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**Abstract.** As a result of the analysis of the data available and collected in recent years, in contrast to the well-established ideas about the polygenic and poly-stage nature of the mineralization, it is indicated that the gold mineralization of the Central Kyzyl Kum is formed as a result of the formation of a single ore-magmatic system, which develops in the same type regardless of the composition and age of the host rocks; during the formation of deposits, the most important thing is the presence of a process that promoted ore formation, which should serve as the basis for judgements in problems of the genesis and forecasting of industrial facilities. Some problematic issues on the geology of ore deposits are noted.

## 1. Introduction

It is well known that in the field of fundamental researches on ore formation, over the past years, certain successes have been achieved [1-3, etc.]. In near past, the attention to the geological industry, including fundamental research, as in other areas of science, has somehow decreased, large scientific schools which were created by our founder scientists have practically disappeared. The President of the Republic of Uzbekistan noted the importance of the mining industry in the economic development of our Republic and, taking fundamental measures to reform and develop it, he emphasized the need for a radical intensification of fundamental research in the field of geology.

In this regard, let us briefly discuss some fundamental problems in the field of geology of ore deposits, which are waiting for their solution. It should be noted that some of the issues under consideration are investigated and solved by our specialists. Instead, over the past decades, experimental geology and modeling of the natural processes of formation of mineral deposits have shown special development on a global scale.

Establishing the genetic characteristics of industrial concentrations of useful components is not only theoretical, but also of great practical importance in terms of developing predictive and search criteria and identifying promising areas and positions. Since it is the ideas about the features of the formation and localization of mineralization that determine the strategy of prospecting.

In this regard, the Muruntau deposit is of great interest - a world-class gold ore giant, on the issues of the formation conditions of which there has been controversial on the pages of domestic and foreign literature for many years [4,6,13,14,16 etc.]. Regarding the method and time of formation of its ores, there are dozens of different, sometimes conflicting views and worldviews, which are reflected in the well-known work [16].

Here, based on a critical analysis of the results of previous studies and the data obtained by the authors in recent years [8-10, etc.], as well as modern theoretical premises of the patterns in formation of ore concentrations in natural systems [11,13], views on the genesis of gold mineralization are presented. Central Kyzylkum, particularly the Muruntau deposits, built on facts.

At the same time, the question was put in the following way - what is the reason for the emergence of ore (as a concept of an industrial category; “ore is a formation with an industrial content of a useful component” (Geological Dictionary, 2012), in connection with the paper will focus on the processes that form industrial mineralization, and not small concentrations of a useful component of purely geochemical or mineralogical interest.

It should be noted that the most common assumption was that Muruntau belongs to deposits with sedimentary-epigenetic [4], in some models, marked as metamorphogenic or metasomatic-metamorphogenic nature of mineralization [17], as well as hydrotherms associated with magmatic sources [11, 13, 15 and others].

Ultimately, in recent years, an alternative model has been born, which is followed by a significant part of researchers, combining the “signs” of both sedimentary-epigenetic and postmagmatic-hydrothermal ore genesis, and attributing polychronous and polygenic nature to the mineralization of the Muruntau deposit [13, 16]. The authors note that “…the ever more widespread recognition of the polychronicity and polygenicity of gold-bearing associations has brought together the competing genetic concepts for a long time, the alternativeness of which is important only in solving the (hypothetical) question about the sources of gold.”

Unfortunately, it should be noted that similar "scientific" approaches on the issues of the genesis of deposits entail some dangers in the terms of the practical application of the results of fundamental research, since genetic models are the basis for identifying predictive and prospecting criteria and determine the strategy and direction of geological exploration work and ultimately - the allocation of promising areas and the discovery of new deposits. The statement of purely ephemeral assumptions and constructions misleads practical geology. These include the identification of “geochemical specialization of strata”, “elevated geochemical background” of rocks, or even “ore-bearing (!) strata”, which, in fact, indicate that prospecting should be focused on identifying these rocks. But the nature of ore-forming systems is different and its identification requires deep scientific research with a comprehensive, methodic sound analysis of research results based on fundamental theoretical constructions on the issues under consideration.

## 2. Methods and materials

Here are some of the research results obtained in recent years:

1) On the important role of carbonaceous metasomatism in the formation of ores. In the ore-bearing strata of the Central Kyzylkum, carburized rocks are found everywhere. Most researchers consider the carbonaceous matter (HC) of the host rocks in the Central Kyzylkum to be brought from the mantle [6-7]. At the same time, there is no explanation for the reason of the most intense "carburization" of the finest-grained (pelitic) and least permeable rocks over vast areas. The basis for judgements about the hypogene carburization of rocks in this region is sometimes observed sharp blackening ones of them in the structures of sliding faults is the result of mylonitization [17].

The development of hydrocarbons in the host rocks of the Central Kyzylkum has a regional character, which is clearly observed in weakly metamorphosed siliceous rocks extending vast areas. In them, hydrocarbons are distributed in the form of cryptogranular grains, distributed over the mass of the rock (content up to a few%), without any connection with the zones of "mantle metasomatism and deep faults

even [7]". Most researchers consider the hydrocarbons of the host rocks of the Central Kyzyl Kum as a product of metamorphism of the bioorganic matter of primary sediments [16].

The data obtained show that the HC content decreases as a result of intensity of metamorphic and, especially sharp metasomatic processes intensifies - the rocks are intensively lightened. During hydrothermal transformation, hydrocarbons are removed [17].

The facts above make it possible to cast doubt on the dominant importance and (or) the presence of carbonaceous metasomatism in the formation of gold mineralization in the Central Kyzyl Kum.

2) As regards black shale strata "specialized" for gold, up to "…ancient placers" [16] in the Central Kyzyl Kum. In order to identify the relationship between the contents of elements and the conditions of rock formation, statistical processing of geochemical data was carried out for individual samples, reflecting rocks of various genesis (regional metamorphosed, contact metamorphic and metasomatic) and composition. At the same time, the contents of ore elements in the host rocks were determined in their unchanged differences, which should be used to determine their geochemical background. It has been established that the content of gold and other elements in sedimentary rocks has a lower or clarke value, which is confirmed by numerous data [8, 16]; their significant contents are confined only to metasomatically altered rock varieties [8], the formation of which is associated with postmagmatic hydrothermal processes. In theoretical terms, this means that the gold ore mineralization of the Central Kyzyl Kum is genetically related to the processes (derivatives) of the formation of granitoid intrusions, and in practical terms, similar (gold-rare metal) ores can be predicted in connection with the aureoles of post-magmatic processes in favorable geological and structural positions. We also note the presence in the region of gold deposits (with rare metals), where mineralization is not localized in carbonaceous sedimentary rocks (Zarmitan and others).

2) On the confinement of gold mineralization to certain, on the example of Muruntau - to the "variegated Besapan", suites and stratigraphic levels of metamorphic rocks and their prospects. Isotope-geochronological studies (Rb-Sr-method) of metamorphic and igneous rocks of the Muruntau ore field made it possible to establish the chronology of the formation of the deposit [12]. It has been established that "... the age of the greenschist metamorphism of the ore-bearing Besapan suite was 401 ± 11 Ma, and the main stage of hydrothermal ore formation coincides with time of the formation of igneous rocks of the second stage (quartz syenite-porphyries and kersantites) - 273.1 ± 1.6 million years and is separated from the time of intrusion of granitoids in the first stage (Murun alaskite granite) - 286.1 ± 1.2 Ma". The formation of subsequent stages of ore formation "…occurred in separate pulses, 257.6 ± 2.2 Ma, 230.2 ± 3.5 Ma and 219.4 ± 4.2 Ma, which were caused by pulses of tectonic activity in the region at that time."

The data indicates that the regional metamorphism of the Besapan Formation is confined to the Silurian-Devonian boundary and is separated from ore-metasomatic processes in the Muruntau ore field and belong to different geotectonic epochs, and exclude the metamorphogenic model of ore formation in the rocks of individual suites or sequences. Here we briefly dwell on the isolation of hydrothermal ore formation from the time of intrusion of granitoids of the first stage. In recent years, it has been noted that the formation of igneous formations and the multi-stage nature of associated mineralization have been noted, and it has been indicated that the formation of rare-metal or gold-rare-metal ores lags slightly behind the time of intrusion of granitoid massifs - mineralization is associated with the subsequent, post-magmatic stage of mineral formation. For example, the gold-rare metal mineralization of the Sautbay and Sarytau (V. Bukantau) deposits was formed after the intrusion of dike formations (diorite porphyrites, etc.), which intruded after the consolidated granitoid massifs. Then, dikes of the subsequent stage (lamprophyres, etc.) are emplaced and gold mineralization itself is superimposed on them, consisting of several stages, which also fall on different time intervals (257.6 ± 2.2, 230.2 ± 3.5, and 219.4 ± 4.2 Ma - according to [12]). But in fact, all these formations are derivatives of a single evolving ore-magmatic system.

Thus, in the Central Kyzyl Kum, gold mineralization coincides with the age with the Permian granitoids [17, 20]; is located in rocks of different composition and a wide age interval, i.e. superimposed on sedimentary-terrigenous ("black-shale") deposits, as well as on granitoid rocks from the Precambrian

to the Lower Permian [8, 15]; the formation of mineralization is genetically related to the formation and derivatives of granitoid magmatism. At the same time, the formation of intrusive formations may consist of several stages, but heterogeneous (rare-metal, gold-rare-metal, gold-silver, etc.) mineralization will be associated with separate stages of a single stage of the postmagmatic process.

3) the relationship of igneous formations with mineralization: based on the intersection of the most productive mineral complexes with granodiorite-porphyry dikes, a conclusion was made about the pregranitoid age of mineralization at the Muruntau deposit [16], and on the basis of the superposition of ore-metasomatic associations on dikes, an "important" conclusion about their separation in time and the absence of a connection between mineralization and magmatism.

## 3. Results and discussion

Based on the presence of ore dikes, the formation of metasomatic formations and various mineral associations of the Muruntau megastockwork, by some researchers, is explained by the presence of two stages of mineral formation of different ages [16]. It has been established that the formation of igneous formations and various types of gold mineralization, even within the same tectonic-magmatic cycle, is a multi-stage process that is most fully manifested in large deposits, reflecting the duration and multi-stage nature of magmatic, postmagmatic activity and the long-lived nature of ore-localizing structures [8,11,16]. Therefore, the conclusions about the pre-ore and post-ore nature of dikes and, moreover, the absence of a relationship between magmatism and mineralization, to put it mildly, are not entirely appropriate - some dikes can be post-ore in relation to rare metal mineralization, but on the same object - pre-ore in relation to gold or gold -silver.

Based on the intersection of the most productive mineral complexes with granodiorite-porphyry dikes, a conclusion was made about the pre-granitoid (metamorphogenic) age of the mineralization of the Muruntau deposit [16], and, based on the superposition of ore-metasomatic formations on lamprophyres, about their separation in time and the absence of a connection between mineralization and magmatism.

The above data show that intraore dikes of various compositions are often noted, especially at large deposits. Thus, the intersection of scheelite-gold-feldspar associations by granodiorite-porphyry dikes at the Muruntau deposit is not a basis for attributing mineralization to pre-granitoid (metamorphogenic) formations.

Comparison of the results [8-9] shows the similarity between the sequence of formation of vein-magmatic and ore paragenic mineral associations of deposits of rare-metal and gold-rare-metal deposits of Western Uzbekistan.

The relationships under consideration can be reflected, to some extent, a generalized integral model of the formation of endogenous mineralization, where material formations are formed in the following age sequence: pregranitoid diorite-porphyrites and lamprophyres → intrusion of granitoid intrusive → magnesian skarns → pre-ore dikes of diorite-porphyrites, syenite-porphyrites → skarns calcareous, quartz-K-feldspar metasomatites (mainly areal) of the early alkaline stage of post-magmatic processes → quartz-pyroxene-scheelite, quartz-K-feldspar-gold-scheelite, amphibole-biotite-quartz (with scheelite and gold) productive associations with a high content of bismuth in ores → intrusion of intraore dikes (lamprophyres, diorite-porphyrites) → vein birsite, eisite, argillisite metasomatites, in association with gold-arsenic, gold-polysulfide and gold-silver ore associations → barren quartz-carbonate, zeolite veinlets.

All these processes occur under conditions of changing geodynamic conditions, leading to the repeated emergence (or renewal) of fault structures that supply, distribute, and localize mineralization of various types [18-19].

An analysis of the available and newly obtained data made it possible to state some problems of the geology of ore deposits, which are a continuation of scientific achievements and developed on the basis of the ideas of the metallogenic school created by Kh.M. Abdullayev, are as following:

1. In deposits of noble and rare metals, mineralization is associated with magmatic processes, including dike formations of various age and composition. What are the relationships of these

formations in - spatial, genetic, age terms? How are dikes of different composition related to granitoid intrusions and mineralization, and where are the centers of their formation? Since, in recent years, a multi-stage nature of the formation of various igneous formations and heterogeneous mineralization has been established.

2. Development of the theoretical foundations for the regularities of the formation and distribution of mineral deposits in natural systems and the creation on their basis of integral models that reflect the parameters of the formation of deposits and the search and forecast base. In this regard, it should be noted that unfounded approaches and ideas on the formation of mineral deposits create a certain danger in the practical application of the results of fundamental research in applied geology, since genetic models of mineralization should determine the basis of exploration and strategic directions of geological exploration and, ultimately, serve as an important theoretical basis leading to the discovery of new deposits.
3. Determination of the material composition of gold mineralization, mainly micromineral complexes, distribution features of various parageneses of ore minerals and ore-accompanying elements in space and time, based on modern worldviews, reflecting the patterns of formation and localization of deposits in natural systems and the creation of new science-based material forecast complexes. At present, it is problematic to achieve significant progress in the field of complex deep processing of minerals, without the widespread use of precision (high-precision) research methods. This is clearly evidenced by the results of foreign studies in this direction. It is necessary to ensure the wide use of microprobe research methods, which provide the instrumental basis for the implementation of these important scientific and practical developments and technological solutions [20-22].
4. One of the important scientific directions in the Republic was the study of metasomatic processes and associated mineralization. The data obtained recently and the results of experimental studies indicate the need to revise the existing scientific views in this area. In particular, it is important to establish the relationship of various metasomatites with heterogeneous mineralization, in particular skarns with tungsten ores, the significance and sequence of the formation of various near-ore changes during the formation of gold mineralization, their formational subdivision, and other issues.
5. The importance of fault tectonics in the location of various igneous formations and ore deposits has been established. Recent studies have obtained preliminary data on the relationship of various intrusive formations, metasomatic and ore formations formed at separate stages of a single ore-magmatic stage, with fault structures of various directions [23,24]. The study of the regularities of the stage-by-stage formation of tectonic structures of individual mining regions, depending on the features of their geodynamic development, serves to identify the nature of the location of various mineral deposits and acquires important prognostic significance [25].

## 4. Conclusion

In the region, gold mineralization coincides in age with Permian granitoid magmatism; is located in rocks of different composition and a wide age interval, superimposed on carbonaceous sedimentary-terrigenous deposits, as well as on granitoid rocks from the Precambrian to the Lower Permian; the formation of mineralization is genetically related to the formation and derivatives (postmagmatic solutions) of granitoid magmatism - in the formation of deposits, the presence of a process that contributed to ore formation is most important; in the localization of mineralization, discontinuos tectonics is fundamental; these features should serve as the basis for judgments in matters of genesis, location and forecasting of industrial facilities.

The formation of gold mineralization in the subject area is a long process (but one stage!) and it is associated with various mineral-geochemical parageneses. In gold-rare-metal deposits located in near-intrusive space, gold is associated with the manifestation of rare-metal, bismuthine-telluride (main productive), gold-arsenic and silver-gold-sulfosalt stages of ore formation. In gold-silver objects

localized on remote parts of igneous bodies, gold mineralization is composed of a combination of gold-arsenopyrite (main productive), gold-polysulfide-telluride and silver-gold-sulfosalt associations.

These conclusions are quite justified and are consistent with the fundamental regularity of the evolution of ore-forming systems, according to which all endogenous gold deposits, regardless of age, geological and tectonic position, composition of the deep substrate and host rocks, are characterized by a standard set of several productive gold-bearing mineral associations, and the process ore deposition is controlled by the laws of thermodynamics - mainly by changing the temperature and acid-base of the solution.

The solution for these issues contributes to the development of the geological science in the Republic as a whole and particularly, is of great practical importance as a predictive and prospecting basis for geological exploration.

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