

AP19174774 “Investigation of the impact of underground mining on surface social facilities” - p.m. N. Huangan

Relevance:

The mining of ore by a chamber-column system is one of the most effective ones. The significant disadvantages of the technology used are the loss of ore in the pillars left to maintain the developed space (voids), the accumulation of the volume of voids and their collapse after the destruction of the pillars due to the long service life (decades). Sudden collapses of developed spaces over large areas are accompanied by man-made earthquakes.

In 1996, after a number of major collapses accompanied by earthquakes, a new Concept for the further effective and safe development of the Zhezkazgan field in the prevailing mining and geomechanical conditions was developed and coordinated with the Committee of the GGTR RK and approved by the Minister of Industry and Trade of the Republic of Kazakhstan. Three fundamental provisions were fixed in it, according to which the commercial operation of the field will be completed: 1) finalization of the remaining balance reserves with a chamber-column system, for which, in the conditions of Zhezkazgan, there is no acceptable alternative for mining ordinary and lower value ore; 2) simultaneously with the primary development of the remaining balance reserves, re-develop previously abandoned targets with the return of ore from losses; 3) during re-development, to carry out depreciation of accumulated voids with a controlled self-destruction of the overlying strata.

The main objective of the project is to assess the seismic risk in the area of Zhezkazgan settlement as a result of the impact of mining operations.

The effect of underground mining operations during the mining of ore bodies and/or abandoned inter-chamber pillars on the deformation of the Earth's surface with buildings is investigated by numerical modeling of the stress-strain state of the array using finite element methods using COMSOL and MATLAB application software packages developed specifically for engineering and scientific research, including in the field of geomechanics.

To assess the impact of underground mining on the stability of protected objects, the absolute (mm) and relative (mm/m) subsidence of the surface of the slide is used.

Calculations of the displacement of the mountain range and numerical modeling of the geomechanical state of the mined areas of the daytime surface along profile lines will give the values of vertical subsidence. This is a conclusion about possible serious deformations of surface objects falling into the displacement zone, and, accordingly, about the need to relocate residents of the settlements of Zhezkazgan and Krestovsky to a safe place.

The project purpose:

The purpose of the project is to carry out calculations of geomechanical parameters of the displacement of the mountain range and numerical modeling of the geomechanical state of the mined areas of the daytime surface along three profile lines showing the values of absolute vertical subsidence of the daytime surface. This allows us to conclude about possible serious deformations of surface objects falling into the displacement zone.

Expected and achieved results:

Achieved results:

The dependence of the energy class of man-made earthquakes on the area of destruction was obtained according to the data “Forecast of collapses at the Zhezkazgan copper deposit. Mining Information and Analytical Bulletin, 1, 95-105. German V.I., Mansurov V.A. (2010).”

The graph illustrates the relationship between the energy class and the size of the destruction zone, allowing you to visualize how changes in the destruction area are associated with different levels of energy activity of man-made earthquakes (Figure 1).

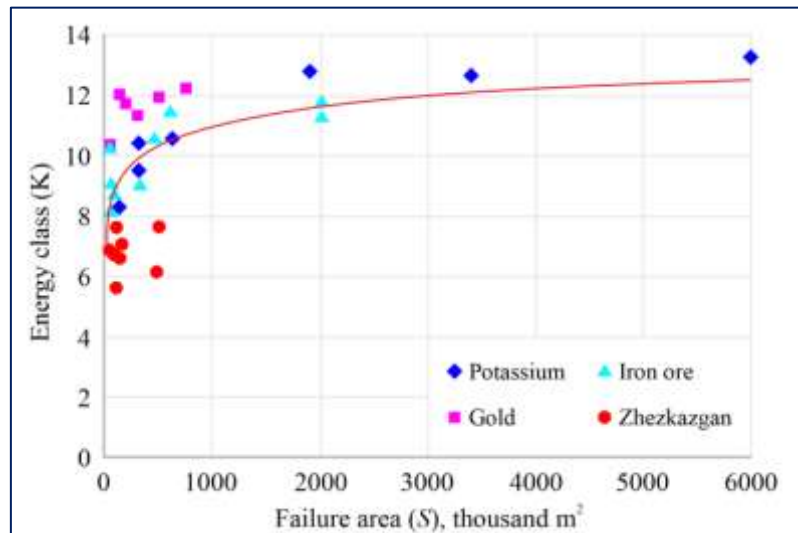


Figure 1 – Relationship between the energy class of man-made earthquakes and the destruction zone (according to Herman V.I., Mansurov V.A.)

Figure 2 also shows a graph of the dependence of the energy classes of man-made fields on the area of rock destruction. The graph is based on two data sets: measured data (1) and calculated data (2).

The graph shows that both sets of data show a similar relationship. The energy class increases as the area of rock destruction increases. It can be concluded that the zone of rock destruction is one of the main factors affecting the energy class of a technogenic deposit. The larger the area of rock destruction, the higher the energy class of the deposit.

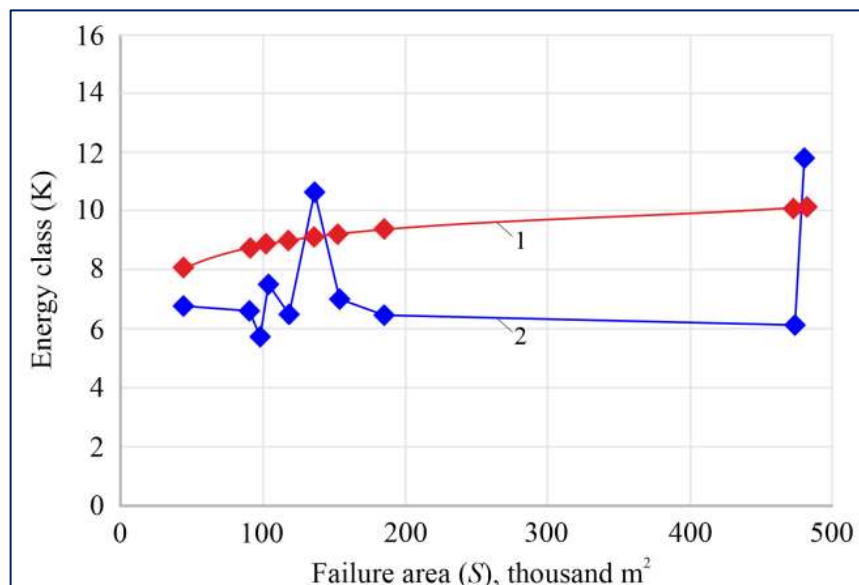
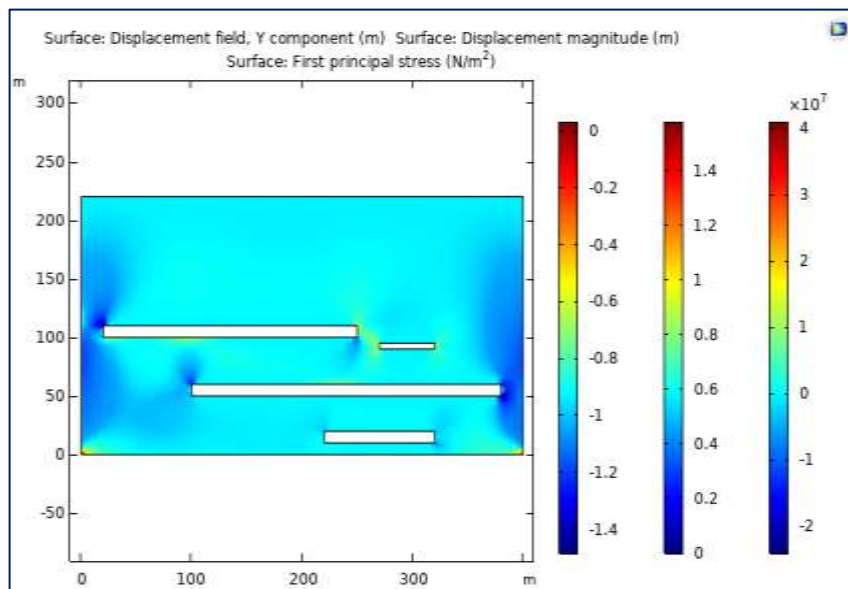
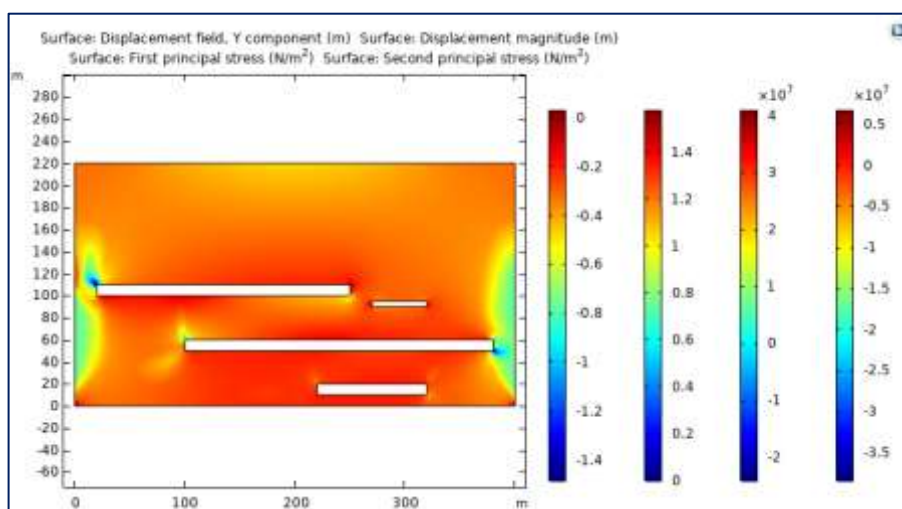


Figure 2. Indicators of energy classes of technogenic fields depending on the area of rock destruction:
1 – measurement data; 2 – calculated data

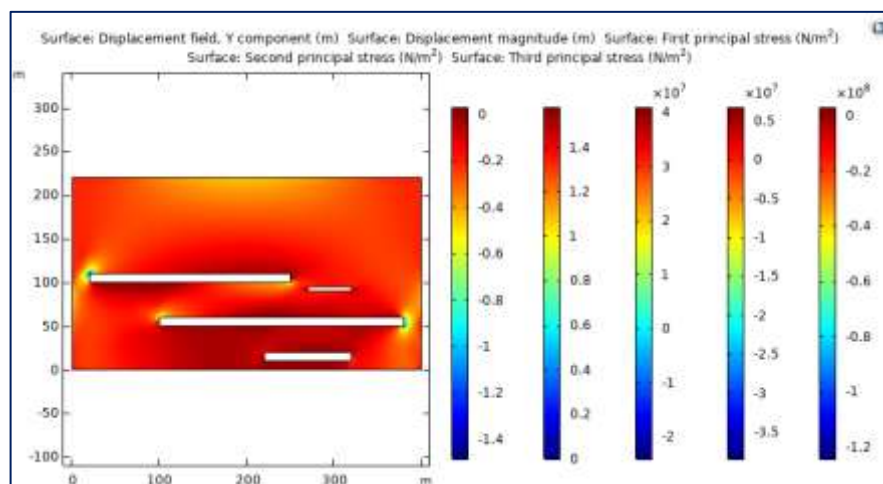
Analyzing the graphical fields of the main normal stresses in Figure 3, it can be concluded that the main normal stresses decrease with distance from the face, since the face affects the redistribution of stresses in the rock mass.



A)



B)



B)

**Figure 3 – Graphic fields of the main normal voltages:
(A- σ_1 , B- σ_2 , B- σ_3)**

As a result of the project, there will be developed a methodology for assessing the impact of mining operations on the condition of surface protected areas. The technique is implemented using PC applications and includes the procedure for modeling geomechanical processes, assessment of the stress-strain state of the rock mass, calculations of displacements and subsidence of the surface within the displacement zone.

The methodology will allow the technical services of mining organizations to optimize the procedure for conducting mining operations in terms of their planning, taking into account the time factor.

1. At least 2 (two) articles will be published in journals from the first three quartiles by impact factor in the Web of Science database or having a CiteScore percentile in the Scopus database of at least 50.

2. At least 2 articles and (or) reviews will be published in peer-reviewed foreign and (or) domestic publications recommended by CQAFSE.

3. It is planned to receive 2 certificates on entering information into the state register of rights to objects protected by copyright.

Research Group:

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List of publications:

1 article in the journal included in the CQAFSE database (Huangan Nurbol, Assainov Sergey Tursunovich, Shakhatova Aliya Talgatovna “Geomechanical assessment of the impact of excavation site processing on the location of underground geomechanical structures”. University Proceedings No.3 (92) 2023, Section “Geotechnologies. Life safety”, pp. 213-219 DOI 10.52209/1609-1825_2023_3_213,).

2. 1 article in the journal included in the scopus database, Mining of Mineral Deposits, percentile is 78, Q1 (B. Tolovkhan, A. Smagulova, N. Khuangan, S. Assainov, S. Issagulov, D. Kaumetova, B. Khussan, M. Sandibekov. «Studying rock mass jointing to provide bench stability while Northern Katpar deposit developing in Kazakhstan» Mining of Mineral Deposits. ISSN 2415-3443 (Online) | ISSN 2415-3435 (Print) Volume 17 (2023), Issue 2, 99-111. <https://doi.org/10.33271/mining17.02.099>)

3. A certificate of state registration of intellectual property rights was received (Certificates of entry of information into the state register of rights to copyrighted objects No. 39404 dated October 4, 2023 (author Huangan Nurbol, Assainov Sergey Tursunovich).

4. A certificate of state registration of intellectual property rights was received (Forecasting the impact of mining operations on the processing of reserves on the state of geomechanical structures and surface objects - No. 42698 dated February 7, 2024 (author is Huangan Nurbol)).

Information for potential users:

An analytical report has been compiled based on the results of geotechnological studies on the study of physical and mechanical properties and structural features of the rock mass. A brief geological description of the Zhezkazgan deposit.

A database of physical and mechanical properties of ore bodies and host rocks has been compiled. The influence of mining and geological and mining engineering conditions of the deposit on the parameters of underground mining operations during the mining of ore bodies.

The obtained research results allow us to draw reasonable conclusions about the possibility or impossibility of conducting underground mining operations in specific areas of the field.

Scope:

Mining enterprises engaged in the development of minerals using underground methods.

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