The Relationships Between Kaolinite Crystal Properties and the Origin of Materials for a Brazilian Kaolin Deposit

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Abstract: The clay particles in a kaolin deposit from Brazil were investigated by X-ray diffraction (XRD), differential thermal analysis (DTA), analytical transmission electron microscopy (ATEM), and electron paramagnetic resonance (EPR) to examine the relationships between morphological and chemical properties of the crystals and to relate these properties to formation conditions. The XRD patterns show the dominant presence of kaolinite with minor amounts of gibbsite, illite, quartz, goethite, hematite, and anatase. ATEM observations show two discontinuities in the deposit as indicated by changes in morphology and size of the kaolinite crystals. At the base of the deposit, hexagonal platy and lath-shaped particles (mean area of 001 face = 0.26 μm^2) maintain the original fabric of the parent rock which characterizes an *in situ* evolution. In the middle of the deposit a bimodal population of large (mean area of 001 face > 0.05 μm^2) and small (mean area of 001 face < 0.05 μm^2) sub-hexagonal platy kaolinite crystals occurs. This zone defines the boundary between the saprolitic kaolinite and the pedogenic kaolinite. Near the top of the profile, laths and irregular plates of kaolinite, together with sub-hexagonal particles, define two different depositional sources in the history of formation of the deposit. Crystal thickness as derived from the width of basal reflections and the Hinckley index are compatible with the morphological results, but show only one discontinuity. At the base of the deposit, kaolinite has a low-defect density whereas in the middle and at the top of the profile, kaolinite has a high-defect density. Likewise, EPR spectroscopy shows typical spectra of low-defect kaolinite for the bottom of the deposit and typical spectra of high-defect kaolinite for the other portions of the deposit. Despite the morphological changes observed through the profile, the elemental composition of individual kaolinite crystals did not show systematic variations. These results are consistent with the deposit consisting of a transported pedogenic kaolinite over saprolite consisting of *in situ* kaolinized phyllite.

Key Words: ATEM • Defect • EPR • Formation Condition • Kaolinite • Morphology • Saprolite • Soil • XRD

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