

Energetics of kaolin polymorphs

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ABSTRACT

The enthalpy of formation of kaolin polymorphs at 298 K has been determined by drop-solution calorimetry into molten lead borate at 975 K. Corrections have been made for impurities in the samples. The standard enthalpy of formation from the elements is: kaolinite -4120.2 ± 6.6 kJ/mol, dickite -4107.6 ± 5.7 kJ/mol, nacrite -4104.0 ± 7.6 kJ/mol, and halloysite -4097.5 ± 5.6 kJ/mol. Using entropy data from the literature, the standard free energy of formation from the elements at 298 K is -3799.4 ± 6.4 kJ/mol for kaolinite, -3785.1 ± 5.6 kJ/mol for dickite, and -3776.8 ± 5.8 kJ/mol for halloysite. The effect of crystallinity (Hinckley index ranging from 1.6 to 0.4) on the enthalpy of formation of kaolinite is smaller than 5 kJ/mol, the experimental error. The relative stability of the polymorphs probably does not change significantly with pressure and temperature over their range of occurrence. Thus the geological occurrence of halloysite, nacrite, and dickite, which are metastable phases, must be interpreted in terms of kinetics or as the result of a specific synthesis path, rather than as resulting from changes in the thermodynamically stable phase assemblage.