

High-pressure behavior of clinochlore

MARK D. WELCH^{1,*} AND WILLIAM G. MARSHALL²

¹Department of Mineralogy, The Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.

²ISIS Facility, Rutherford Appleton Laboratory, Chilton, Didcot, Oxon OX11 0QX, U.K.

ABSTRACT

The room-temperature bulk modulus of synthetic end-member clinochlore, $\text{Mg}_5\text{AlSi}_3\text{AlO}_{10}(\text{OD})_8$, has been determined in the pressure range 0 to 6.5 GPa using neutron powder diffraction: $K_0 = 75.4(2.7)$ GPa, $K'_0 = 4$; $K_0 = 72.3(2.4)$ GPa, $K'_0 = 5.4(1.0)$. A structural comparison is made with the related mineral brucite, $\text{Mg}(\text{OH})_2$. Clinochlore is a much stiffer structure than brucite ($K_0 = 41 - 47$ GPa). Both minerals have very similar in-plane compressions of their polyhedral sheets and so their very different bulk moduli arise from different compressibilities normal to the structural layering. Rietveld refinements of neutron-diffraction data for clinochlore collected at 0, 1.2, 2.5, and 4.7 GPa reveal that compression normal to the layering is equally partitioned between the interlayer and the 2:1 layer; the octahedral sheets of the brucite-like and 2:1 layers are uncompressed to 4.7 GPa. Increasing pressure strengthens the $\text{H3(D3)} \cdots \text{O3}$ hydrogen bond, which contracts linearly from 1.88(2) Å at 0 GPa to 1.77(2) Å at 4.7 GPa, possibly with a concomitant lengthening of the O6-H3(D3) hydroxyl bond from 1.05(2) Å to 1.10(2) Å over the same pressure range.