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Sound speed and refractive index of amorphous $CaSiO_3$ upon pressure cycling to 40 GPa

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Abstract

Brillouin spectroscopy at room temperature and pressures up to 40 GPa documents nearly identical elasticity and refractive index of amorphous $CaSiO_3$ created by two different methods: temperature-quenching the melt at ambient pressure and pressure-amorphizing crystalline wollastonite at room temperature. We find reproducible hysteresis of 0 to 8% on pressure cycling that is small relative to the 30 to 60% changes in shear and longitudinal wave velocities over this pressure range. Together with observed changes in refractive index and previous results from Raman spectroscopy, these measurements reveal a continuous and reversible change in atomic packing induced by pressure. Unlike many other silicate glasses, amorphous $CaSiO_3$ exhibits highly reproducible properties, behaving smoothly and reversibly under pressure cycling and possessing similar structure and elasticity regardless of synthesis paths for the starting material, which suggests that the amorphous solid may mimic the liquid over the pressure range investigated.

Keywords: High pressure, glass, silicate, Brillouin