A Thermodynamic Model for the Solubility of Anhydrite in Saline Fluids: Applications to Hydrothermal Ore Deposits

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Sulfur plays multiple crucial roles in the formation of ore deposits. It is a common ligand for valuable metals in solution, and its redox sensitivity means sulfur is important in redox processes. Sulfur is also a common anion in both ore and gangue minerals. Anhydrite is a sulfate gangue mineral commonly observed in association with sulfide ore minerals in hydrothermal ore deposits, such as porphyry copper and volcanogenic massive-sulfide (VMS) deposits. Despite the abundance of anhydrite in these hydrothermal ore deposits and the intimate relationship between anhydrite and ore mineralization, there is currently no comprehensive numerical model for the solubility of anhydrite in saline fluids. Previous modelling of the solubility of quartz in aqueous brines proved useful for better understanding the hydrothermal evolution and vein-forming processes of both porphyry and VMS system. Analogous modelling of the solubility behaviour of anhydrite in these hydrothermal systems would be a valuable tool, hence requiring a new, quantitative solubility model. Here we present the development, calibration, and application of a new thermodynamic model for the solubility of anhydrite in saline fluids over a range of pressures and temperatures. We illustrate how this model can be applied to visualize the behaviour of the solubility of anhydrite as it follows fluid flow paths typical of hydrothermal ore deposits.

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