

报告题目: 爆破应力波诱导矿柱岩爆的动力失稳机理

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摘要: 岩爆机理的研究一直是采矿与岩石力学界的热点和难点之一。在矿山开采的实践中, 我们发现爆破动力扰动对矿柱岩爆的发生有诱导和激励的作用。本项目将从岩体结构动力学的独特角度, 把矿柱岩爆视为地下采矿结构的动力不稳定性现象, 通过建立参数微分方程和动力失稳准则, 构建爆破参数与岩爆发生率的定量数学关系以及岩爆和非岩爆的分界线, 从理论上揭示爆破应力波对岩爆的诱导机理: 包括参数共振机理, 摄动微扰机理, 爆破应力波幅值、波形、频率和能量不同作用的定量分析等, 从而为工程实践预防和控制岩爆提供理论指导。

Dynamic Buckling Mechanism of Pillar Rockbursts Induced by Blasting Waves

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Abstract: Rockburst is a term used to describe a sudden and violent failure of rock ranging in magnitude from abrupt ejection of small rock fragments to sudden collapse of a large section of a roof or sidewalls in underground excavation, which could cause damage of equipment, casualty of workers, or even abandonment of tunnels and mines. Rockburst has been regarded as the least understood and the most feared mining hazard problem facing underground rock excavations. Traditionally, rockbursts were classified into strain, pillar, and fault-slip rockbursts. However, rockbursts are also known to occur at stress levels well beneath the rock yield strength (e.g., in shallow workings), in mines where the rock is far from brittle, or without the presence of geological discontinuities. A plausible explanation of rockbursts is the buckling mechanism, which has been identified as one of the main mechanisms for rockbursts. It is observed that rockbursts are often induced by dynamic loadings from mining excavations, such as drilling and blasting in underground mining. This talk studies the mechanism of pillar rockbursts in underground mining, by considering rockbursts as a dynamic instability problem of underground rock structures. The governing equation of a pillar's motion is set up and the mechanism of pillar rockbursts is studied analytically and experimentally through a practical example. New findings include: (1) A new explanation of the “sudden and violent” phenomenon of rockbursts, characterized by exponential growth of the amplitudes of transverse displacement responses, even in the presence of rock damping; (2) identification of the critical role in inducing rockbursts of dynamic loadings that bear frequencies approximately double the natural pillar frequency; (3) the effect of perturbation of dynamic loadings during the occurrence of rockbursts; and (4) It is not the shape of a pulse but the impact energy to decide the occurrence of pillar rockbursts. Based on the mechanism obtained, measures are proposed to alleviate the hazard of rockbursts in underground excavation.

Key references:

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