

# SOLUTION MINING RESEARCH INSTITUTE

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PAPER



## GEOCHEMICAL AND ROCK MECHANICS ASPECTS OF ANHYDRITE/GYPSUM PHASE TRANSITIONS

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### INTRODUCTION

Design of engineering structures in rock masses is based on the potential deformational behavior of the rock system under the induced state of stress. Deformational behavior of a rock mass can be modeled with an appropriate constitutive law based on various rheological models widely used in rock mechanics. For most rock types, various constitutive laws can be used with confidence as long as there is no interaction between the rock-forming minerals and water. However, if water geochemically interacts with the rock forming minerals, some modifications in the constitutive laws become inevitable.

Dissolution is one form of an interaction of water with the rock-forming evaporitic minerals. Based on the relative degree of solubility of the evaporitic minerals, solution mining methods are widely used for salt extraction. Geochemical transition between sulfatic minerals and water is another form of the interaction. In this presentation, geochemical phase transitions in anhydrite ( $\text{CaSO}_4$ ) and gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) will be brought to the attention of researchers and practicing engineers.

Anhydrite may hydrate into gypsum or gypsum may dehydrate into anhydrite depending upon the changes in the geochemical conditions. Hydration of anhydrite to gypsum may yield molar volume increases up to 62.6 percent and dehydration of gypsum to anhydrite may yield molar volume decreases up to 38.5 percent. Volume changes in the calcium

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sulfate bearing rocks may cause disturbances in the state of stress, resulting in excessive deformations of unexpected nature in the evaporitic rock sequences. Temperature, pressure and salinity of liquids are the most prominent factors controlling the geochemical phase transitions. If the geochemical stability of a calcium sulfate system is disturbed, the transition between anhydrite and gypsum continues until the stability of the system is reached.

In this paper, the geochemical stability of the anhydrite/gypsum systems and resultant volume changes in the solid state are presented together with potential implications of these volume changes for several engineering fields.

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