AMERICAN JOURNAL OF EDUCATION AND LEARNING
ISSN: 2996-5128 (online) | ResearchBib (IF) = 10.91 IMPACT FACTOR
Volume-4| Issue-6| 2026 Published: |30-06-2026|

# ENSURING THE STABILITY OF UNDERGROUND MINE WORKINGS IN ORE DEPOSITS

https://doi.org/10.5281/zenodo.20705940

**A.D. Melikulov**
*Deputy General Director for Research and Innovation, LLC "75-Special Administration"*
**G.X. Bakirov**
*PhD, Associate Professor of the Department of Mining Engineering, Almalyk State Technical Institute*
**D.X. Zuxritdinov**
*Tashkent State Technical University named after Islam Karimov, Tashkent, Uzbekistan*

## Abstract

This article addresses the problem of ensuring safe mining operations in gold-bearing ore deposits of the Angren mining administration under conditions of high stress and geodynamic instability of the rock mass. A technology based on the use of destressing boreholes is proposed and scientifically substantiated as an effective method for controlling geostatic and technogenic stresses. It has been established that the application of destressing boreholes leads to stress redistribution within the rock mass, reduction of accumulated elastic energy, and formation of relaxation zones. The results of numerical modeling and field-scale experiments demonstrate a significant decrease in maximum stress values and an increase in geodynamic stability. Furthermore, optimal parameters of boreholes (diameter, length, spacing) and their integration into the mining process are scientifically justified, enabling a reduction in rockburst hazards and an improvement in industrial safety. The obtained results are important for the active control of the stress-strain state of the rock mass and for ensuring safe and efficient mining operations.

## Keywords

underground mine workings, ore deposits, stability, geomechanics, support systems, monitoring, rockburst, elastic energy, destressing boreholes, safe mining operations, geodynamic instability, controlling geostatic and technogenic stresses

## Introduction

The development of underground ore deposits causes redistribution of stresses in the surrounding rock mass. As mining depth increases, the risk of deformation, support failure and collapse also increases. Therefore, maintaining excavation stability is one of the key tasks of underground mining engineering.

According to the currently applied mining system and technological scheme, there is a possibility of the formation of pillars exceeding 8–15 m in width in areas adjacent to the ore body boundaries or within zones limited by tectonic faults during mining operations. Such pillars may cause local stress concentration within the rock mass and act as a geomechanical factor that increases the risk of rock bursts. Therefore, under such conditions, it is necessary to optimize the parameters of destressing boreholes (length, diameter, spacing, and orientation) and to develop additional technological measures aimed at ensuring the geomechanical stability of the pillars.

The technological scheme designed for rock mass destressing предусматривает drilling destressing boreholes with an average length of 10 m in the waste rock mass between sublevel drifts driven along the contact of the ore body (Figure 1). During this process, strict control of the spatial arrangement of the boreholes and their mutual parallelism is required, as this represents an important geomechanical condition for preventing uneven stress redistribution and for forming symmetrical relaxation zones within the rock mass.

Before and after the implementation of ore mass destressing operations, special monitoring boreholes are drilled to perform a comprehensive assessment of the stress–strain state (SSS) of the rock mass. These boreholes have a diameter of 72 mm and a length of at least 10 m, enabling the monitoring of variations in normal stresses (σ), shear stresses (τ), and deformations (ε) within the rock mass.

Based on the results of this monitoring, the patterns of stress redistribution, the degree of elastic energy accumulation, and the effectiveness of the destressing technology are scientifically evaluated. As a result, the geodynamic stability of the rock mass and the seismo-dynamic safety of mining operations can be comprehensively ensured.

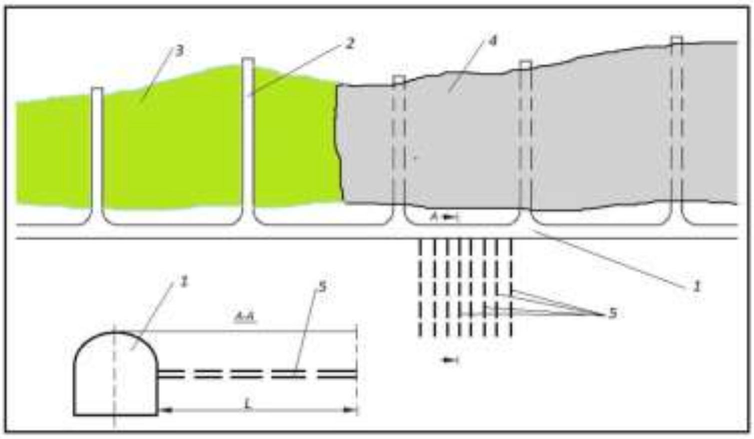

**Figure 1. Scheme of destressing the highly stressed rock mass surrounding a sublevel drift:**
**1** – sublevel drift;
**2** – drilling heading (drill drift);
**3** – ore body;
**4** – mined-out void (excavated-out space);
**5** – destressing boreholes.

**Conclution**

The results of the conducted scientific research and pilot-scale industrial studies have demonstrated the possibility of significantly reducing the additional technological costs associated with drilling destressing boreholes. At the same time, a substantial increase in the flexibility and technological efficiency of the process of forming protected zones within the rock mass has been achieved.

The wide range of drilling configurations and methods makes it possible to create protected zones using destressing boreholes under virtually any mining-geological, geomechanical, and tectonic conditions. This approach enables active control of the stress–strain state (σ, τ, ε) of the rock mass, limits the accumulation of elastic energy, and reduces the risk of rock bursts.

Therefore, the proposed method for the formation of protected zones has found wide application in the development of hazardous rock-burst-prone mining areas. In practice, it is recognized as a universal geotechnological solution characterized by high technological reliability and economic efficiency.

Figure 2. General view of an underground mine working supported by steel arch support.

As shown in Figure 2, the excavation is subjected to continuous geomechanical influence from the surrounding rock mass. The support system maintains the stability of the opening under operational conditions.

Figure 3. Local damage and cracking of lining elements caused by rock pressure.

Figure 3 demonstrates the consequences of stress concentration around the excavation contour. Cracks and displacement of lining elements indicate deterioration of the geomechanical condition of the surrounding rock mass.

## REFERENCE:

Brady B.H.G., Brown E.T. Rock Mechanics for Underground Mining. Springer, 2017.

Hoek E., Brown E.T. Underground Excavations in Rock. CRC Press, 2019.

Hudson J.A., Harrison J.P. Engineering Rock Mechanics. Elsevier, 2000.

Bieniawski Z.T. Rock Mechanics Design in Mining and Tunneling. Balkema, 2011.