Ethiopian International Journal of Multidisciplinary Research

pISSN:2349-5707 Volume:12,Issue 12,December-2025 eISSN:2349-5715

ANALYSIS OF ROCK PRESSURE DURING MINING OF THE LOWER HORIZONS OF THE "ZARMITAN" GOLD DEPOSIT

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Abstract: This article analyzes rock pressure issues in the deep horizons of the Zarmitan gold deposit in Uzbekistan. With increasing mining depth, the dangerous growth of rock pressure, the dominance of horizontal tectonic stresses, and the complexity of mining and geological conditions are examined. The analysis is based on existing studies and modeling results, and recommendations are provided to reduce the risk of dynamic phenomena such as rock bursts.

Keywords: Zarmitan deposit, deep mining, rock pressure, geomechanics, rock burst, underground mining.

Introduction

As near-surface rich reserves are depleted, mining operations at the Zarmitan deposit are gradually shifting to deeper horizons. The Zarmitan deposit is well known for its complex geological structure extending to depths exceeding 1 km and for its gold-bearing veins. As depth increases, the natural stresses in the rock mass intensify, leading to increased rock pressure and a higher risk of sudden rock bursts. Effective management of rock pressure is therefore of critical importance for ensuring operational safety and efficiency.

Mining and Geological Conditions and Stress State

The Zarmitan deposit is characterized by a complex block structure and high horizontal tectonic stresses, which are a key factor in the formation of abnormal stress zones. Studies indicate that horizontal stresses in this area may exceed vertical (gravitational) stresses by a factor of 1.4 or more [2, 3].

- **Geological characteristics:** The deposit consists of vein-type and linear stockwork ore bodies located within a fragmented rock mass. The presence of numerous tectonic faults further complicates stress distribution, as these structures act as weakened zones and centers of high stress concentration.
- **Stress distribution:** Numerical modeling and field measurements confirm that the highest stresses occur along the contours of mine openings, especially in arch-shaped sections. The location of stress concentration zones depends on the orientation of tectonic faults and the geometry of excavation.

Analysis of Rock Pressure Manifestations

The high-stress environment of the Zarmitan deposit classifies it among mines prone to rock bursts. The main manifestations of rock pressure include:

- **Rock bursts and shocks:** Dynamic events that disrupt mining operations and pose serious safety risks. They typically occur in high-stress zones near mine openings and along tectonic faults.
- **Zonal disintegration:** The formation of ring-shaped fracture zones around deep tunnels as a result of stress relief and redistribution. This phenomenon requires robust support systems to maintain stability.
- **Deformation and instability:** The stability of mine openings is closely related to the intensity of acting stresses and the physical and mechanical properties of the surrounding rock mass.

Mitigation Strategies and Mining Systems

pISSN:2349-5707 Volume:12,Issue 12,December-2025 eISSN:2349-5715

To ensure safety and efficiency at deep horizons, the use of specialized technologies and mining systems is recommended. The selection of an appropriate mining method must consider complex geomechanical conditions and the thickness of ore bodies.

- **Support systems:** The application of effective support technologies is essential to control deformation and prevent collapse.
- **Mining methods:** Recommendations often include variations of mining methods with backfilling (e.g., top-down or bottom-up). The use of cemented backfill materials helps manage rock pressure, maintain stability, and improve overall safety [1, 4].
- **Geomechanical modeling:** Advanced numerical modeling methods (such as the finite element method) are used to predict stress patterns, assess stability, and design optimal operational parameters, including stope dimensions and pillar sizes.

Conclusion

The analysis of rock pressure in the deep horizons of the Zarmitan gold deposit highlights the necessity of comprehensive geomechanical assessment and the implementation of specialized mining methods. The dominance of horizontal tectonic stresses requires careful planning, strong support systems, and the application of appropriate mining techniques such as backfilling, which collectively reduce the risk of dynamic rock pressure phenomena.

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