American Mineralogist, Volume 91, pages 1293–1299, 2006

Stacking structures in pyrophyllite revealed by high-resolution transmission electron microscopy (HRTEM)

TOSHIHIRO KOGURE,[1,2,*] MAYUMI JIGE,[3] JUN KAMEDA,[1] AKIHIKO YAMAGISHI,[1,2] RITSURO MIYAWAKI,[4] AND RYUJI KITAGAWA[3]

[1]Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-0033, Japan
[2]CREST, Japan Science and Technology Corporation, Honcho 4-1-8, Kawaguchi, Saitama 332-0012, Japan
[3]Department of Earth and Planetary Sciences, Faculty of Sciences, Hiroshima University, 1-3-1 Kagamiyama, Higashi-Hiroshima, 739-8526, Japan
[4]Department of Geology, The National Science Museum, 3-23-1 Hyakunin-cho, Shinjuku-ku, Tokyo 169-0073, Japan

ABSTRACT

Stacking structures in pyrophyllite, $Al_2Si_4O_{10}(OH)_2$, were investigated mainly by using high-resolution transmission electron microscopy (HRTEM). The specimens examined were large lath-shaped crystals (Berosovska, Urals, Russia) and massive aggregates of fine platy crystals (Nohwa, southwest Korea). Both specimens showed powder X-ray diffraction (XRD) patterns similar to those reported previously as the 2*M* polytype. The common stacking sequence in the two specimens is not monoclinic with two-layer periodicity as previously reported, but a uniform orientation of the 2:1 layers and near complete disorder of two alternative directions of interlayer displacement, i.e., lateral displacement between the two tetrahedral sheets across an interlayer region. The directions of interlayer displacement are about $\pm 2\pi/3$ from that of the intralayer shift (lateral displacement between the two tetrahedral sheets within a 2:1 layer). Simulation of powder XRD patterns by this stacking model closely approximates the experimental pattern. Elongation of the lath-shaped Berosovska crystals corresponds to the direction of the intralayer shift, as seen in illite-1*M*.

2:1 layers with different orientations, and interlayer displacement almost parallel to the intralayer shift, were occasionally observed as stacking faults. Such disorder occurs more frequently in the massive Nohwa specimen than in the Berosovska specimen. Sub-micrometer domains of the 2*M* stacking sequence with regular alternation of the two directions of interlayer displacement were found in the Nohwa specimen.

Keywords: Crystal structure, pyrophyllite, electron microscopy, order-disorder, XRD data