

Abstract

of dissertation for the degree of Doctor of Philosophy (PhD)
Specialty 6D070700 – Mining engineering

Zeytinova Sholpan Bekzhigitovna

Scientific and methodological basis of mineshaft location in combined ore mining

Relevance of the study. The development of the ore mining industry in the Republic of Kazakhstan in recent years has been accompanied by the implementation of new underground horizons for many producing mineral deposits, the exploitation of which initially began by open-pit mining. With an increase in the depth of opencast mining, the volume of overburden increases sharply and opencast mining becomes unprofitable, since further mining requires a significant amount of capital mining and preparatory work. For this reason, a number of large ore deposits on the territory of the republic (Nurkazgan, Kentobe, Sayak, Akzhal, Ushkatyn-3, etc.) began to switch from open-pit mining to underground mining, that is to the open-underground combined method (combined development).

In the transition from open-cut method underground at the first stage a problem solving task that involves opening the underground part of the Deposit is primarily the type of opening, such as the main access roadways and secure its location. Combined mining is a relatively new area in mining, and contains some aspects that require special research in terms of little-studied. The problem of choosing the right safe location for opening workings in the conditions of combined development, in particular vertical shafts, with the calculation of their stability from the perspective of sophisticated geomechanics is just this little-studied area. The solution of this problem affects the efficiency of opening and preparing the underground part of the field and, in General, the entire process of complete mining of the field.

With an increase in the depth of mining, the solution of geomechanical problems that affect the problem of choosing the location of mine shafts and calculating their stability in the conditions of combined development and the uncertain geomechanical state of the massif that occurs under the influence of both underground and open-pit mining becomes an important scientific and technical task that affects the further development of the process of complete mining of the entire field. Existing methods for determining the factors influencing the choice and justification of the location and calculating the stability of vertical workings are unlikely to provide a reliable result due to the fact that they link the workings to the conditions of a purely underground excavation in a previously unaffected array.

In general, when designing an ore mine (mine), the correct choice of the location of the shaft is due to the fact that, firstly, the total length of transport and

ventilation workings, and, consequently, the costs of their implementation and maintenance, and secondly, the total path underground freight traffic and ventilation, therefore, the cost of transporting goods, airing mine workings, loss of minerals (causes of loss). While developing deposits in a combined way, the near-contour part of the massif is exposed to multiple loads of simultaneous open-cut and underground works. This method of development leads to a complication of the state of the massif under the influence of various factors that are constantly evolving in space and time.

In this regard, the problem of choosing the location of mine shafts and assessing the geomechanical state of the rock mass near mine in the combined (underground-open) method of mining ore bodies is an important and urgent problem for both researchers and industrial workers.

The aim of the work is to substantiate a safe location for a mineshaft based on studying the regularities of the influence of the near-mine rock mass in the combined development of an ore deposit.

The idea of the work is to choose a safe place for laying a mine shaft in the conditions of combined development of an ore Deposit based on the study of the stress-strain state of the massif in its vicinity, taking into account a new factor of technogenic impact – open pit space.

Research objectives:

- review and analysis of the current state of the issue of opening fields with vertical shafts in world practice in the context of the transition from open pit development to underground;
- systematization and development of a new refined classification of methods for opening under-pit reserves during combined development;
- identification the features of engineering and geomechanical tasks in the combined development of deposits opened by vertical shafts;
- research and experimental studies to determine the values of equidistance vertical shafts from the top edge of pit wall;
- numerical modeling of the stress-strain state of the rock mass in the zones of the location of vertical shafts, taking into account the parameters of the open pit, the depth of development, physical and mechanical properties of rocks, etc.;
- development of a generalized methodology for selecting the location of vertical shafts in combined development of deposits.

Research methods. To solve the problems posed in the dissertation, a comprehensive research method was applied, including an analysis and review of the state of the art of opening deposits with vertical shafts in the transition from open-pit mining to underground, scientific and experimental research in production conditions, numerical modeling of the stress-strain state of the rock mass, analysis of modeling results using computer programs.

Scientific provisions submitted for defense:

1. The area is safe location of the vertical mine shaft with a combined development with the influence of new factor of man's impact – open-pit space is

determined on the basis of an assessment of pit slope stability and the processes of displacement of rocks in the contact zone of the pit

2. Mathematical modeling of the stress-strain state of the near-pit rock mass in the area of vertical shafts allows one to assess the nature of stresses from the design parameters of the pit, the depth of development, the physical and mechanical properties of rocks and the shape of the pit.

Scientific novelty of work:

– classification of underground opening methods in combined field development;

– mathematical model of the stress-strain state of the rock mass near vertical workings for conditions of combined field development using the finite element method;

– the established dependences of the change in stress values around the vertical shaft on the depth of the location of the points under study, the depth of the open pit, the distance from the upper edge of the open pit to the shaft;

– generalized method for choosing a rational location for vertical shaft shafts in combined development of deposits.

Significance of the study:

1. Development of methodological provisions and requirements for the choice of the location of vertical shafts in the combined development of deposits;

2. Classification of underground opening methods for combined methods of field development, which allows systematizing scientific and methodological principles and criteria for determining the area of a safe location for vertical shafts in open-underground mining.

3. Methodological provisions for choosing a safe distance (location) of a vertical shaft from the upper edge of a pit, based on an assessment of the stability of the pit walls and the processes of rock displacement in the near-contact zone of the pit.

4. Mathematical model of the stress-strain state of the rock mass near vertical workings during combined field development using the finite element method.

5. A generalized method for choosing a rational location for a vertical shaft under conditions of combined field development.

The reliability and validity of the scientific provisions, results and conclusions are confirmed by the complex of research works carried out in the conditions of the Zhairam Mining and Processing Plant; the results of numerical modeling of the stress-strain state of the rock mass near vertical workings during the combined development of deposits, the indicators of the physical and mechanical properties of rocks in which are similar to the conditions of the Akzhal deposit.

Testing publication and work. The main provisions of the work were reported and received approval at scientific seminars of the Department of Development of Mineral Deposits, NJSC Karaganda Technical University; at the International scientific and practical conferences "Integration of science, education and production - the basis for the implementation of the Plan of the nation"

(Karaganda: KSTU, 2015-2018, 2020); Materials of the XII international scientific and practical conference. Scientific horizons (2016). Certain provisions of the dissertation were carried out within the framework of research state budget topics: No. AP05135203 "Development of intelligent information systems for calculating technological parameters of mining processes" (grant funding for scientific research of the Ministry of Education and Science of the Republic of Kazakhstan for 2018-2010).

The results of scientific research have been introduced into the educational process in the core disciplines of the specialty "Mining engineering" and in the generalized method for choosing a rational location for laying a vertical shaft in combined development of deposits, agreed by the General Director of Nova-Zinc LLP and approved by the Executive Director of NJSC "KarTU".

The main provisions and results of the research performed are set out in 13 printed works, including 4 published in editions recommended by the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 2 are published in an international edition included in the Scopus database.

The structure and volume of the thesis. The dissertation work consists of an introduction, 4 sections and conclusions set out on 133 pages of printed text, contains 93 figures, 9 tables, a list of references from 89 titles and 6 appendices on 32 pages.

The author expresses his gratitude to the domestic scientific consultant, Doctor of Technical Sciences, prof. Isabek T.K. and foreign scientific consultant, Doctor of Technical Sciences, prof. Karsten Drebenstedt, as well as the teaching staff of the Department of Development of Mineral Deposits for their support and assistance in the implementation of scientific work.