American Mineralogist, Volume 83, pages 516–524, 1998

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

ALEXANDRE ZOTOV,^{1,2} ALEXANDRE MUKHAMET-GALEEV,¹ AND JACQUES SCHOTT^{2,*}

¹Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, 109017 Moscow, Russia ²Laboratoire de Géochimie, CNRS-OMP-Université Paul-Sabatier, 31400 Toulouse, France

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 ($\Delta G_{1,298}^{0}$) of dickite deduced from $\Delta G_{(1)}^{0}$ and the $\Delta G_{1,298}^{0}$ of kaolinite (Zotov et al., in preparation) is $-908.36 \pm$ 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.