Spherical Kaolinite: Synthesis and Mineralogical Properties

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Abstract: Spherical kaolinite has been synthesized for the first time from noncrystalline aluminosilicate material in hydrothermal experiments conducted between 150 ° and 250 ° C and under autogenous vapor pressure. Spherules, whose mean diameters depended on growth conditions (0.1 – 0.6 μm), were formed surrounding the noncrystalline aluminosilicate in all products of 150 ° and 200 ° C runs and coexisted with platy or lath-shaped kaolinite in the products of 250 ° C runs. The estimated percentages of spherules in the products increased from about 1% in the 150 ° C-15 days product to about 74% in 200 ° C-8 days product, and decreased from about 21% in 250 ° C-2 days product to 0% in 250 ° C-8 days product. Lattice images by high-resolution electron microscope indicated that the spherules consisted of nearly concentric stackings of layers with a unit spacing of 7 Å, which were sectored by radiating boundaries. The mean chemical composition of the spherules (Al_2O_3/SiO_2 = 0.58) analyzed by the analytical electron microscope is similar to that of kaolinite (Al_2O_3/SiO_2 = 0.5). Even in the case of the product abundant in spherule (200 ° C-8 days), X-ray powder diffraction patterns of the wetted products, e.g., of the 200 ° C-8 day run, showed the 7.14- Å (001) reflection of kaolinite. The 020 reflection was broad, indicating the existence of abundant (001) layer displacements. The b axis (8.94 Å) were within the kaolinite range (8.93 – 8.94 Å). No infrared absorption peaks were observed at 3550 cm^{-1} which would correspond to halloysite. The differential thermal analysis slope ratios of the endothermic peak at about 550 ° C (1.4 – 2.3) were in the kaolinite range (0.78 – 2.39).

Key Words: Halloysite • High resolution electron microscopy • Infrared spectroscopy • Kaolinite • Spherules • Synthesis • X-ray powder diffraction

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