

ABSTRACT

Dissertation for the degree of Doctor of Philosophy,
Speciality: 6D070600 – «Geology and exploration of mineral deposits»

Omarova Gulnara Magauvianovna

«INVESTIGATION OF MINERALOGICAL CRITERIA OF GOLD-METASOMATIC TYPE DEPOSITS (BASED ON THE KOKKIYA DEPOSIT)»

The main study object is the Kokkiya gold deposit. The main gold-concentrating minerals are: pyrite, quartz, sericite. Native gold is an economic component. A number of ore minerals, which determine the geochemical specifics of ore formation at the deposit, are among the minor rare minerals. Among the rare minerals should be noted tellurides of gold (calaverite), bismuth (tsumoite), silver (petzite).

1. Relevance. The thesis –is concerned with the study of regularities in the distribution of ore components in deposits of the Kokkiya ore cluster, which is located on the northern slopes of the Kyrgyz Range and is prospective for the discovery of gold-bearing ores.

Within the Kokkiya deposit there were carried out research work to study the mineralogical and petrographic features of ore bodies in order to establish the zonal distribution of their mineral constituents, as well as the sequence of formation of minerals and the isolation of productive associations for the detection of gold.

Investigation of the metasomatic gold deposit Kokkiya was aimed at understanding the key genetic issues of ore formation. The relevance of these studies has increased due to the fact that almost all quartz-vein type deposits with high gold content have been almost worked out today, it is time to pay attention to large-volume deposits with small gold contents similar to the Kokkiya field.

2. The aim of the dissertation is to study mineral composition of the ores and to identify specific features of the formation of gold ore mineralization in the Kokkiya field in order to obtain additional knowledge on the genesis of the metasomatic gold deposit and the nature of the distribution of gold and other components in the ores.

It is also important to identify metasomatic zoning in the field, which contributes to the development of mineralogical criteria with the identification of gold-bearing metasomatites within the deposit, which are the main concentrators of gold mineralization.

3. Objectives of the study

1) Study of the geological structure of the host rocks and ore deposits;

2) the study of the rock and mineral composition of ore bodies, the identification of the main minerals - gold concentrators and the patterns of gold distribution in mineralized metasomatites, the forms of their occurrences by modern electron microscopic methods;

3) development of mineralogical criteria of mineralization with the allocation of gold-bearing metasomatites, which are reservoirs of gold mineralization;

4) studying the conditions for the formation of metasomatic mineral associations and the features of their distribution at the deposit and within individual ore bodies;

5) the definition of typomorphic features and properties of minerals, mineral associations and the direction of their changes in the process of metasomatic mineral formation, the definition of metasomatic zoning and variability of gold fineness with depth.

4. Resolving the above tasks as a result of the conducted research allowed the candidate to defend the following main protected positions:

First protected position. In the perspective for minerals area of the North Tien Shan fold system, various intrusions and their effusive analogues are developed, which are sources of mineralization, located in the suture zone. By their nature, magmatic formations are derivatives of the mantle plume embedded in the lithosphere at the beginning of the Caledonian tectonic magmatic activation of the continent of Kazahia. The formation of a peculiar geotectonics of the Kyrgyz-Terskey mineragenic zone and adjacent territories is associated with a superplume that operated during the Paleozoic period.

Second protected position. In the vertical metasomatic column of the ore field of the Kokkiya deposit, quartz-sericite metasomatites of different degree of pyritization containing gold mineralization, are of interest. Among them are microscopically isolated sericite-pyrite rocks (sericitolites) with elevated concentrations of gold, which can serve as a search criterion.

Third protected position. Findings of tellurides of gold, silver and bismuth minerals are reliable indicators of the prospectivity of gold mineralization with depth. The variability of the gold fineness is related to the depth of mineralization, as well as the processes of mineral formation from early associations to late ones. Following the increase of the content and fineness of gold with depth, it is possible to predict the level of the denudation cut of the ore bodies of the deposit with the average gold content, which plays certain role in estimating the degree of prospectivity of similar deposits.

5. Scientific novelty of the work:

1) gold-bearing types of metasomatites have been characterized within the Kokkiya deposit with identification of mineralogical zoning within metasomatites; 2) detailed mineralogical-petrographic description of metasomatites using microscopic and microprobe studies was performed; 3) the typomorphic features of minerals of the ore complex and the distribution of gold along the laterals and the depth of the deposit are studied; 4) mineral associations favorable for gold deposition

have been identified, the sequence of formation of minerals has been established, the attribution of the identified ores to a gold-metasomatic geological-industrial type has been justified.

6. Practical significance

The practical significance of the work consists in the possibility of using the obtained scientific results and mineralogical criteria for more effective justification of regional and local forecasts in the region for the gold mining industry as a whole or for a particular enterprise. Knowledge of distribution of economic components will contribute to the improvement of mineralogical and technological research.

Determination of mineral composition of ores at macro level and micro levels, include: identification of typomorphic features of minerals, establishing the sequence of formation of minerals and the character of zoning in their distribution; identification of physical-chemical conditions for the formation of minerals, and the establishment of indicator minerals, making it easier to solve the most important issues in determining the genesis of the formation of the deposit, and also in developing new prospecting criteria. In the proposed dissertation, the above-mentioned range of topics is investigated, which determines its practical significance.

7. Main results of the study

Analytical studies in research laboratories in Kazakhstan, Russia, Poland and Canada were carried out. The gold of the Kokkiya deposit was determined in metasomatites as a result of a microscopic study of polished sections and thin sections. The gold content was determined by the method of atomic adsorption carried out at the deposit, in the laboratory of LLP Golden Compass Zhambul.

With the help of X-ray spectral microanalysis on a Superprobe 733 JEOL Electroprobe Microanalyzer, Japan (performed by Levin and Kotelnikov, Institute of Geological Sciences, Almaty), a gold fineness was determined. The study of the internal structure of mineral aggregates and elemental composition was carried out in the scientific laboratory of Adam Mickiewicz University by a scanning electron microscope (SEM) and energy dispersive X-ray spectrometer (EDS) with a microanalyzer.

In the Warsaw Institute of Geological Sciences at the Electron Probes Micro Analyzer CAMECA SX 100 there were carried out further studies of polished sections and thin sections and a high-precision qualitative and quantitative chemical microanalysis carried out.

Also, by methods of scanning electron microscopy and X-ray fluorescence microanalysis, using the equipment of the "Center for Studies of Mineral raw materials and the state of the Environment" of the Southern Federal University semi-quantitative analysis was performed and the gold fineness was determined. Spectral analysis for 24 elements (30 samples) was performed in the Help Geo laboratory. Chemical analysis was performed (20 samples) in Canada, in the laboratory "AcmaLab".

During 2016-2017 the author successfully passed two foreign scientific internships at the Institute of Geological and Geographical Sciences Adam Mickiewicz University in Poznan (Poland). This professional training was of great importance to carry out analytical studies using state-of-the-art analytical equipment in the world-class laboratory.

8. Factual material and personal contribution of the author

In the Kokkiya deposit, gold was studied in samples selected personally by the author from the drillcore (220 samples) and the open pit (43 samples). 113 thin sections and 105 polished sections are described.

Great experience and invaluable research skills were obtained in the interdepartmental educational and research "Innovation Geological and Mineralogical Laboratory" of the university, where work was carried out from the preparation of samples to micromineralogical research.

During the last years the PhD student worked as an executor of the scientific and technical program: "Scientific support of geological study of subsurface resources and geological evaluation works for replenishment of mineral resources" (2015-2017) and now continues to work as an executive in the position of junior research fellow on the financed topic program BR05233713 on "Comprehensive geological study of subsurface resources for development of resource base and development of new sources of ore raw materials in Kazakhstan" (2018-2020).

The PhD student is also the executor of the contract with the LLP "KAZ Minerals Aktogay" project on "The influence of the near-fault tectonics within the Aktogay deposit on the change in the mineral composition of copper-porphyry mineralization."

The research materials were included in the production report on the calculation of the deposit's reserves (Loparev et al. SCR report, 2017).

In addition to the author's own materials, research results of the scientific leader A.B. Baybatsha were also utilized.

A number of the previous research works were also used, including: Sannikov A.G, Rafailovich M.S, Zhautikov T.M, Plotinskaya O.Yu., Sazonov V.N, Koroteev V.A and others, as well as groups of foreign authors whose publications are listed in the list of sources.

Approbation of work.

The main content of the work is set out in 12 co-authors and individually published articles. One article was published in News of the National Academy of Sciences of the Republic of Kazakhstan, which indexed in the Scopus database. Three articles in scientific journals of the Committee of the CCES of the Ministry of Education and Science of the Republic of Kazakhstan were published.

The main results of the research are approved as reports at international and national scientific and practical conferences: At the 16th International Multidisciplinary Scientific Geoconference SGEM 2016 (Albena, Bulgaria, June 30-July 6, 2016), at the 17th International Multidisciplinary Scientific Geoconference SGEM 2017 (Albena, Bulgaria, June 27-July 6, 2017), included in the Scopus database; at the II International Conference on Applied Mineralogy &

Advanced Materials & XIII International Conference on Applied Mineralogy. (Italy, 2017); at the International Scientific and Practical Conference dedicated to the 50th anniversary of the Department of TTDW (November 9-13, 2016) and at the annual Satpayev Readings that took place at the KazNITU named after K.I. Satpayev.

Structure and amount of work. The thesis consists of an introduction, four chapters, a conclusion, an appendix and a list of cited literature (98 titles). The total amount of work is 120 pages, including 80 figures and 5 tables.