American Mineralogist, Volume 87, pages 1443–1457, 2002

Revised structure models for antigorite: An HRTEM study

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ABSTRACT

We have revised the structure model of antigorite so that they conform to observations made using high-resolution transmission electron microscopy (HRTEM) images and selected-area electron diffraction. The new models retain the original half-wave configuration proposed by Kunze (1956). The Kunze model, and all subsequent research, assumes the occurrence of four- and eight-membered silicate rings in one of the two places where there are reversals of tetrahedron orientations in the tetrahedral sheets. However, TEM images at sufficiently high resolution show no traces of such rings and only half the number of octahedral-sheet offsets as occur in the Kunze model. Using our measurements and models, we generated atom positions for antigorite unit cells having various modulation lengths and then calculated the corresponding images, which provide good matches with our experimental HRTEM images. We also characterized and described antigorite structures with different modulation wavelengths and stacking sequences. Depending on the number of polyhedra in a unit cell and the presence or absence of *b*/3 shifts between adjoining tetrahedral and octahedral sheets, the antigorite crystals have monoclinic or triclinic symmetry, which we call antigorite-*M* and antigorite-*T*, respectively. By resolving the tetrahedral and octahedral positions, we were able to make a direct estimate of the compositions of specific antigorite samples.