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NUMERICAL MODELING OF GRAVITY-ASSISTED SOLUTION MINING OF EVAPORITES

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Abstract

Solution mining is rapidly becoming the preferred method to economically extract evaporite minerals, such as halite, trona, and potash. With recent advances in horizontal drilling technology, opportunities for extracting evaporites from bedded deposits using a relatively small number of holes have increased significantly. One well is used to inject water into the evaporite bed and the pregnant solution is extracted through another hole. An undercut is developed by dissolution starting near the injection hole. As the undercut grows, evaporite mass above is expected to move into the empty space due to gravity. Rubblizing the evaporite accelerates the dissolution process.

In this paper, a sequentially coupled simulation approach is presented for modeling both the dissolution process of trona in the Green River Basin of Wyoming and resulting caving phenomena. The dissolution model assumes density-driven convection along the evaporite-cavity brine interfaces with diffusion-controlled dissolution of the evaporite. The resulting caving phenomena are simulated using the UDEC code. Trona beds, expected to directly participate in the caving processes, are modeled as Voronoi blocks. After the excavation is created, the strata deform due to gravity loading. Some of the materials will move into the void space and be dissolved in the injected water. Results demonstrate a feasible approach to simulate the processes by combining a model of the horizontal solution cavity evolution with a geomechanical model that predicts the onset and extent of caving. This modeling approach can be used in designing and optimizing gravity-assisted solution mining projects in bedded evaporite deposits.

Key words: Caving, Horizontal Drilling, Computer Modeling, Evaporite Dissolution, Rock Mechanics