

---

# Surface Layer Types of Kaolinite: A High-Resolution Transmission Electron Microscope Study

Ma Chi<sup>†</sup> and Richard A. Eggleton

Cooperative Research Center for Landscape Evolution and Mineral Exploration, Department of Geology, Australian National University, Canberra, ACT 0200, Australia

<sup>†</sup> Present address: Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125.

**Abstract:** High-resolution transmission electron microscopy (HRTEM) examinations have indicated that three types of surface layers may exist in natural kaolinite crystals. *Type 1* has the expected 7-Å surface layer as terminations. *Type 2* has one 10-Å pyrophyllite-like (or low-charge beidellite-like) layer as the surface layer on one side of a kaolinite particle (*i.e.*, the layer sequence is TOTOTO ... TOTOTOT, where T stands for tetrahedral sheet, O for octahedral sheet). Some industrial-grade highly-ordered kaolinites have such a 10-Å 2:1 surface layer on one side of the crystal. The spacing between the 10-Å layer and the adjacent 7-Å layer is not expandable. *Type 3* kaolinite has one or several 10-Å collapsed smectite-like layers at one or both sides of a stack, *i.e.*, (TOT)TOTO ... TOTOTOT(TOT), forming a special kind of kaolinite-smectite interstratification. This type has only been recognized in some poorly-ordered kaolinites. The surface smectite layer(s) contribute to higher cation exchange capacity (CEC) values. These 10-Å surface layers were not detectable by X-ray diffraction (XRD). HRTEM and electron diffraction examination also revealed the structural features of individual kaolinite crystals. All kaolinites (from various origins and sources) studied show C-face-centering of non-hydrogen atoms. Defects within the layer structure are common in both well-ordered kaolinite and poorly-ordered kaolinite.

**Key Words:** 2:1 Layer • Clays • HRTEM • Kaolinite • Pyrophyllite • Smectite • Surface Layer

*Clays and Clay Minerals*; April 1999 v. 47; no. 2; p. 181-191; DOI: [10.1346/CCMN.1999.0470208](https://doi.org/10.1346/CCMN.1999.0470208)

© 1999, The Clay Minerals Society

Clay Minerals Society ([www.clays.org](http://www.clays.org))

---