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SUBSIDENCE RESULTING FROM SOLUTION MINING; TECHNIQUES FOR DETECTION OF SUBSIDENCE AND RESEARCH INTO THE MECHANICS OF CRATERING

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Introduction - Solution Mining

Solution mining is the technique for production of a soluble mineral by introduction of a suitable solvent into the deposit and removal of the resulting solution. In its common commercial reduction to practice access to the deposit is by wells drilled for the purpose. Although production of brine has been known for ages, the industry has seen its greatest expansion following development of drilling, casing, cementing, and logging practices in the oil industry. Wells are operated to produce salt for use as the raw material in chemical manufacture or salt production, or to excavate the salt when the resulting cavity is desired - to be used for storage or disposal. The term solution mining is now applied to removal of salt or other soluble mineral (e.g., potash) from massive deposits by introduction of a simple solvent, usually water. By contrast, in situ leaching is the technique for removal of a mineral from its matrix by utilization of a special solvent. The distinction is that solution mining is applied to massive deposits and large voids are created, whereas in in situ leaching, selective dissolving usually takes place and the matrix is left in place.

Creation of cavities in salt deposits by dissolving results in removal of support of the rocks surrounding the new cavity. Stability of the sides and roof of the cavity then is dependent upon the mechanical properties of the materials constituting the walls and roof of the cavity in this new role. Description and quantification of these materials in engineering terms is the purview of the relatively new field of rock mechanics. Gravity is the operative force. Rocks deposited as sedimentary layers are now asked to perform in tension as cavity roof materials with support removed by dissolving of the underlying salt, and to assume overburden loads requiring support.

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Looking at the cavity stability problem in simplest terms, if span loads are within the capability of the new roof rock the cavity will remain stable. If the cavity is enlarged, the roof will sag as the rock layers downwarp. Further cavity enlargement results in roof rock breaking into the cavity (a mechanism referred to as "stoping") layer by layer until stability is restored. This activity is recognized by the well operator since breaking away of the roof rock usually also breaks the well tubing necessary for production of saturated brine from the base of the cavity, requiring workover for redrilling to restore the pipe. Stoping can also be detected by logging devices which will measure progress of the activity even behind well casing, assuming the casing is intact (examples: neutron and cement bond logging).

The above discussion serves to introduce the basic concepts of solution mining and rock mechanics input to cavity design.