near-latitudinal depth faulting has led to the formation of the Delidag-Mehmana cross uplifted block in the Mehmana ore region. Mehmana, Gazikhanli, Bashlibel and Delidag acid intrusive complexes, which are considered to be ore-bearing, are adapted to this block [3,15].

The presence of near-meridional and near-latitudinal local structures in the regular location of ore deposits and occurrences within the boundaries of various ore-magmatic systems is considered an additional favorable structural criterion. The ore controlling and ore-bearing structures branched out from these regional structures. Different types of mineralization (quartz-sulfide veins and veinlets, copper-molybdenum-porphyry vein and stockwork zone, pyrite-polymetallic and copper-polymetallic veins, copper-porphyry ore stockworks, ore columns where ores form concentration) are adapted to the zone of high fracture in the spatial and genetic relationship of such structures within the boundaries of the ore-magmatic system. Ore columns, usually vein-shaped ore masses, are attracted to the contact zone of frontal zone rocks of metasomatic alterations, or rather, to the outcrops of veins in poorly porous blocks of rocks [2]. As you can see, structural criteria play an important role in the arrangement of deposits in the studied ore regions, and special attention should be paid to them, especially to the northeast faulting structures and alteration zones during geological exploration.

As a rule, it has been proven that copper-polymetallic mineralization is located in the regional-scale upthrust and thrust type fault zone within the Mehmana ore region. Secondary-type upthrusts and upthrust-thrusts are involved in the role of ore-controlling structural elements here. The geological structure of the ore-hosting system depends significantly on the degree of transformation of the pre-mineralization faults in fault-type deformations. Mineralization, which characterized by the transition of early thrust-type faults to small-amplitude internal movements, was found in deposits and occurrences that retained their original characteristics (pre-mineralization). The arrangement of copper-polymetallic mineralization in such objects is mainly subject to bending type structures along the extensions of ore masses. Fault paragenesis was represented only by small fracture systems in the area where copper-polymetallic mineralization is localized [3,15].

Small-amplitude faults and transverse dislocations occurred on ore-controlling faults during the mineralization stage within the Mehmana copper-polymetallic deposit. The ore formation process in the deposit is related to several stages of mineralization. Pyrite-quartz mineralization was formed at the early stage of mineralization, and the copper-polymetallic (quartz-pyrite-chalcopyrite-sphalerite and quartz-sphalerite-galenite) stage, which is considered the most productive stage, was formed at the last stage [16]. The arrangement of ore masses and columns within the deposit was controlled by the bending type faults determined by the direction of internal mineralization dislocation. It was found in the north-eastern flank of the deposit that the ore-bearing and non-ore-bearing intervals of fault deformations usually reflect compressional and extensional flexures. From the morphostructural point of view, the ore masses are adapted to flexural structures, which are oriented counterclockwise from the general extension of faults and have a more inclined orientation. Such ore-bearing intervals arrange sulfide-quartz veins and veinlets with veined morphology accompanied by impregnated-veinlet mineralization along their extension and dip [16].

The role of lithological-facies factors in the arrangement and localization of ore deposits is considered important. However, the effects of these factors on localization of mineralization are much less compared to structural factors. Determining the stratigraphic level in the arrangement of ore deposits in the Murovdag ore region is of particular importance. This factor affects the characteristics of the spatial arrangement of deposits and occurrences, as well as the quantity and quality of ores to a certain extent. As it is known, most of the deposits and occurrences belong to the Kimmeridgian and Calloway-Oxford ages in this ore region. A more favorable lithological section for the localization of copper-polymetallic ores was Kimmeridgian volcanogenic layer complexes, especially Late Jurassic riftogenic limestones here [3,15]. Regardless of structural arrangement conditions, lithologic-facies conditions form a concentration in the upper part of the basalt-rhyolite complex section. In terms of mineralization, the rocks of this complex are enriched with syngenetic sulfide mineralization of volcanogenic-sedimentary and hydrothermal-metasomatic origin. Ore-bearing fault structures are located along the steeply dipping boundaries of rocks, which are contrast for petrographic characteristics, or in blocks of brittle basic effusive rocks within this stratigraphic horizon. These rocks are turned into secondary quartzites that bear sulfide mineralization at great depth on almost the entire thickness of the rocks along fault deformations and tectonic zones.

The analysis of the regularity of the regional arrangement of copper-porphyry deposits of the Lesser Caucasus on a tectono-magmatic basis shows that one of the main criteria of mineralization localization is the presence of *magmatic formations*, which were formed at the Kimmeridgian stage, at the orogenic stage of the Alpine epoch of geological development of the region. These include gabbro-diorite-grano-diorite, granite-granosyenite, gabbro-plagiogranite and monsonite-granodiorite formations [3].

The products of gabbro-diorite-granodiorite complexes are spread in a wide range among the ore-bearing magmatic complexes with which copper-porphyry deposits and occurrences are related within ore-magmatic systems, and the basalt-andesite-dacite complex forms a single volcanic and plutonic association with them. Copper-porphyry deposits are spatially and genetically adapted to later phases and differentiates of intrusive complexes, dykes and small intrusives, and sometimes volcanic centers (necks) [3,11, 17].

The following criteria are used by most researchers [11,17] to determine the genetic relationship of copper-porphyry deposits with certain intrusives: 1) the involvement of deposits in spatially defined intrusive complexes or groups of intrusive rocks; 2) coincidence of the time of formation of certain phases and differentiates of ore deposits and intrusives; 3) spatial or mineralogical transitions between igneous rocks and deposits; 4) the presence of a certain association between a certain group of intrusive rocks and certain types of deposits.

It can be stated that all the deposits and occurrences, included in the Goshgarchay ore-magmatic system, are spatially located in the endo- and exo contact zone of the intrusive complexes, as well as in the contact zone between different phases of the Goshgardag group intrusives and in their intensively fractured phase rocks, especially gabbro-diorite massifs and dyke systems forming an association with the intrusive complex. In most cases, the inheritance of the directions of ore-bearing tectonic fractures, which occurred during volcanic processes, the formation of intrusive complexes and late tectonic movements, was observed. The relation of ore deposits and occurrences with magmatic complexes is confirmed by the formation of endogenous mineralization in high-temperature mineralization of hydrothermal origin or deep magmatic source, especially in skarns, secondary quartzites, as well as quartz, quartz-sulphide and quartz-carbonate vein and vein zones.

It is possible to mention the outcrops of ore veins and zones among the search signs within the ore regions. A high content of sulphides in ores is also considered a prospecting sign. At the same time, metasomatic alterations, mineralization observed in them, paragenetic connection of copper mineralization with diorite-porphyrite and granodiorite-porphyrite dyke complexes (in the area of Goshgarchay, Goshgardag, Gizilarkhaj deposits and occurrences) and ore fragments found in modern sediments and other factors are involved as search signs.

Accurate geological and metallogenic studies and prediction of ore-bearing zones and areas are of special interest for the correct directivity, scientific justification and increase of effectiveness of prospecting and exploration works in ore-mining regions. They are based on the geological data obtained on ore regions and deposits as a result of geological-planning, prospecting and thematic works within the Murovdag and Aghdam uplifts. Metallogenic studies are based on complex formation-metallogenic works. At this time, the stratigraphic level of mineralization, lithofacies characteristics, relationship with tectonic elements and igneous rock complexes are taken into account [3,4].

The method of formation-metallogenic analysis is considered to be quite reliable during the assessment of the amount of separate ore deposits and occurrences, as well as in the assessment of the prospects of ore regions and areas. The experimental use of this method on geological objects helps to clarify the structural relationship in the spatial approximation of certain formation-type ore occurrences and their relationship with the igneous bedrocks.

The following main principles of prediction of complex ores in Murovdag and Aghdam anticlinoriums can be mentioned based on the abovementioned materials: 1) Re-assessment of the metallogenic profile of the complex ores of the contact belt of the Murovdag and Mehmana granitoid massif with the regularity of the arrangement of the main industrial types. This is considered the basis of developing the regional prediction method; 2) the main role of the block structure in the localization of copper-porphyry and complex ores; 3) Discovering ore-controlling zones (the occurrence of magmatism, hydrothermal processes, the presence of ore occurrences of various metals, etc.) that determine the position of industrially important ore areas and ore occurrences at the junction with other directional structures; 4) Determining the role of the normal development of folding and fault tectonics of the region and distinguishing the ore-controlling role of the northwest structures; 5) The arrangement of copper-porphyry, copper-polymetallic and copper-pyrite mineralization within anticlinorium composed of thick volcanites; 6) adaptation of mineralization to Bajocian rhyolite, andesite and dolerite porphyrite and their pyroclastolites; 7) controlling mineralization by depth faults, large transverse thrusts and fault zones that act as ore-bearing and ore-controlling channels; 8) genetic correlation of mineralization with Jurassic granodiorites; 9) presence of northwest, north-northeast, and northeast oriented fault-deformation systems, which are considered favorable for the localization of mineralization; 10) adaptation of the mineralization to the development strip of the dyke complex; 11) the presence of pre-mineralization and post-mineralization wallrock metasomatic alterations; 12) presence of jointing zone of linear, annular and arched depth structures of different genetic nature; 13) Discovery of hydrothermal-metasomatic alteration and mineralization zones, which are indirect search signs for the detection of promising areas for mineralization, with the help of satellite data (Landsat, ASTER).

Taking into account the abovementioned factors of prediction, the predicted scheme of promising ore-bearing areas and minerals of the Murovdag uplift was developed (Fig. 2.).

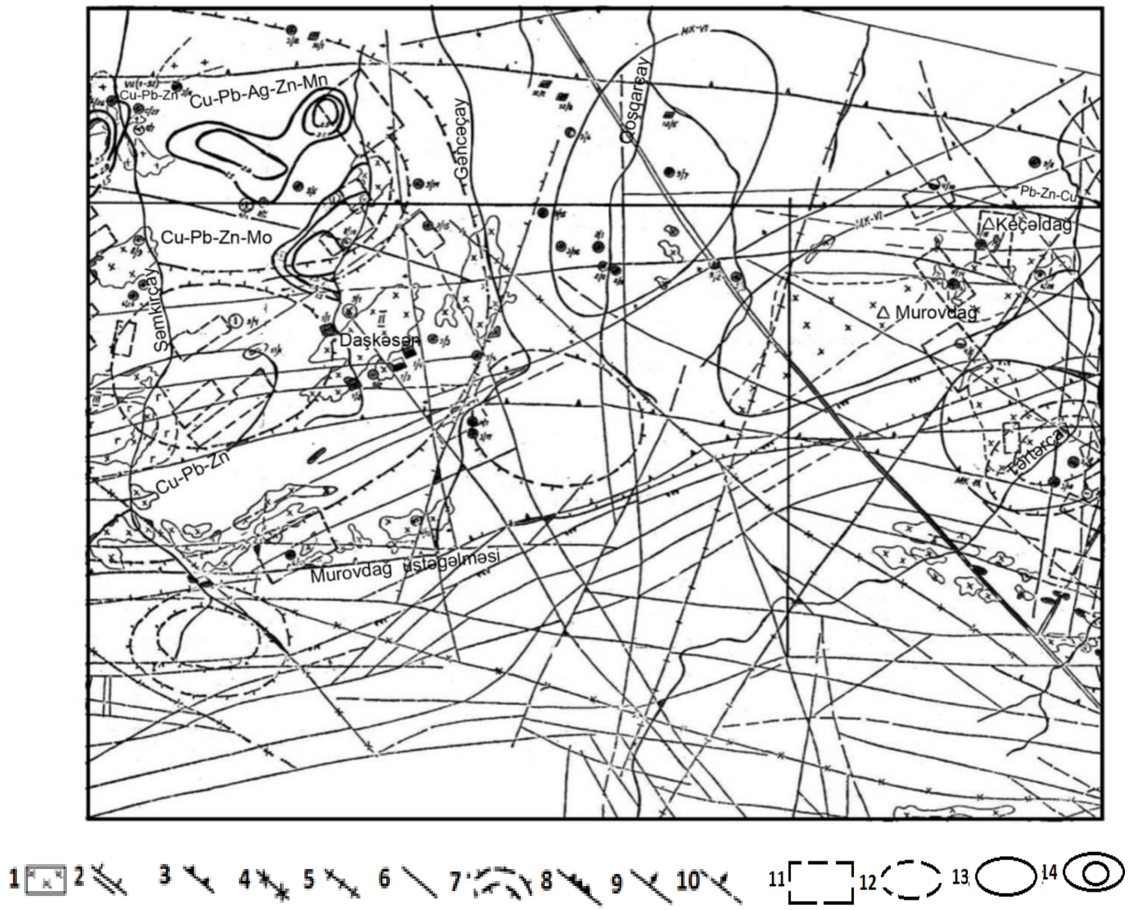

Figure 2. Arrangement scheme of prospective ore-bearing structures and minerals of the Murovdag uplift

1-gabbro-quartz-diorite-granodiorites; 2- fault deformations; 3- regional faults located on the border of large tectonic blocks; 4- regional near-meridional magma-ore controlling faults; 5- northeast oriented lineaments; 6- lineaments corresponding to local faults within blocks and structures; 7- annular and oval structures; 8- deep bedding faults; 9- Faults in the lower part of the Alpine complex; 10- Intrablock faults in the lower part of the Alpine complex; 11- anomalous areas discovered for copper mineralization based on geophysical data; 12- Boundaries of geochemical anomalies (Cu-Mo-Ag-Pb-Zn-Co) on secondary aureoles; 13- Primary complex placer halos of Cu-Mo-Ag-Pb-Zn elements; 14- boundaries of geochemical anomalies along placer flows.

Conclusion and suggestions. The positive results of prospecting and assessment works in the Lok-Karabakh metallogenic zone were determined by the purposeful prospecting for gold, copper and polymetallic ores in the Early and Late Bajocian volcanogenic and volcanogenic-sedimentary rocks within the Murovdag and Aghdam uplifts. The main purpose of the geological exploration work to be carried out is the discovery and exploration of hidden noble and non-ferrous metal mineralization. The search for ore masses is carried out based on a detailed study of the geological structure of the region, analysis of geological anomalies and structural elements. As a result of the complex surface geophysical, geochemical and other geological works carried out within the Murovdag and Aghdam uplifts, potential promising areas for mineralization were discovered, where separate facies of hydrothermal-metasomatic alterations, which bear copper-porphyry, copper-polymetallic, copper-gold-pyrite mineralization, are developed. Syngenetic and post-mineralization hydrothermal-metasomatic alterations (quartzization, chloritization, sericitization, propylitization, kaolinization, etc.) with abovementioned mineralization can be effectively used as an indirect search sign for the discovery of various types of hydrothermal noble and non-ferrous metal mineralization.

Analysis of the morphostructural characteristics of the region, genetic or paragenetic relationship of mineralization with igneous rocks, geomorphological studies accompanied by paleogeographical analysis, correlation ratios of geological sections of existing deposits with geological sections of ore fields and regions, development and selection of search criteria, signs and methods of deposits, all regularities that have influenced the spatial arrangement of deposits to one degree or another should be comprehensively taken into account for metallogenic prediction of ore regions, areas and deposits and assessment of potential mineralization.

As a whole, the prospect of discovering copper-gold-pyrite, copper-polymetallic, copper-porphyry, copper-pyrite and other types of deposits and occurrences within the Murovdag and Agdam uplifts is characterized by the wide development of Jurassic volcanism products. Copper-pyrite, copper-gold-pyrite, and copper-polymetallic mineralizations are genetically and spatially related to acid differentiates of volcanism. The deposits of this formation, as well as veined quartz-polymetallic mineralization are classified as industrially important deposits due to their geological-exploration and assessment parameters obtained on the deposit. Extensive development of volcanogenic rocks within the Mehmana copper-polymetallic deposit and the Elbeydash copper-polymetallic occurrence, presence of structural, magmatic, facies-lithological and stratigraphic factors, formation analysis of rocks, wide occurrence of facies types of hydrothermal-metasomatic alterations, copper-polymetallic veins and extensive development of veinlet-type mineralizations and a number of geological criteria lay the groundwork for the search and initial prediction of lenticular-layered polymetallic ores.

The development of the Eocene volcanogenic-sedimentary rock complex in the Mehmana ore region is of special interest as stratigraphic factors for the search of new prospective areas of pyrite-type lead and zinc mineralization. First of all, the prediction-assessment works should cover the entire ore region, including the Mehmana copper-polymetallic deposit and its flanks, along with geological-exploration works. Prediction and assessment works in the ore region should include direct signs (primary placer aureoles, flow aureoles, high amount of indicator elements) of nodes of potential ore regions, mapping of various types of volcanic structures, results of special geological-mineralogical-geochemical, accurate geophysical and geochemical mapping works, data on conducting boreholes and ore mining and interpretation of obtained results, direct signs of potential ore fields, interpretation and generalization of data obtained during the prediction assessment of ore fields and potential deposits for mineralization.

In order to discover hidden industrial mineralization within the Elbeydash depression, which is considered promising for copper-polymetallic mineralization, the geological-exploratory works to be performed in the future should first be directed to the search for volcanic structures with favorable cover and to the study of their morphostructural and petrological-mineralogical characteristics. At the same time, taking into account the wide development of various volcanogenic and volcanogenic-sedimentary rock complexes, lithological-facies criteria should be taken into account in a complex along with stratigraphic criteria for predicting promising areas for copper-polymetallic mineralization. For this purpose, carrying out geological-structural mapping and accurate geological-geophysical and geochemical-mineralogical works, mapping of various types of anomalies (geochemical, mineralogical, geophysical), demarcating the borders of secondary placer aureoles and building structural wells and carrying out other geological works are necessary here.

REFERENCES

[1] Abrams, M.J., Brown, D., Silver Bell., Arizona, porphyry copper test site: the Joint NASA-Geosat test case study, Section 4, Tulsa, OK // American Association of Petrolium Geologists, – 1985. – 73 p.

[2] Babazadeh V.M., Mammadov M.N., Ahmadov D.M., etc. Middle Jurassic magmatism, mineralization of the Murovdag anticlinorium and the role of fault structures in its arrangement // News of Baku University. Series of natural sciences, - Baku: - 2010. No. 4, - pp. 106-113

[3] Babazadeh V.M., Mahmudov A.I., Ramazanov V.G. Copper and molybdenum porphyry fields. – Baku: Azerneshr, - 1990, - 376 p.

[4] Babazadeh V.M., Mammadov M.N., Ahmadov D.M., Imamverdiyev N.A., Mansurov M.I. On the prospects for discovering new ore fields and occurrences within the Karabakh uplift (based on remote sensing data) // News of Baku University. Series of natural sciences, - 2011, - No. 4, - pp. 138-152

[5] Voevodin V.N. Principles and general scheme of predicting ore deposits // News of the National Academy of Sciences of Ukraine, Earth Sciences, - 2008, - No. 2, - pp. 110-116

[6] Volkova T. Information analysis in prediction of endogenous mineralization // Proceedings of the Don State Technical University, Series of Mining and Geology, - 2001, - Issue 32, - pp. 31-37

[7] Galandarov B.G. Polymetallic ore formations of the Lesser Caucasus / Abstract of the dissertation of Doctor of Geological and Mineralogical Sciences - Baku: - 2010, - 49 p.

[8] Karimov A. Petrology and ore-bearing of the Mehmana granitoid intrusion - Baku: Academy of Sciences of the Azerbaijan SSR, - 1965, - 165 p.

[9] Konovalov B.T. Search model of Jurassic polymetallic mineralization // Proceedings of the IV International scientific conference. - Novocherkassk: NPO Temp, - 2004, - pp. 183-189

[10] Kochnev A.P., Yurenkov E.G. Basics of Typification of Prediction and Exploration Models // Irkutsk: News of the Siberian Branch of the Earth Sciences Section of the Russian Academy of Natural Sciences. Geology, Prospecting and Exploration of Ore Fields, - 2014, - No. 1 (44), - pp. 74-80

[11] Krivtsov A. Geological foundations of prediction and prospecting of copper-porphyry fields. - Moscow: Nedra, - 1983, - 256 p.

[12] Kurbanov N.K. Geological and genetic assumptions for prediction and prospecting for fields of non-ferrous and noble metals in the Alpine volcanogenic eugeosyncline of the Lesser Caucasus // Proceedings of the CSRIGP, issue 189. – Moscow: -1984, - pp. 3-36

[13] Mansurov M.I. Geological and genetic model of the Goshgarchay ore-magmatic system of the Murovdag uplift (Lesser Caucasus, Azerbaijan) // - Baku: News of the Azerbaijan National Academy of Sciences. Earth Sciences, - 2013. No. 4, - pp. 16-22

[14] Mansurov M.I. Prospecting and prediction criteria for identifying promising areas and new types of mineralization of the Murovdag horst-uplift // News of Baku University. Series of natural sciences, - 2013. - No. 4, - pp. 107-118

[15] Mansurov M.I. Prospects for exploration and prediction of non-ferrous metal fields of the Aghdam anticlinorium // News of Baku University. Series of natural sciences, - 2014, - No. 3, - pp. 137-148

[16] Mansurov M.I. Geological and prediction factors of the discovery of promising areas and new type mineralization in the junction zone of Murovdag-Aghdam uplifts. News of Baku University. Series of natural sciences, - 2022, - No.1, - pp. 38-47

[17] Mansurov M.I., Karimli U.I. Prospects for exploration and prediction of fields of non-ferrous and precious metals of the Mehmana ore field (Lesser Caucasus, Azerbaijan) / Collection of abstracts of

reports. Scientific and methodological foundations for prediction, prospecting and assessment of fields of non-ferrous and precious metals, diamonds-status and prospects. XI International Scientific and Practical Conference. Moscow, FASU, CSRIGP, 2022, pp. 143-145

[18] Mansurov M., Imamverdiyev N., Karimov V., Ganbarova E., Damirov T., Mursalov S., Pashayev N. The discovery of structural elements and zones of hydrothermal alterations by using ASTER satellite data in the margins of Gadabey and Murovdag ore districts (Lesser Caucasus, Azerbaijan) // Journal Geology, Geografy and Geoecology. Dnepropetrovcsk, Ukrain. 2021, 30 (3), p.512-527. Doi:10.15421/112147.

[19] Pavlova I.G. Copper-porphyry fields (regularities of arrangement and prediction criteria). - Leningrad: Nedra, - 1978. - 276 p.

[20] Ramazanov V.G., Galandarov B.G., Khasayev A.I. et al. Geological and geophysical foundations for prediction of endogenous mineralization (using the example of porphyry copper fields of the Lesser Caucasus) // Mining and geological journal, – Zhitikar: – 2009. No. 1-2, – pp. 6-11

[21] Tommaso, I.D. Nora Rubinstein, N., Hydrotermal alteration mapping using ASTER, data in the Infiemillo porfhyry deposit, Argentina // Ore Geology Reviews, – 2007. v. 55, – pp. 70-79

[22] Reynolds, T.J., and Beane, R.E. Evolution of hydrothermal fluid characteristics at the Santa Rita, New Mexico, porphyry copper deposit // Economic Geology, –1985. v. 80, – p.1328-1347

[23] Stolper, E., and Newman, S. The role of water in the petrogenesis of Mariana trough magmas // Earth and Planetary Science Letters, – 1994. v. 121, – p. 293-325

[24] Titley, S.R. Characteristics of porphyry copper occurrence in the American southwest // In Mineral Deposit Modeling. Canada, Ontario, – 1995, – p. 433-464

[25] Ninomiya, Y. A stabilized vegetation index and several mineralogic indices defined for ASTER VNIR and SWIR data – Proc. // IEEE International Geoscience and Remote Sensing Symposium, v.3, Toulouse, Franse, – 2003. 21-25 july, – p. 1552-1554

[26] Sabins, F.F. Remote Sensing for Mineral Exploration // Ore Geology Reviews, –1999, v.14, – pp. 157-183

[27] Spatz, D.M. Wilson, R.T. Exploration remote sensing for porphyry copper deposits, westerm America Cordillera // Proceedings Tenth Thematic Conference on geology Remote Sensing. environmental Research Institute of Michigan, Ann Arbor, MI, – 1994. – p.127-130