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The dramatic increase of the global population and extensive urbanization has similarly increased the requirement for minerals from the mining industry. With the depletion of near-surface ore deposits, underground mining is being increasingly employed all around the world. However, the excavation of ore deposits using underground mining inevitably results in massive, dangerous, underground voids (also known as 'goaf' or 'stopes'). Stress redistribution happens once these voids have been created and, sometimes, disastrous accidents are triggered. To support the underground excavation, ore pillars must be left to ensure the stability of the stopes, leading to resources being wasted and a decrease of the financial return of the mine.

As a result, the mine backfill technology that places single or mixed materials in underground stopes is growing rapidly and attracting increased attention from both academia and industry. It has been proven that mine backfill provides ground support for mining operations, reduces ore dilution, and allows safe disposal of solid wastes. Moreover, the surface subsidence can be minimized, thereby reducing rehabilitation costs.

The successful application of mine backfill heavily depends on the design of backfill materials, which have been rapidly developed in recent years. Related research topics, such as studies on the consolidation mechanism of cementitious materials, the rheological mechanism of backfill slurry, the mechanical mechanism of backfill body and its environmental effects, have produced high-speed developmental outcomes accordingly. In addition, intelligent backfill that employs Internet of Things (IoT) technology and/or artificial intelligence techniques has been developed and applied to increase the efficiency of backfill materials. Today, there is an increasing need for advanced studies exploring the engineering potential of backfill materials and creating novel methods for their fabrication, enhancement, and transportation.

This special issue aims to collect new discoveries about and new applications for backfill materials to promote waste recycling and environmental protection in the mining industry.

Potential topics include but are not limited to the following:

▶ Backfill aggregates, either natural or artificial, that can be used for mine backfill, such as distinctive tailings, waste rock, smelting slag, coal gangue, construction waste, and agricultural waste

▶ Cementitious materials that can bond the particles or bulk aggregates through physicochemical action, such as Portland cement, slag, phosphogypsum, mixed cementitious materials, and special cement designed for a given aggregate

▶ Backfill auxiliary additives, including materials that can improve the mechanical and rheological properties of backfill, such as hardening accelerating admixture, water reducer, expansive agent, and pumping agent

▶ Intelligent backfill that employs Internet of Things (IoT) technology and/or artificial intelligence techniques, such as big data in mine backfill, machine-learning aided decision-making, automatic detection, software development, and integrated backfill design

▶ The required strength of the backfill material, its mechanical mechanism(s) and interactions with the surrounding rock mass, microstructural properties, hydraulic conductivity, degradation/durability characteristics of CPB materials, and the similar

▶ The rheology of backfill, including rheological model, pressure drop in pipeline transportation, time-dependent properties, and thixotropy

▶ The effect of mine backfill on the environment, including the control of surface subsidence, the toxicants from backfill to underground water, novel evaluation methods to qualify such toxicant release, and novel approaches to reduce or even eliminate the toxicant release

▶ Case studies of typical mine backfill materials in engineering applications

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