

**AP22787307. Development of technology for supporting mine workings on deep horizons based on the study of the geomechanical condition of rockmass. sc.sp. – Imashev A.Zh.**

***Relevance***

Development of the mining industry in the Republic of Kazakhstan is accompanied by the commissioning of new levels for the extraction of minerals, which requires a significant amount of mining and capital and preparatory work. With increasing the depth of mining operations over 700 m, the solution of geomechanical problems and issues of controlling the state of the massif becomes increasingly complex; manifestation of the intensity of deformation processes during the driving and supporting of mine workings begins, and the number of cases of collapse of the roof and sides of the workings also increases. The change in the stress-strain state of the rock massif around the workings at deep levels occurs due to the action of high stresses on the contour of the working.

Driving workings at great depths is always accompanied by redistribution of the original stress field, while a secondary stress field is formed. One of the main shortcomings in substantiating the stability parameters of rock outcrops in the marginal part of the massif is insufficient studying of geomechanical processes. The reason for this is that the models used to describe geomechanical processes that occur near the massif of anthropogenic outcrops do not quite correctly reflect the sizes of inelastic deformation zones. Despite the large volume of theoretical and experimental studies of the assessment of the stress-strain state of the rock massif around mine workings, there is still no final scientifically based approach to reliably determine the zones of inelastic deformations, especially at deep horizons. Ensuring the safety of mining operations is achieved by correctly substantiating the geomechanical state of the massif and calculating the load on the support of mine workings. When conducting studies, it is necessary to apply the experience of foreign countries, where the problems of rock stability are solved using the results of studies that have been practically tested in deposits, based on rating classifications of rock quality.

Based on the analysis and review of the state of the art, the ***objective of the applied research work*** was formulated: to determine the parameters of the inelastic deformation zone around a working at deep horizons, taking into account the fracturing of rocks depending on the depth of the working and the cross-sectional shape of the working, the physical and mechanical properties and elastic modulus of rocks to select the types and parameters of support in accordance with the rating classifications of the massif. Assessment of the power of inelastic deformation zones during the driving and supporting of mine workings in the mines of Kazakhstan, especially at depths of mining operations above 700 m, which is necessary for assessing the stability of the rock massif containing the working, planning mining operations, selecting the parameters of the support and support systems for workings, is currently not carried out or is methodologically unreliable. Therefore, the forecast of the parameters of inelastic deformation zones during the driving of development mine workings at deep horizons is an urgent scientific and practical research task.

***Expected and achieved results***

The analysis of world experience in conducting mining operations at great depths was performed, namely, the main mining, geological and mining engineering problems affecting the stability of the rock massif around the workings at deep levels were identified.

Laboratory studies were conducted in the Rock Mechanics Laboratory of Nazarbayev University to determine the ultimate strength of rock samples for uniaxial compression and tension. Rock samples were tested using an electrohydraulic testing system for uniaxial testing of rocky soils UCT-1000 (Figure 1a). Placing a sample under a press to determine its strength under uniaxial compression is shown in Figure 1b. The load was increased until the sample failed, with its maximum value recorded. Rock strength passports were constructed using the Mohr-Coulomb and Hoek-Brown criteria.

Mine studies were conducted to study the fracturing of the rock massif and the effect of fracturing on the formation of inelastic deformation zones. The degrees of the development depth impact on fracturing, the stress-strain state of the rock massif and stress changes, as well as zones of their concentration in the rock massif around the workings were also determined. Studies were conducted to determine the effect of the cross-section shape on the formation of zones of inelastic deformations of rocks at deep levels. There was studied the fracturing zone of rocks in the marginal part of the workings, as a result it was established that the size of the conditional fracturing zones of rocks is 1-1.3 m.



**Figure 1 – Destroyed rock samples**

***List of publications in 2024***

1. A.Zh. Imashev, A.A. Mussin, G.B. Yeskenova, G.Zh. Zhunusbekova. Studying possible zones of inelastic deformations of rocks at deep horizons // Mining Journal of Kazakhstan, 2024. No. 8 (232). - P. 42-47. <https://doi.org/10.48498/minmag.2024.232.8.004>

2. Certificate of the information entry into the state register of rights to objects protected by copyright No. 49516 dated September 9, 2024 was received. Imashev A.Zh., Mussin A.A., Yeskenova G.B., Zhunusbekova G.Zh. Studying possible zones of inelastic deformations of rocks at deep horizons.

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### ***Information for potential consumers***

The objects of the study are domestic mining enterprises, where mineral extraction is carried out at deep horizons. Currently, the mining depth at the Orlovsky and Artemevsky mines is 800 m or more. There are also a number of underground mines: Voskhod of the Voskhod-Oriel LLC, Ushkatyn-3 of the Manganets Zhairrema JSC, Zapadny Karazhal of the Orken LLC that plan to carry out mining operations at deep levels.

### ***Scope***

Mining enterprises carrying out mining operations at deep levels.

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