

An experimental study of kaolinite and dickite relative stability at 150–300 °C and the thermodynamic properties of dickite

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ABSTRACT

The Gibbs free energy ($\Delta G_{(1)}^0$) of the reaction kaolinite \leftrightarrow dickite was generated from solubility measurements of natural kaolinite and dickite performed in acid solutions at temperatures ranging from 150 to 300 °C under vapor-saturated conditions. The $\Delta G_{(1)}^0$ values increase from -0.620 ± 0.150 to -0.218 ± 0.210 kcal/mol with increasing temperature from 150 to 300 °C. Regression of these data yields a value of -0.90 ± 0.10 kcal/mol for $\Delta G_{(1)}^0$ at 25 °C. The standard Gibbs free energy of formation ($\Delta G_{f,298}^0$) of dickite deduced from $\Delta G_{(1)}^0$ and the $\Delta G_{f,298}^0$ of kaolinite (Zotov et al., in preparation) is -908.36 ± 0.40 kcal/mol. The results obtained in this study indicate that kaolinite is metastable relative to dickite at temperatures to at least 350 °C. It follows that the timing of observed kaolinite to dickite transformations in diagenetic and many hydrothermal systems is controlled by the kinetics of this reaction rather than thermodynamic equilibria.