

**AP14972873 “Development of economical technologies for the development of ore deposits in order to increase the completeness of mineral extraction”
– p.m. Balpanova M. Zh.**

Relevance

At present, the issues and tasks of rational use of all available mining, geological and technological resources for maintaining the proper level of efficiency of underground mines are becoming increasingly relevant, while one of the most important reserves for increasing the efficiency of mine development should be considered the most complete extraction of reserves due to the subsequent excavation of supporting pillars.

A common system for developing horizontal and inclined ore deposits is the room-and-pillar mining system with subsequent extraction of pillars (recycling). The system is highly productive, but has significant drawbacks: ore losses in the panel as a whole reach 20...40%, which increase under conditions of increased rock pressure, due to premature collapse of the roof and pillars. The main structural elements in the room-and-pillar mining system are the ceiling (roof of the chamber) and the pillar.

Despite the large volume of theoretical and experimental studies on the assessment of the stress state of structural elements of the development system, there is still no final scientifically based approach to the effective design of process parameters for mining ore deposits. The generally accepted method for calculating the parameters of the development system is to calculate the parameters of pillars and spans of stopes depending on the depth of development and based on empirical dependencies obtained at specific deposits, which is not always applicable to other similar deposits. Even taking into account the fact that mining and geological conditions at one deposit can change to the same extent, and the use of rock sliding parameters from one section of the deposit to another section can lead to an increase or decrease in the magnitude of the load acting on the pillars. This, accordingly, leads to an increase or decrease in the size of the pillars, loss of minerals, imbalance of the geomechanical structure «pillar – roof» and its collapse.

Therefore, the problem of increasing the efficiency of ore deposit development, taking into account the stress-strain state of the massif to ensure the complete extraction of minerals, is an important task from a practical and scientific point of view, the solution of which allows reducing the costs per unit of extracted mineral.

Based on the conducted analysis and review of the state of the issue, the goal of the scientific and applied work was formulated - the creation of new technologies for the development of ore deposits, ensuring the complete extraction of minerals, by establishing the order and direction of the development of pillars in the panel, based on determining the load on the pillars, by constructing sliding curves for each lithological type of rocks that make up the overlying strata.

Therefore, the relevance of the problem of developing process flow charts for optimizing the parameters of deposit development, taking into account the geomechanical state of the rock mass during the development of stratified (layered) ore bodies, is always an important task in the mining industry.

The aim of the project is to create new technologies for the development of deposits that ensure the complete extraction of minerals by determining the order and direction of mineral extraction on panels based on determining the load on deposits by creating sliding surface curves for each lithological type of rocks.

Results achieved:

New resource-saving technologies for the development of ore bodies have been developed and tested, ensuring the complete extraction of minerals from the subsoil. The efficiency of the proposed technological scheme has been confirmed by technical and economic calculations.

A development system has been substantiated that ensures complete extraction of minerals.

Scientific research has been brought to practical implementation. The results obtained are used at the Zhomart mine of the «Zhezkazgantsvetmet» production association of Kazakhmys Corporation LLP.

In addition, within the framework of the grant project:

- Balpanova M.Zh. completed her dissertation on the topic «Geomechanical support for the development of reservoir deposits using an open space cleaning system».
- The research results were used in the development of the project «Experimental industrial development of ore reserves of panels 21 and 22 using a room-and-pillar system with massive remaining pillars» (PZ 20-22/03-PZ). This is confirmed by acts and certificates of implementation (Appendix 1).

Main publications and patents:

1. Balpanova M.Zh., Kuttybayev A.E., Takhanov D.K., Zhienbayev A.B. Conditions of the overlaying stratum collapse with outcrop during re-mining the Zhaman-aybat deposit // Kazakhstan Mining Journal. – 2024. – No.8. – P. 34–41. DOI: <https://doi.org/10.48498/minmag.2024.232.8.005>.
2. Rabatuly M., Balpanova M. Improvement of methods for predictive calculation of earth surface subsidence during development of horizontal ore deposits. Certificate No. 50765 dated 11/24/2024.
3. Balpanova M.Zh., Kainazarova A.S. Geomechanical support for the development of reservoir deposits // Monograph. EETI, Ekibastuz, 2024. - 116 p. ISBN 978-601-7609-84-9.
4. Balpanova M.Zh., Takhanov D.K., Zhienbayev A.B., Ivadilina D.T. Monitoring Earth Surface Displacement during Pillar Re-Mining: A Case Study of the Zhomart Mine // Heliyon. – 2025.

Technical and economic indicators:

Based on the data for the projected sections (panels 21 and 22) of the Zhomart mine, the following results were achieved:

- productivity: the actual productivity of panels 21 and 22 for the period from 2021 to August 2022 was 248 thousand tons, equivalent to 260 thousand tons per year.
- ore loss: 2%.
- depletion: 7.8%.

Optimal parameters of the room and pillar mining system have been developed and tested:

1. For a mined-out space height of 6 m:
 - chamber width: 28 m;
 - equivalent distance between cameras: 56 m.
2. For a mined-out space height of 12 m:
 - chamber width: 35 m;
 - equivalent distance between cameras: 49 m.

During numerical modeling of all stages of repeated pillar extraction, the pillar strength coefficient remained no lower than 1.0, which confirms the reliability of the development system parameters and positive test results.

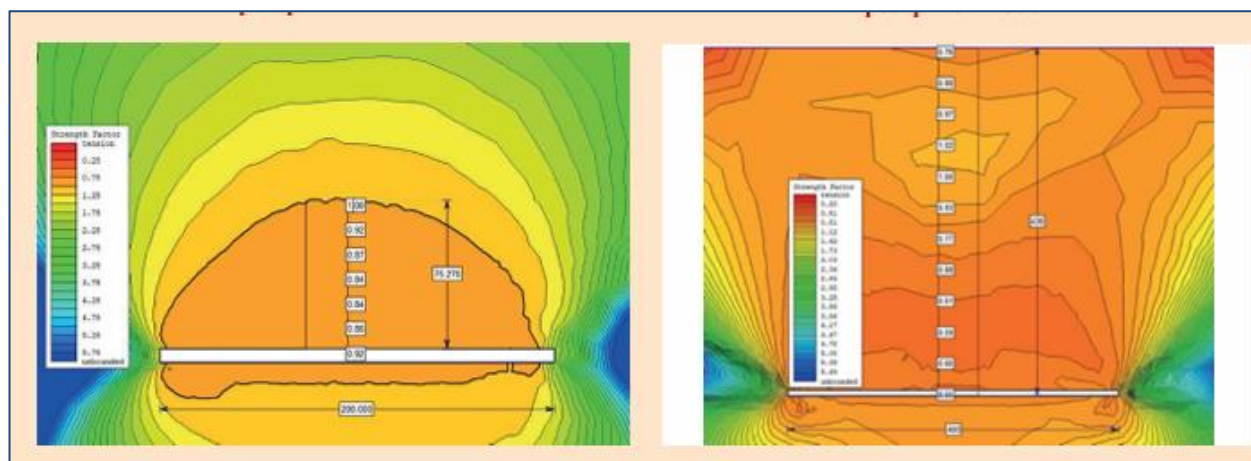


Figure 1– Collapse arch with a width of the mined space of 200 m and 400 m

Research group

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2. Kozhogulov Kamshybek Chonmurunovich - scientific consultant, PhD, professor, director of the Institute of geomechanics and subsoil development of the national academy of sciences of the Kyrgyz Republic

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<https://www.scopus.com/authid/detail.uri?authorId=57193738833>

Publication list:

1. M. Balpanova, A. Zhiembayev, Zh. Assanova, M. Zharaspayev, R. Nurkassyn, B. Zhakupov Analysis of the roof span stability in terms of room-and-pillar system of ore deposit mining // Mining of Mineral deposits, 2023, Volume 17 (2023), Issue 1, p. 129-137, Scopus 71%.

<https://doi.org/10.33271/mining17.01.129>

2. Balpanova M. Zh., Takhanov D. K., Zhiembayev A., Zhunusbekova G. Geomechanical support of the lowland mine excavation system at Zhaman - Aybat deposit // Mining Journal of Kazakhstan, Almaty: Publishing house of Scientific and Production Enterprise Interrin LLP, 2023, No. 2, pp. 37-42, CQASHE

2. «Method for erecting an artificial pillar» Patent for utility model of the Republic of Kazakhstan No. 8447 dated 06.20.2023, Balpanova Meroy Zhumagaliyevna, Takhanov Daulet Kuvatovich, Balabayev Oyum Temirgaliyevich, Patent of the Republic of Kazakhstan.

3. Resource-saving technology for the development of ore deposits ensuring the complete extraction of minerals. Takhanov D.K., Balpanova M.Zh. Certificate No. 30113 dated 11/08/2022

4. Theoretical foundations for the development of methods of forward calculation of ground subsidence above mines Takhanov D.K., Balpanova M.Zh. Certificate No. 31487 dated 12/29/2022

5. Balpanova M.Zh., Kuttybayev A.E., Takhanov D.K., Zhienbayev A.B. Conditions of the overlaying stratum collapse with outcrop during remining the Zhaman-aybat deposit // Kazakhstan Mining Journal. – 2024. – No.8. – P. 34–41. DOI: <https://doi.org/10.48498/minmag.2024.232.8.005>.

6. Rabatuly M., Balpanova M. Improvement of methods for predictive calculation of earth surface subsidence during development of horizontal ore deposits. Certificate No. 50765 dated 11/24/2024.

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8. Balpanova M.Zh., Takhanov D.K., Zhienbayev A.B., Ivadilina D.T. Monitoring Earth Surface Displacement during Pillar Re-Mining: A Case Study of the Zhomart Mine // Heliyon. – 2025.

Information for potential users

The results of the project implementation make it possible to increase the level of industrial safety at mining enterprises developing flat and inclined deposits, and to create the prerequisites for an economical technology for developing ore deposits in order to increase the completeness of mineral extraction.

Also, as a result of the project implementation, based on the results of a set of studies (theoretical and in-kind), including an assessment of the stability and destruction of the massif around the support pits and mined-out spaces, a new technological scheme for the development of ore bodies will be developed, which will ensure the stability of quarries at the reconstruction stages.

Application area –mining industry.

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