Kaolinite Synthesis: The Role of the Si/Al and (Alkali)/(H^+) Ratio in Hydrothermal Systems

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Abstract: The Si/Al ratio of an hydrothermal system plays an important role in kaolinite synthesis. If the atomic Si/Al ratio of a system is greater than 2 · 0, kaolinite will disappear at 345 ± 5 ° C and 2 kbars water pressure according to the reaction kaolinite + 2 quartz → pyrophyllite + H_2O. If the atomic Si/Al ratio is less than 2 · 0, however, kaolinite will persist until 405 ° C where it will react according to the equation 2 kaolinite → pyrophyllite + 2 boehmite + 2 H_2O. The Si/Al ratio of the system and temperature are also factors in determining whether *b*-axis ordered or disordered kaolinite will crystallize. The ordered variety is favored by a lower Si/Al ratio and a higher temperature than is the disordered form.

Hydrothermal experiments also show that kaolinite can be synthesized at 150 ° C and 5 bars pressure in distilled water from amorphous starting materials. Previous investigators were unsuccessful in forming kaolinite under these conditions because their systems were contaminated with alkalis.

Attempts to synthesize halloysite and dickite failed, but halloysite was converted to kaolinite at 150 ° C, suggesting that halloysite can be synthesized only at low temperatures.

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