ABSTRACT

dissertation of Shayiakhmet Tanirbergen Kerimbekuly on the topic "3D modeling of the Beskempir deposit for the assessment of mineral resources and engineering and geological conditions", submitted for the degree of Doctor of PhD in the specialty: 6D075500 – "Hydrogeology and engineering geology"

General characteristics of the work.

Administratively, the Beskempir gold deposit is located in the Southern region of Kazakhstan, 260 km northeast of Mount Zhambyl and 510 km northwest of Almaty, in the immediate vicinity of the village of Akbakai. The village is connected to the Almaty–Karaganda highway by an asphalt road 120 km long and is located at the same distance from the Kiyakhty railway station.

The deposit in question is located within the L tablet-43-98- B-b-3,4. The geographical coordinates of the center of the deposit are as follows: 45007'16" east longitude.

The main purpose of this scientific research is to develop a scientific method for solving engineering and geological problems based on 3D modeling using data obtained as a result of specially conducted engineering and geological studies of exploration wells and mining operations in the conditions of an underground method of field development.

Based on the results of the author's scientific research at the Beskempir deposit, to assess and predict possible risks associated with changes in engineering and geological conditions (hereinafter referred to as IGU), with geological negative phenomena that lead to a decrease in the stability of the massif when it is opened by underground mining. The created 3D block model of the IGU parameters is one of the most important tools for achieving safe mining, rational mining of reserves and protection of the geological environment.

Based on the results of the author's scientific research conducted at the Beskempir deposit, it was possible to assess and predict possible risks associated with changes in engineering and geological conditions (hereinafter referred to as IGU), as well as with geological negative phenomena that may lead to a decrease in the stability of the massif when it is opened by underground mining. The created 3D block model of the IGU parameters is one of the most important tools for ensuring safe mining, rational mining of reserves and protection of the geological environment.

Assessment of the current state of the scientific or scientific-technical problem being solved.

Engineering geology of MPI is one of the developing scientific fields of applied branches of engineering geology. The need for an engineering and geological study of various deposits of metallic, non-metallic and combustible minerals arose from the practical needs of the development and creation of mining facilities based on them.

With the development of mining science and practice, specialists of various profiles have faced the issues of assessing the conditions and forecasting changes in

the geological environment with a view to its rational use and protection during the development of deposits with increasingly difficult natural conditions. To solve the above tasks that arise during the development of mineral deposits, engineering geology turned out to have extensive experience in studying the patterns of geological processes and phenomena, as well as the conditions of construction and operation of various structures.

V.D. Lomtadze, P.N. Panyukov, I.P. Ivanov, G.G. Skvortsov, B.V. Smirnov, V.V. Fromm, A.B. Baybatsha and others were actively involved in the development of engineering geology of MPI.

The emergence of engineering geology of MPI as a separate applied field of science in independent Kazakhstan is associated with the name of akad. Kazakh National Academy of Natural Sciences (KazNAEN), Doctor of Geological and Mineralogical Sciences, Professor A.B. Baybatsha. In the period from 1971 to 2003, he conducted engineering and geological studies during the exploration and operation of various mining and field sites - in existing and under construction mines, mines, quarries and sections. The results of his research have been published in the form of a monograph "Engineering geology of mineral deposits with the basics of geoinformatics", which is an invaluable and the only work in the country on an integrated approach to studying the IGU of solid mineral deposits.

In recent years, almost all of the country's leading mining companies have completely switched to assessing the mineral resources of deposits with the basics of 3D modeling using the data obtained in the geological support of mining operations. Unfortunately, engineering geology (IGU assessment) is currently lagging significantly behind MPI geology (MP assessment). The reason for this disharmony is the incomplete solution of engineering and geological problems during exploration and in the process of preparatory and operational work, and sometimes complete disregard for engineering and geological research.

Noting the development of engineering geology at MPI as a scientific field and the fact that scientists, production and design organizations have already done a decent amount of work in this applied section of engineering geology, it must be said that many important and complex issues and methods for solving engineering and geological problems during exploration and during the operation of the deposit have not yet been sufficiently developed.

Thus, the principal methodological techniques and research methods were selected, the totality of which made it possible to implement a rational set of field, laboratory and desk work on a detailed study of the IGU. Based on the results of the above-mentioned studies and the purposeful processing of all the obtained geological information, the creation of a final database of engineering and geological parameters and 3D models of elements of geological and structural features was achieved, using which the IGU of the Beskempir deposit was assessed. Further, based on the IGU assessment, a forecast of changes in the stability of the massif and possible adverse geological phenomena in underground mining operations within the field was carried out.

Justification of the need for this research work.

Recently, the engineering geology of the MPI has faced a serious problem in creating clear methods and proposals, as well as recommendations for assessing the IGU and forecasting negative geological phenomena and processes. These studies are aimed at ensuring the rational use of the geological environment and its protection from the negative effects of mining enterprises. Although some results have already been achieved, there are many issues that require special study. Much more work needs to be done in this relevant area to develop effective methods and recommendations that will help minimize negative impacts and ensure sustainable development.

The above problem has not been solved due to the lack of powerful computer technology in Soviet and post-Soviet times. Without modern computer technologies, it is impossible to process a large amount of information and factual data. Solving engineering and geological problems using innovative computer technologies has huge advantages that were previously impossible. Therefore, the assessment of IGU MPI on the platform of innovative computer technologies is very relevant today.

Within the framework of the dissertation work, for the first time in Kazakhstan, an assessment of the IGU vein gold deposit was achieved in a digital environment using 3D modeling: the results of the study are processed in modern mining and geological information systems, a database of engineering and geological studies and various volumetric 3D models of the deposit are created, on the basis of which the anisotropy of engineering and geological parameters within the mountain range is determined. breeds. Further, the software provides a qualitative and quantitative assessment of the IGU of the deposit, forecasting the complexity of its development and negative geological processes and phenomena.

This approach is historic for the country, as the engineering geology of the MPI is moving to a new level both in the scientific direction and in practice. In this regard, the thesis is of great scientific and practical importance.

The relevance of the topic.

Today, mining operations are carried out in many mining enterprises without taking into account the complexity of mining deposits. The mine fields involve heavy, progressive and powerful modern mobile equipment such as self-propelled equipment, the introduction of which is carried out without justification by specially conducted engineering and geological studies. As a result of this approach, extensive roof outcrops and huge voids of the worked-out space are formed in the mining areas of ore bodies, massive destruction of the pillars, collapse of roof rocks and other phenomena occur, thereby creating dangerous conditions for mining operations. There are statistics that provide information that three quarters of fatal accidents in underground mines occur during roof collapses and the destruction of supporting pillars or transportation operations.

The thesis emphasizes that only an all-round study of the components of engineering and geological conditions and the use of the capabilities of mining and geological information systems through the creation of three-dimensional 3D models can provide quantitative and qualitative indicators for assessing the IGU of a deposit (determining the anisotropy of engineering and geological parameters

within the rock mass (MGP) in space). The obtained 3D models characterizing the IGU of the deposit make it possible to reliably and reliably predict the complexity of field development, geological processes and phenomena (arising and developing under the influence of mining operations), and the stability of the massif. Thus, 3D models will ensure the rational use of natural resources, increase the safety and efficiency of operation and environmental protection. At the current level, the assessment of IGU deposits with the basics of 3D modeling is very relevant.

The novelty of the theme.

The author of the dissertation, based on many years of work in underground mines and the accumulated experiences of domestic and foreign specialists in the field of engineering geology of solid mineral deposits, conducted special engineering and geological studies at the Beskempir deposit of the Akbakai ore field as part of the full theoretical course of the university's doctoral program. The results of scientific research are presented in this dissertation, the scientific novelty of which is as follows:

1. For the first time in Kazakhstan, the IGU MPI was evaluated based on 3D modeling of vein deposits, which was used to obtain qualitative and quantitative indicators of spatial heterogeneity, anisotropy and variability of IGUS:

1.1) the necessary composition and optimal scheme of the performed research of the IGU MPI in conducting mining operations in underground conditions are proposed;

1.2) for the first time, a database has been created based on the results of research on the components of the IGU and the necessary types of information have been identified for its creation.;

1.3) various 3D volumetric models have been created for the first time: structural, geological and block models of the deposit;

1.4) for the first time, an algorithm for selecting parameters in the software for evaluating the IGU MPI was developed;

2. For the first time in the country, a forecast of the occurrence and development of possible adverse geological phenomena was made based on the assessment of the IGU MPI using 3D volumetric modeling at the stage of construction and operation of mining facilities in underground conditions.

The purpose of the research: To develop a scientific and practical method for assessing the IGU MPI with the basics of 3D modeling in the development of deposits by underground method.

The object of research is the Beskempir gold deposit, which is being developed underground.

Research objectives:

1. Study of engineering and geological components and their development in the conditions of underground mining operations at the Beskempir deposit under development;

2. Analysis of the hydrogeological conditions of the studied deposit in the engineering and geological aspect to determine the influence of groundwater on the development of the deposit by underground method;

3. Assessment of engineering and geological conditions and mineral resources of the Beskempir gold deposit;

4. Forecast of the stability of the rock mass and the likelihood of negative geological processes and phenomena in the mine workings.

The main protected scientific positions:

1. Studies have been conducted on the following key components of the engineering and geological conditions of the deposit, such as terrain, geological structure, physical and mechanical properties of the rock mass, their fracturing, and others. All the data obtained during the work has been digitized and used to form a database of engineering and geological data designed to visualize the components of the IGU MPI in three-dimensional space.

2. The influence of groundwater has been established as one of the factors causing changes in the properties of rocks, as well as initiating the development of geological processes and phenomena that complicate the construction of underground mining, field operation and engineering work.

3. Various 3D volumetric models have been created: structural, geological and block models of the deposit. Based on them, an assessment of the engineering and geological conditions of the Beskempir deposit and mineral resources was carried out, taking into account the engineering and geological difficulties.

4. The zoning of the rock mass according to the categories of stability was carried out, and the forecast of the occurrence of negative geological processes and phenomena in the mine workings was carried out.

The practical significance of the dissertation lies in its scientific and applied value. In general, the work performed is aimed at optimizing the stages of engineering and geological research at the stage of exploration and operation of the deposit, increasing the efficiency and reliability of the assessment of the IGU MPI, forecasting changes in IGU, possible adverse geological phenomena and the stability of the massif. The validity and reliability of the scientific and practical method of assessing the IGU with the basics of 3D modeling are confirmed by the results obtained during the excavation of preparatory underground mining and cleaning operations in the Beskempir deposit mine.

The results of the scientific research of the author of the dissertation have been introduced into production at an existing production facility and are successfully operating at the Beskempir deposit, they serve to prevent possible risks associated with changes in the IGU MPI, geological negative phenomena that lead to a decrease in the stability of the massif when it is opened by underground mining. The created 3D block model of the IGU MPI parameters is one of the most important tools of the mine for achieving safe mining, rational development of reserves and protection of the geological environment (Information on the implementation of the author's development is provided in Appendix 1).

Publications and approbation of the work. The results of scientific research have been tested in the form of 12 published scientific articles, including 2 works in publications included in the Scopus database, and 3 articles in scientific publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of

Kazakhstan, reported and discussed in the form of reports at international conferences., republican and university scientific conferences: in Uzbekistan – materials of the international scientific conference dedicated to the 100th anniversary of the birth of the Academy of Sciences. Academy of Sciences of the Republic of Uzbekistan Ibragim Khamrabayevich Khamrabayev (2021); in the proceedings of the Satpayev readings: 2019-2021.

The structure and scope of the dissertation. The dissertation is presented in 138 languages and includes an introduction, four chapters, a conclusion and a list of sources used, consisting of 121 titles. It contains 76 visual drawings and 31 tables.