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Determination of melanterite-rozenite and chalcanthite-bonattite equilibria by humidity measurements at 0.1 MPa

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Abstract

Melanterite ($FeSO_4 \cdot 7H_2O$)-rozenite ($FeSO_4 \cdot 4H_2O$) and chalcanthite ($CuSO_4 \cdot 5H_2O$)-bonattite ($CuSO_4 \cdot 3H_2O$) equilibria were determined by humidity measurements at 0.1 MPa. Two methods were used; one is the gas-flow-cell method (between 21 and 98 °C), and the other is the humidity-buffer method (between 21 and 70 °C). The first method has a larger temperature uncertainty even though it is more efficient. With the aid of humidity buffers, which correspond to a series of saturated binary salt solutions, the second method yields reliable results as demonstrated by very tight reversals along each humidity buffer. These results are consistent with those obtained by the first method, and also with the solubility data reported in the literature. Thermodynamic analysis of these data yields values of 29.231 ± 0.025 and 22.593 ± 0.040 kJ/mol for standard Gibbs free energy of reaction at 298.15 K and 0.1 MPa for melanterite-rozenite and chalcanthite-bonattite equilibria, respectively. The methods used in this study hold great potential for unraveling the thermodynamic properties of sulfate salts involved in dehydration reactions at near ambient conditions.