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Acquisition and evaluation of thermodynamic data for morenosite-retgersite equilibria at 0.1 MPa

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Abstract

Metal-sulfate salts in mine drainage environments commonly occur as solid solutions containing Fe, Cu, Mg, Zn, Al, Mn, Ni, Co, Cd, and other elements. Thermodynamic data for some of the end-member salts containing Fe, Cu, Zn, and Mg have been collected and evaluated previously, and the present study extends to the system containing Ni. Morenosite ($NiSO_4 \cdot 7H_2O$)-retgersite ($NiSO_4 \cdot 6H_2O$) equilibria were determined along five humidity buffer curves at 0.1 MPa and between 5 and 22 °C. Reversals along these humidity-buffer curves yield $\ln K = 17.58–6303.35/T$, where K is the equilibrium constant, and T is temperature in K. The derived standard Gibbs free energy of reaction is 8.84 kJ/mol, which agrees very well with the values of 8.90, 8.83, and 8.85 kJ/mol based on the vapor pressure measurements of Schumb (1923), Bonnell and Burridge (1935), and Stout et al. (1966), respectively. This value also agrees reasonably well with the values of 8.65 and 9.56 kJ/mol calculated from the data compiled by Wagman et al. (1982) and DeKock (1982), respectively. The temperature–humidity relationships defined by this study for dehydration equilibria between morenosite and retgersite explain the more common occurrence of retgersite relative to morenosite in nature.