Nanomorphology of Kaolinites: Comparative SEM and AFM Studies

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Abstract: Nanomorphological structure of well-crystallized Georgia and poorly crystallized North Queensland kaolinite particles have been compared using field emission scanning electron microscopy (SEM) and atomic force microscopy (AFM). In general, there is good agreement in information from the 2 very different imaging techniques. AFM gives more detailed information on step and ledge dimensions, microvalleys and crystallographic orientation of irregularities on basal planes and edges of the crystallites. There are major differences in nanomorphology and surface structure between the 2 kaolin samples with the Georgia kaolin showing 200 – 500-nm, relatively flat basal planes with some cascade-like step growth 50 – 100 nm wide. The edges, apparently flat and right-angled in SEM images, appear beveled in AFM images due to artifacts from the aspect ratio of the AFM tip. The North Queensland kaolinite has much more complex surface structure with anhedral crystallites attached to larger particles, high density of steps and nm-scale irregularities (often crystallographically directed). The additional step edge site contribution from the attached crystallites is estimated as a minimum of 6%, giving a total edge contribution above 30% of the kaolinite total surface area. These structures will generate a substantial pH-dependent charge across the surfaces of the North Queensland kaolinite platelets. An idealized, uniform, pH-independent, negatively charged basal plane cannot be assumed from these structures. There is also some evidence, from both SEM and AFM images, of curvature in the thinner, poorly ordered structures of the North Queensland kaolinite particles.

Key Words: Atomic Force Microscopy • Kaolinite • Morphology • Scanning Electron Microscopy

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