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Editorial: Geological disasters in deep engineering: mechanism, warning, and risk mitigation—volume II

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Editorial on the Research Topic
Geological disasters in deep engineering: mechanism, warning, and risk mitigation—volume II

Introduction

In the pursuit of resources and space from the deep Earth, a multitude of deep underground projects have been completed, currently under construction, and have already been planned. These projects involve various fields, including water conservancy and hydropower, mining, transportation, deep laboratory research, national defense, and more. However, due to the complex geological environments and high ground stress, the construction of these projects frequently encounters various geological disasters, such as severe rockburst, significant deformation, substantial water inrush, and large-scale collapse. These geological disasters pose severe threats to construction safety and hinder the advancement of underground engineering practices. It is worth noting that the deformation behavior of surrounding rock and the development process of geological disasters differ significantly between deep and shallow engineering projects. Consequently, there is an urgent demand for the development of new geological disaster theories, monitoring techniques, warning systems, and risk mitigation methods tailored specifically to deep engineering conditions.

Progress in the Research Topic

To draw the attention of scholars to geological disasters in deep engineering, the current Research Topic titled "*Geological disasters in deep engineering: mechanism, warning, and risk mitigation—volume II*" was organized. This volume showcases new theories, methods, and techniques developed to understand the mechanisms of geological disasters and provides insights

into warning systems and risk mitigation strategies. In total, 28 manuscripts were submitted, and out of these, 10 were selected for publication, resulting in a compilation of 10 papers authored by 49 researchers. These papers primarily focus on two main aspects. The first aspect explores the formation and evolution of geological disasters in deep engineering and their underlying mechanisms. The second aspect delves into warning methods and risk mitigation strategies.

Formation and evolution of geological disasters in deep engineering and their mechanism

Zhu et al. investigated the crack propagation process and energy dissipation law of grouting specimens under radial impact loads. An impact test was conducted with varying air pressures using the split Hopkinson pressure bar test system. The failure mechanism of the samples was analyzed from the perspective of the dynamic failure process and energy dissipation. The research findings offer valuable insights for grouting-reinforced rock masses in deep roadways subjected to impact loads.

Chen et al. utilized the DDA method enhanced with the sub-block fracturing modeling algorithm and the Weibull distribution heterogeneity model to simulate pre-notched rock specimens. The study aimed to investigate the impact of heterogeneity on the reproducibility of macroscale strength and failure patterns of the specimens. This work highlights the significance of considering rock heterogeneity in practical rock engineering.

Fan et al. analyzed the relationship between shear strength and matric suction using direct shear tests on unsaturated coal-bearing soil, the filter paper method for matrix suction measurement, and scanning electron microscope tests. From a microscopic perspective, the internal reasons for the shear strength attenuation of unsaturated coal-bearing soil under dry-wet cycles were revealed. This study provides valuable supplementary information for understanding the engineering properties and stability of unsaturated coal-bearing soil.

Ma et al. studied the fatigue failure processes in intermittent jointed rock masses subjected to repeated stress waves. The failure processes of discontinuous jointed rock masses were numerically simulated using the Autodyn element software. This study holds practical significance for the long-term qualitative analysis of rock mass engineering.

Huang et al. present the results of a series of undrained strength tests using a Berkeley simple shear device, and an expression for the undrained shear strength of high plasticity clay was developed. The undrained shear strength of clay is a critical parameter for designing embankments and pile foundations.

Chen et al. investigated the time-varying fatigue reliability of the inverted structure of a subway tunnel under the influence of train loads. The findings from this study offer valuable insights into the health and reliability of subway tunnels and facilitate their condition monitoring.

Warning methods and risk mitigation for geological disasters in deep engineering

Chen et al. conducted a study on regional flash flood susceptibility prediction, employing various machine learning models to develop modeling rules. This research holds practical importance in the fields of flash flood and geological hazard prevention and control, road planning, and the development of suitable risk mitigation strategies in southwest and southern China.

The safe mining of steeply inclined and extra-thick coal seams presents significant challenges due to coal bursts. In light of mining-induced seismicity triggered coal burst in a typical steeply inclined and extra-thick coal seam, Cao et al. investigated the failure mechanism and control of such occurrences. This study sheds light on effectively managing coal bursts induced by mining-induced seismicity in steeply inclined and extra-thick coal seams.

Xiang et al. explored and established an elastic-plastic analytical formula for the grouted rock surrounding a shaft under the combined influence of thermal, hydraulic, and mechanical fields based on the Mohr–Coulomb yield criterion. This study provides a theoretical foundation for optimizing grouting reinforcement parameters in deep shafts.

The stability control of surrounding rock in deep roadways is increasingly challenging, with grouting reinforcement support emerging as the prevailing approach. Yan et al. conducted a study on a similar ratio experiment and characteristic analysis of quasi-sandstone, offering theoretical references for similar material simulation tests related to grouting in quasi-sandstone.

The construction of deep engineering projects demands a stronger focus on science and technology innovation. The papers featured in this Research Topic volume facilitate knowledge exchange within the deep geoengineering community, providing insights on enhancing the sustainability and disaster resistance of deep engineering projects.

Author contributions

G-LF: Writing–original draft. LG: Writing–review and editing. JZ: Writing–review and editing. CZ: Writing–review and editing. ZZ: Writing–review and editing.

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Conflict of interest

LG was empolyed by BGRIMM Technology Group.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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