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LETTER

Novel high-pressure behavior in chlorite: A synchrotron XRD study of clinochlore to 27 GPa

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ABSTRACT

The high-pressure behavior of synthetic end-member II*b* clinochlore, $Mg_5Al(Si_3Al)O_{10}(OH)_8$, has been studied by synchrotron X-ray powder diffraction to 27 GPa at 300 K. A non-quenchable, reversible transformation occurs between 9 and 10 GPa that is dominated by compression normal to the structural layering and has an associated small but significant shear of the β angle from 97.2 to 96.3°. The high-pressure chlorite is more compressible than the low-pressure phase. Diffraction patterns of the high-pressure chlorite are very similar from 10 to 27 GPa, indicating that it persists stably with no significant change in β to very high pressures: β is effectively locked at the transformation to the high-pressure structure. It is proposed that the transformation is not polytypic and that the distortion reflects reorganization of the interlayer hydrogen bonding, possibly involving novel proton behavior as adjacent sheets of cations of the brucite-like and tetrahedral layers close down on the sheet of interlayer protons. The transformation is likely driven by O atom close-packing requirements imposed by pressure.