

In Situ Recovery Keynote Address

DEVELOPMENTS IN IN-SITU RECOVERY PERMEABILITY ENHANCEMENT

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ABSTRACT

In-situ recovery (ISR) has the potential to unlock mining opportunities in deposits that may otherwise be uneconomical to process by conventional means. Three critical components for the successful implementation of ISR include: (i) containment and hydrogeological control; the lixiviant must be directed to the region of interest and be retained within this region, for economic and environmental reasons. (ii) Minerals of value must be leachable and the lixiviant system should display good in-situ chemistry; the chosen lixiviant system should be capable of dissolving the metal of interest from the host mineral(s), ideally with preferential dissolution of value minerals over gangue minerals. Environmental impact is an additional important consideration with regards the lixiviant choice. (iii) Access to value minerals; the economic success of an operation depends on the extent of valuable metal recovery within a certain timeframe. ISR has been applied to readily permeable rock because solution flow is possible in these deposit types. Hard-rock environments pose a greater challenge because of the lack of contact of solution with the value mineral, and furthermore, aspects such as vein-hosted or disseminated mineralisation need to be considered. It is also preferable that reaction products do not limit further dissolution, such as by impermeable product layer formation (passivation) or precipitation, which could block solution flow.

This paper presents current options for access creation and permeability enhancement. The most advanced approach includes hydraulic fracturing, while blasting presents an attractive technology for creating fractures in rock. Branched and directional drilling has provided an approach for accessing targeted regions in a deposit. Less traditional access-creation methods include cryogenics, and the use of high voltages and microwaves. Permeability enhancement and improved lixiviant/mineral contact may also be achieved by approaches such as electrokinetics, the use of mass-transfer agents, pulsed pumping, and natural access creation by leaching (although flow reduction may occur by chemical precipitation and/or product layer formation).

Techniques for permeability enhancement, their status and various merits, and other influencing factors will be described.

Keywords: In-situ recovery, Permeability enhancement, Access creation, Hydraulic Fracturing, Blasting, Cryogenics, High voltage, Microwaves, Electrokinetics, Mass transfer agents