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GRAVITY-ASSISTED SOLUTION MINING OF TRONA: NUMERICAL MODELING OF OVERBURDEN FRACTURING AND ROOF FAILURE

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Abstract

The concept of gravity-assisted solution mining of bedded evaporites, trona in particular, envisions that creation of a solution cavity in the evaporite bed will ultimately result in failure of the cavity roof. In the best case, collapse of the evaporite remaining above the solution cavity would rubblize the evaporite, increase its surface area in contact with the lixiviant, and thus increase economic recovery. Fracturing and possible collapse of the overburden can have deleterious effects, however, such as connecting the solution mining horizon to an overlying fresh water aquifer, connecting the solution cavity to beds containing undesirable minerals, such as halite in the case of trona mining, or restricting flow in the solution cavity. This work used the ABAQUS extended finite element (XFEM) technique (Dassault Systèmes, 2014) to simulate initiation and propagation of discrete cracks above a solution cavity created in a hypothetical trona bed similar to that found in the Green River Formation of southwest Wyoming (USA). The solution cavity geometry was created using a semi-empirical solution cavity evolution model described in Ghosh and Walter (2014). The geomechanical simulations did not suggest large failure of the cavity, as envisioned in the gravity-assisted solution mining concept. The results are consistent with previous simulations using a Voronoi block simulation approach (Ghosh and Walter, 2014). The simulations did, however, indicate a potential for fractures to develop in the overburden that could connect the solution mining horizon to overlying trona beds. The current simulations used a generalized mechanical stratigraphic framework and generic rock material properties from the literature. Future work incorporating site-specific conditions (i.e., more representative subsurface geology and material properties) could be used to reduce costs through increased efficiency and reduced hazards.

Key words: Trona, Computer Modeling, Rock Mechanics, Solution Mining, Evaporites, Cavern Dissolution Modeling, Geology