TYPMORPHIC FEATURES OF THE QUARTZ OF VARIOUS GENETIC TYPE AND COMPOSITION OF MINERAL PARAGENESIS OF ORE-GRADE GOLD IN KARAKCATAU MOUNTAINS (WEST UZBEKISTAN)

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Abstract

As a result of complex studies - geological-structural, morphostructural analytical, mineralogical mapping of quartz formations, detailed geochemical work and analysis of geochemical fields – forecasting prospecting features of gold ore taxon’s: ore zone; ore field; deposit and ore body. They are characterized by groups of criteria: morphostructural, stratigraphic-lithological, structural-tectonic, magmatic, geophysical, metasomatic, mineralogical, geochemical factors and attributes, and a geological-genetic model of the gold-bearing ore-forming system in the collapse zone. Favorable geological and structural conditions for the localization of gold mineralization in the mountains of Karakchatau are associated with the areas of long-term tectonic-magmatic activation in metalliferous sediments of Є-О contrast lithological composition. The coincidence of manifestations of gold mineralization to the blocks formed by transverse faults at the sites where they intersected the Karakchatau crush zone was noted. To the channel-localizing parts inside are blocky and unextended interblock tectonic structures with positions in favorable “structural traps” in their azimuthal curvatures of executed productive types of hydrothermal, sulfidizing quartz. The results of mineralogical mapping of quartz formations along the Karakchatau crush zone (Western Uzbekistan) are considered. Five genetic types of quartz are distinguished. The most productive of them is hydrothermal quartz of types 3 and 4 associated with pyrite,arsenopyrite and gold, which forms vein fields in areas of kinks and expansion of the zone of crushing. Identification of any goods and services that can be used for commercial purposes, including in the geological structure, other regions of Western Uzbekistan.

Keywords:
Gold, mineralogical mapping, typomorphism, quartz, Karakchatau, Uzbekistan, genetic type.

1. Introduction

The Karakchatau mountains are taken place among the areas with the potential of covered ore-grade gold in Nurata region. The purpose of the study is to expand and reveal the mineral resource base of the Republic of Uzbekistan for gold, covered and concealed, inaccessible depths, mineralization in areas with operating mining enterprises.

In the modern formulation, typomorphism is a phenomenon in which a number of minerals and their paragenetic associations are formed in strictly defined, relatively narrow in the range, thermodynamic conditions, clearly recording the nature of these conditions. The main directions of the theory of the typomorphism of minerals include - general geological, crystal and morphological, chemical, structural, isotopic and thermal and barometric characteristics. A mineralogical study of the rock samples from vein quartz formations of various genetic types of the Karakchatau shear zone focused on the features of the external appearance of quartz, the mineral composition of paragenesis, and the interrelationships of minerals and the morphology of quartz (Babaev, 1951; 1985).

2. Regional Geology

The Karakchatau mountains are located in regional structures within the Zarafshan-Turkestan structural-formation zone, with which the prevailing part of the industrial gold potential of Western Uzbekistan is associated with (Figure 1). The regional ore controlling structures of the first order are the branches of the South Nurata deep fault - the North and South, the component link of the last Karakchatau and Karatau fault zones (Koloskova, 2007). The crushing zones are important for ore forming hydrothermal system and ore-controlling structures of the collision stage, within which the prevailing number of objects are located, in the mining region, with a variety of mineralization. The traced length within the outcrops of the Pre-Mesozoic basement is from 90 to 180 km, respectively, the width of both complex zones of dislocated fault varies from 1-2 to 5-6 km. On the bearing of these zones, local shear zones are revealed, representing individual branches of the general structure.

As for the features of the geological structure and ore content, are composed of intensively dislocated Pre-Mesozoic formations, which are represented with two main complexes of rocks: sedimentary - terrigenous, siliceous and carbonate rocks; and intrusive - dikes. The cover-folded structure of the mountains of Karakchataus, as well as of the South Nuratau region as a whole, was formed because of prolonged processes of sedimentation, (Koloskova, 2007; 2008; Yanovsky, 1990).
3. Material and method

Studying of the typomorphism of quartz was based on visually observed signs, the study of polished tin sections, scanning electron microscope (SEM), and spectral analysis data. About 2000 points of mineralogical mapping are unevenly distributed depending on the natural prevalence of quartz bodies and the exposure of pre-Mesozoic rocks. Quantitative indicators identify anomalous areas identified within the individual segments of the zone.

4. Distribution of the Quartz Bodies

The index of “silicification”, representing the product of medium length and thickness of quartz bodies at the observation point, in higher values, fixes the range of ore bearing quartzite in the above- and near-intrusive position of the non-eroded granitoid massif and disparate anomalies in other parts of the zone (Figure 2). The morphology of quartzite bodies depends on the intensity and nature of the plastic and brittle tectonic deformations, and the mechanical properties of the rocks: veins predominate, both individual and accompanied, which follow the distribution are linear veins, quartz nests, and differently oriented interlacing veins are negligible. Quartz crystal or quartzite has the ability to respond to stress by changing the internal structure of crystals, the development of plastic or brittle deformation. In some areas, changes predominate without
disrupting the continuity of the crystal rains-bending deformations; in others, the transformations are expressed in the mosaic disintegration of crystals into inhomogeneous areas (Koloskova, 2007; Yurgenson, 1984).

Extensive development of quartz mineralization, correlated in the area distribution at the observation point and at a distance from it to 50-75 m, fixes the high saturation of the Karakchatau zone of crumpling by quartz veins (Figure 2).

![Figure 2](image_url)

**Figure 2.** Extension of vein silicification at observation points. Extensity is the prevalence of quartz mineralization from the observation point (10x10 m area): 1 - within the observation point; 2 - beyond the boundaries of the point (up to 25 m); 3 - can be traced at a considerable distance (up to 50-75 m).

5. **Deformation Degrees of the quartz crystals**

With bending deformations, gradual and unidirectional turns of frame predominate. The degree of deformation is determined by the magnitude of the maximum deviation in the orientation of extinction of different parts of the same grain, referred to the diameter of this grain, which characterizes, as it were, the “curvature of the bend” of the lattice. Intensive deformation is seen only in crystals of early quartz - about 6-8° per 0.1 mm. In later generations, about 2-3° per 0.1 mm. Among the deformations of the bend, simple deformation (in the form of extinction by one wave), complex-striped (several parallel waves), spotted (areas of heterogeneous orientation) are distinguished. This is the first degree of deformation.

With mosaic texture, the large grain of quartz does not get a general bend, but as if broken into parts. The degree of deformation is expressed in the angles of the relative rotation of the mosaic blocks, fixed in a polarized light by their non-simultaneous fading. This is the degree of deformation of the second type.

Fragile deformations are expressed in intracavitary cracking, in the appearance of microcracks along the boundaries of crystals and mosaic blocks, in the development of cracks, cutting crystals. The extreme degree of deformation is the appearance of quartz breccias. In the early stages, recrystallization is closely intertwined with granulation. Part of the continuous fine-grained crystalized sugary crystals masses, consisting of pure and distorted crystals, is a product of recrystallization with a partial reprecipitation of deformed veined quartz.
There is an increase in the intensity of brittle-plastic deformations of quartz, as well as other minerals as they approach large tectonic zones (Petrovskaya, 1956). The strongest locally occurring bending deformations of quartz are observed along the contacts of the veins and in the places of inclusions in the veins of the rock fragments.

6. Mineralogy

Five genetic types of quartz crystals are distinguished according to the complex of features. Metamorphogenic quartz (Q-1): Macroscopically it is white or grayish in color, draining and glassy, often translucent, forming folds along with the surrounding rocks. Under the microscope, this type of quartz is characterized by heterogeneity with the predominance of coarse aggregates measuring 0.1-2.0 mm and larger. The crystals boundaries are uneven - wavy and broken. It is characterized by the occurrences of plastic and brittle deformations of the aggregates of crystals, microgranulation, and recrystallization along the crystals boundaries and microcracks, to the sites of which the allocation of feldspars, chlorite, muscovite, sericite, biotite, rare cubic pyrite crystals are sometimes confined. The extinction of the crystals is predominantly wavy simple or mosaic-wavy, in addition, there are a band-gap wave and a wave of extinction converging toward the center. The angle of propagation of the extinction wave (APEW) is about 2-30 by 0.1 mm. Fragile deformations occurred in the form of cracks, are developed unevenly. In fine veins, small-medium-grained hypidiomorphous-crystalized aggregates of quartz with poorly occurred plastic micro-deformations of crystals of quartz are noted, which, in microscopic studying in polarized light, is reflected by the wavy, uneven or wrinkled extinction of individual grains of quartz.

Often occurring feldspar, supposedly orthoclase, in samples of white and cream tint, developed in the form of rare crystals rains up to 1-2 mm in size fraction and rarely more, the form is usually isometric or slightly elongated. In transparent sections, development of dust-like particles is observed-pelitization, weak kaolinisation . Rarely noted microcline. Later albite-quartz microprotrusions, sometimes briefly of a sixth-order texture, are superimposed.

Pyrite is found in the form of disseminated impregnation of small cubic crystals or pseudomorphs of iron hydroxides in pyrite. Often, thin cracks and films of iron hydroxides of brownish, reddish, and ocher-yellow color are observed along the cracks due to oxidation.

The gold content of metamorphogenic quartz is usually lower than the sensitivity of gold-spectral analysis, sometimes it rises up to 0.1-0.2 g/t, but usually, in quartz the Au content does not exceed 0.0n g/t.

Metamorphogenic-hydrothermal quartz with inclusions of feldspar (Q-2): Feldspar-quartz formations of this type often form secant veins, sub-coarse small lenticular veins, nests of metamorphogenic quartz and metamorphosed sandy-schist rocks. A characteristic feature of this type is an increased content of feldspars of cream and pinkish tint, reaching up to 50-60% of the volume of mineral fulfillment. In the inflating of thin veins, sometimes a pseudo-breccia texture forms, when the granular aggregate of pink feldspar contains relatively isomorphic crystals of quartz.

Visually, the quartz is from white to grayish, translucent, draining, sugar-like and vitreous. Under a microscope in crossed with analyzer, there is a wavy fading and the initial stages of the mosaic texture of crystals, but more often the crystals are almost undeformed. The structure is hypidiomorphic, grained, with grain sizes in the range 0.02-2.0 mm. Wreaths of creamy and pinkish feldspar up to 2-3 cm in size, granular aggregates
of feldspar perform interstices between the crystals of quartz. Feldspar is usually replaced by sericite and kaolinite, which is from single scales to 20-25% of the volume of feldspar outcrops.

The main typomorphic feature of this type is a large amount of feldspar, saturated with pelito-like particles. The crystals of feldspar (albite and orthoclase, predominate albite) have both a good cut and are distinguished by irregular shapes with rare faces. Among them, sections of large crystals up to 1.5 mm and zones of fine-grained aggregates up to 0.1 mm in length are allocated. Among the crystals of quartz, large differences up to 2 mm or more are of primary importance. However, along with them, a large volume of the section is occupied by medium- and fine-grained aggregates of albite of the metasomatic appearance, which forms intergrowths with quartz. On the surface of quartz, dustlike inclusions, and possibly kaolinite, are found to a much lesser degree than on the surface of feldspar. Forms of crystals are very diverse - from angular elongated to irregular and slightly rounded.

The gold content is thousandth-first hundredths g/t, in one case up to 0.8 g/t with an increased content of iron hydroxides in quartz.

Pneumatolytic-hydrothermal quartz (Q-3): Macroscopically quartz from white and light gray to dark gray, coarse-grained, draining, from translucent to transparent in shallow cleavages. Often has a characteristic dull luster. There are veins with a patchy uneven distribution of color from almost colorless to dark gray, rarely reddish. The external appearance of sugar to vitreous is both opaque and translucent. The structure is medium- and coarse-grained, cryptocrystalline. In the quartz veins of large quartz veins, a rhythmic banding was observed, caused by alternating bands of 1-2 mm of translucent and opaque quartz. It contains small isometric and elongated inclusions of muscovite of colorless, slightly greenish and gyro-colored brown iron, white and cream tint feldspar up to several mm in size. Individual crystals of pyrite are observed along cracks, sockets up to 0.5-1 cm in size and thin veins, films of hydroxides of iron and manganese.

Under a microscope is represented by medium-coarse-grain grained aggregates of crystals of the idiomorphic-grained or hypidiomorphic-grained structure. In some cases, grain boundaries are uneven, sinuous. Crystals are characterized by the practical absence of dust-like inclusions, which distinguishes it from other types of quartz. The outflow is normal, characteristic of undeformed quartz or weak cloudy and wavy. Often there is recrystallization of quartz with the formation of fine aggregates along microcracks in association with chlorite and carbonate. Single rutile crystals of isometric and elongated sections up to 0.01-0.01 mm in size, apatite of irregular shape up to 0.2 mm in size are observed (Ivakin and Nazarova, 2001)

In some veins of white and grayish pneumatolytic-hydrothermal quartz, crushing and superficially sulfide mineralization, represented by pyrite and iron hydroxides, was noted. Often under the microscope in quartz with superimposed sulfide mineralization, allotriomorphic-grained aggregates of crystals with optical signs of bending deformation occurrences and crushing are observed. The granular quartz of fine-grained and fine-grained structure develops intensively along microcracks and grain boundaries. There are crystals of feldspar in size up to 2-3 mm and rarely more. This quartz is characterized by intensive fracturing both unsystematic and oriented lamellar. Among the nonmetallic minerals, fine-grained aggregates of ferrous carbonate, sericite, kaolinite, hydromica, chlorite are developed along the fissures. Often these minerals are associated with the occurrences of ore mineralization.
Ore minerals in the form of dissemination, lens, nests, veins and their combinations develop along fissures in quartz, are intensively replaced by secondary minerals of the oxidation zone. Iron hydroxides in the form of dissemination, nests, veins and their various combinations, raids along cracks are very widespread.

Hydrothermal gold mineralization, developing along the fissures, is applied to the pneumatolytic-hydrothermal quartz on the manifestation of gold mineralization of the Alyamdi. In the samples selected of gold-bearing quartz vein, friable ocherous formations in the form of branching veins and nests up to 5-6 cm in size, consisting of limonite of colloform-banded structure with inclusions of reddish-brown goethite, veins of jarosite with a thickness of up to 2-3 mm, rare primitive scorodite (Figure 3-4).

Hypidiomorphic-grained quartz forms intergrowths with albite in the form of a medium- and coarse-grained aggregate. Quartz has a weak cloudy-wavy extinction albite is represented by colorless tabular crystals with polysynthetic twinning (section 1017, Fig. 3c, d). Cracks develop fine-grained idiomorphic-grained quartz, apatite grains are up to 0.2 mm, short-prismatic rutile crystals up to 0.02 mm in size. The distribution of ore mineralization is controlled by cracks in the albite-quartz aggregate and is also associated with later secant quartz-carbonate (ankerite, calcite) veins. To the post-ore are rare veins of white calcite (Mikhailov et al., 2004).
In the heavy fraction of the crushed sample of Alyamdi rare pyrite, malachite, cerussite and native gold are observed (Figure 3b). The color of gold varies from bright yellow to reddish-yellow. Gold grains measuring less than 0.1 mm predominate and represent a thin dust-like class. The form is lumpy, rounded, elongated, irregular. Fused gold and quartz. Larger golds have a tuberculate surface (Figure 4).

Probably the presence of bismuthinite, scheelite, molybdenite within quartz, as indicated by the increased contents of Bi, W, and Mo in the samples, as is the case for As, Ag, and Cu in some other samples are increased in some samples.
Hydrothermal quartz associated with pyrite, arsenopyrite and gold (Q-4): Hydrothermal gold-bearing quartz is macroscopically white, grayish and light gray, sometimes the color distribution is unevenly spotted and a bluish tinge appears, represented by cryptocrystalline opaque aggregates of porcelain or sugar-like appearance (Figure 5a). Contains inclusions of creamy-pink feldspar in the size from 0.1-0.2 mm to 2-2.5 mm, veins and micro-allocation of carbonate, chlorite, sericite, kaolinite. Under a microscope, quartz is characterized by large-crystal aggregates of individuals with abundant pulverous inclusions forming “wrinkles” in the distribution. Hydrothermal quartz is characterized by intense brittle-plastic deformations, characterized by uneven cloudy-wavy extinction, the mosaic texture of crystals, formation of granular quartz along cracks and grain boundaries (Figure 5b), transparent, without dust inclusions. A fine-grained aggregate of quartz with carbonates, sericite, kaolinite, chlorite, pseudomorphs of iron hydroxides through pyrite, jarosite, and native gold develops along the fissures (Figure 5c). Rare nests and impregnations of pyrite are observed in some sections of quartz veins up to a few mm in size; accumulations of iron hydroxides are widespread in the form of nests, veins, and raids along cracks.

In the concentrates of the crushed sample from the limonitized quartz veins, the occurrences of the Tusun mineralization are native, pyrite, chalcopyrite, arsenopyrite, galena, malachite, scorodite in single crystals. Gold native in the heavy fraction of crushed sample 1209 are characterized by free golds of bright yellow color and in intergrowths with quartz, and also by dusty impregnation in quartz. The size of the gold is from 0.01 to 0.75 mm. The form of the various forms of gold: cloddy, lamellar, complex interstitial, elongated and isometric, wire-like, etc. (Figure 5d). The surface of the golden spines is smooth, as well as tuberculate, and turbinate, as occurred more often. In polished sections of the same quartz vein, the individual elongated, vein-like and isometric lumpy and dusty golds are confined to microcracks in quartz (Figure 5e). Accumulations of golds from 0.005 to 0.1 mm in size are associated with microsockets of quartz-sericite-hydromica-kaolinite composition, gold inclusions in iron hydroxides are also observed here. According to the results of the semi-quantitative spectral analysis, the lead content in this same vein is increased by 0.48%, arsenic 0.1%, copper 0.1%, silver 415 g/t, gold 26.25 g/t. High Pb contents suggest the presence of galena.

Two areas of development of vein formations of porcelain quartz (Q-4) have been defined at Naymanbulak and Tusun sites and one field in the Ingichkasay basin west of the Naymanbulak area, almost entirely overlain by a loose cover with separate quartz vein outlets with gold contents of 0.1-0.8 g/t. Separate
sections of porcelain quartz veins with high gold concentrations of the Tusun section contain large nests of ocher congestions of iron hydroxides measuring up to several cm and even up to 10-12 cm.

Post-ore, hydrothermal low-temperature quartz (Q-5): It forms veins in tectonic zones and performs the bodies of quartz breccia. Macroscopically it is white and grayish in color, sugar-like, sometimes finely-grained and metasomatic in appearance.
Figure 5. Gold bearing in Tusun site; a) a sample of white porcelain quartz (Q-4) from the core (1209, 0.9 natural values); b) deformations of the compression and the mosaic texture of crystals of quartz and microgranulation in cracks (slag 1209, with analyzer), magnifying 56; c) native gold (light) in quartz-kaolinite-carbonate micronests (dark) (collection 1209, enlargement 60); d) gold from quartz vein 0.15-0.55 mm in size (concentrate of crushed sample 1209, enlargement 36).

The fine clastic quartz breccia with fragments of intensely silicified rocks characteristic of the type is described at the observation point 836. Debris of intensely silicified rocks ranging in size from 1-2 mm to 3-5 cm, usually acute-angled, forms in quartz from 5-10 to 40-50%. Under a microscope, quartz aggregates are hypidiomorphic-crystallized (a combination of xenomorphic crystals and crystalline forms) of an ungrained structure with a grain size of 0.05-0.1 to 0.5-0.6 mm with poorly occurred micro deformations of the crystals. In association with post-ore quartz, small accumulations of crystals of chlorite, sericite, albite, calcite, kaolinite flake, gypsum are noted.

The results of mineralogical mapping of vein quartz formations along the Karakchatau folding zone show that quartz veins are most intensively developed in the central part of the crushing zone. They form linear zones and fields, concentrated in local geological blocks; vein fields develop in the areas of expansion of the Karakchatau shear zone, and in the areas of its clamping the intensity of quartz mineralization decreases; the location of the fields and their morphology depend on the nature of the block deformation of the shear zone.

The typomorphic mineralogical-geochemical features of vein quartz bodies of different genesis, defined as a result of research, are comparable with the available data on other crushing zones, which allows them to be
recommended as search criteria and criteria for studying prospects for gold in territories of a similar geological structure.

6.1. Results of SEM

Under the SEM, vitreous metamorphogenic quartz (Q-1) (sample 1140) of a cryptocrystalline structure with a grain size range from about 0.1 to 0.2 microns and a banded, lace-like texture contains scattered impregnation of ore minerals up to several microns in size and has a shell fracture. As a result of superimposed processes, recrystallization occurs with the formation of sugar-like quartz sections containing small gas-liquid inclusions of 1 to 1.5 microns in size. A honeycomb structure of quartz was observed against the background of a thin-globular surface with precipitates of a presumably carbonaceous substance of an isometric and elongated shape measuring range from 0.1 to 2 microns in nodes. Some crystals have radial-radiant structure.

The studies under SEM of Q-3 type quartz show a high degree of idiomorphism of crystalline aggregates (Figure 6a). Uneven distribution of gas-liquid inclusions of irregular shape with cut edges and teardrops, possibly of secondary origin (Figure 6b).


Figure 6. a) SEM images of the Sample 1187. Forms of high-temperature quartz aggregates (Q-3) - pseudo-plateau of coarse-grained quartz. Electron microscopy. Coal replica. Magnifying 5400; b) Sample 1017. Vacuoles of gas-liquid inclusions in high-temperature quartz (Q-3) - opened vacuoles of GLI (gas-liquid inclusions) up to 2 microns in size. Electron microscopy. Coal replica. Magnifying 4500.

SEM studies of the cleavages were made it possible to define the presence of gaseous-liquid inclusions of isometric round form up to 15-20 microns in porcelain hydrothermal quartz (Q-4) of a fine-grained structure. In coarse-grained aggregates saturated with the dissemination of ore minerals, there are hexagonal quartz crystals and largely elongated vacuoles of gas-liquid inclusions over quartz growth zones. The quartz “wrinkledness” noted during the study in the sections fixes the crystal growth zones saturated with pulverized gas-liquid inclusions and microinclusions of ore minerals (Figures 7a, b), which are expressed on the clefts by modifications of the forms of the shell fracture.
Fig. 7. SEM images of the sample 371. Zonal structure of hydrothermal quartz aggregates (Q-4); a) “Wrinkled” quartz impregnations of sulfides. Coal replica. Increase. 6000; b) the same with gas-liquid inclusions by growth zones. Electron microscopy. Coal replica. Increase. 6000.

7. Discussion

The evolution of ore-forming processes in the gold-bearing quartz veins of crushing in terrigenous sequences of the cover-folded regions of Western Uzbekistan is recorded by a set of features (geological, metasomatic, mineralogical, geochemical, etc.). We studied the typomorphism of quartz formations in the Karakchatau, since this mineral has a large amplitude in the properties and properties of mineral-forming processes (Yurgenson, 1984, Babaev, 1985, etc.). The obtained data made it possible to consider in comparison to geological evolution ore forming conditions in the studied area.

Gold manifestations are formed as a result of deep hydrothermal fluid circulation in fractures and faults in the early stage of development of the zone of crushing, pneumatolitic-hydrothermal processes associated with granitoids, and telethermal processes with late stage of deep structures (Koloskova, 2007). Late Silurian processes of movement of lithospheric plates were a favorable way for the migration of ascending fluid flows from the subduction zone. Pre-Devonian regional metamorphism is considered by most researchers as one of the earliest processes of concentrating gold in sedimentary strata. In the early-collision stage from the middle Carboniferous, complications of early over thrust along the borders of the covers occur and large plates, which in the late- and post-collision period took the form of zones of crushing, conformal cover-fold structure. At first, the period of collision, when the granite-gneiss layer was not yet formed, the zones of crushing were the structures of migration of mantle fluids, which contributed to the formation of metamorphogenic-metasomatic rocks with a high background metal content, including gold content (Ivankin and Nazarova, 2001): 1) carbonate-sulphide-carbon metasomatites; 2) albite-quartz metasomatites and vein-vein formations of a similar composition. The formation of polygenic collision granitoids of the S-type C3-P1 need to be explained was accompanied by a large-scale migration of gold and a number of ore-bearing elements in the geothermal gradient field of intrusions with a concentration in favorable positions. Dislocations of this period control the placement of dyke and vein type quartz mineralization. With periods of post-collisional tectonic activation of the associated formation of quartz breccias, gold-bearing quartz.
8. Conclusions

In this article, we considered the practical application of one of the natural-geological phenomena defined by the term “typomorphism of minerals”. Field mineralogical mapping of quartz formations was performed along the ore-saturated Karakchatau fault zone with potential of hidden gold mineralization.

Mineralogical study of stone material from fatty-vein quartz formations of different genetic type of the Karakchatau crumple zone paid attention to the peculiarities of the external appearance of quartz, the mineral composition of paragenesis, and the interrelationships of minerals and the morphology of quartz aggregates.

Five genetic types of quartz formations are distinguished by a complex of characters that include metamorphogenic quartz (Q-1); metamorphogenic-hydrothermal (Q-2); pneumatolitic-hydrothermal quartz (Q-3); hydrothermal quartz with sulfides and gold (Q-4); hydrothermal low-temperature quartz, post-ore (Q-5). Mineralogical mapping was carried out in that mapping: in the Karakchatau crush zone quartz veins are most intensively developed in its central part; the nature of their manifestation (vein fields or linear zones), intensity and morphology from fear, etc. (See Attached features of quartz formations are comparable with data on other zones and are recommended as search criteria and criteria for gold in Southern Nuratau, separately described higher.

Established as a result of research of typomorphic mineralogical-geochemical features of fatty-vein quartz bodies of different genesis of comparable data with other crushing zones, which allows them to be recommended as search criteria and criteria for studying prospects for gold in territories of a similar geological structure.

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References

Babaev, K.L. 1951. Genetic characteristics of quartz formations of the Nuratau range. Tr. Institute of Geology 6, Tashkent, ANUSSR.


