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An infrared spectroscopic study of the OH stretching frequencies of talc and 10-Å phase to 10 GPa

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Abstract

The effects of pressure on the OH stretching frequencies of natural talc and two samples of synthetic 10-Å phase have been measured using a diamond-anvil cell and a synchrotron infrared source. The 10-Å phase was synthesized at 6.0–6.5 GPa, 600 °C for 46 hours (sample 10Å-46) and 160 hours (10Å-160). Spectra were collected up to 9.0 GPa (talc), 9.9 GPa (10Å-46), and 9.6 GPa (10Å-160). The OH stretching vibration of Mg_3OH groups in talc occurs at 3677 cm^{-1} at ambient pressure, and increases linearly with pressure at 0.97(2) cm^{-1} GPa^{-1}. The same vibration occurs in 10-Å phase, but shows negligible pressure shift up to 2 GPa, above which the frequency increases linearly to the maximum pressure studied, at a rate of 0.96(3) cm^{-1} GPa^{-1} (10Å-46) and 0.87(3) cm^{-1} GPa^{-1} (10Å-160). Two other prominent bands in the 10-Å phase spectrum are suggested to be due to stretching of interlayer H_2O, hydrogen-bonded to the nearest tetrahedral sheet. These bands also show little change over the first 2 GPa of compression, as most of the compression of the structure is taken up by closing non-hydrogen bonded gaps between interlayer H_2O and tetrahedral sheets. Between 2 and 4 GPa, changes in band intensities suggest a rearrangement of the interlayer H_2O.

Keywords: Talc, 10-Å phase, high-pressure studies, IR spectroscopy