

## **Elasticity of $\beta$ -Mg<sub>2</sub>SiO<sub>4</sub> containing 1.2 wt% H<sub>2</sub>O to 10 GPa and 600 K by ultrasonic interferometry with synchrotron X-radiation**

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### **ABSTRACT**

We have measured the sound velocities and elasticity of synthetic polycrystalline  $\beta$ -Mg<sub>2</sub>SiO<sub>4</sub> containing 1.2 wt% H<sub>2</sub>O to 10 GPa and 600 K using ultrasonic interferometry with synchrotron X-radiation. We determined sample length at high pressure and temperature using the sample's X-ray image and applied travel-time bond corrections appropriate to the experimental cell assembly configuration. Fitting the entire moduli data to third-order finite strain equations yields the adiabatic bulk [ $K_{S0} = 153.3(4)$  GPa] and shear [ $G_0 = 101.8(2)$  GPa] moduli, their pressure derivatives  $(\partial K_S/\partial P)_T = 5.15(6)$  and  $(\partial G/\partial P)_T = 1.68(3)$  and temperature derivatives  $(\partial K_S/\partial T)_P = -0.0179(9)$  GPa/K and  $(\partial G/\partial T)_P = -0.0151(7)$  GPa/K. Comparing the bulk sound velocity contrast between the new hydrous wadsleyite data and olivine (0.38 wt% H<sub>2</sub>O) with seismic bulk sound velocity contrasts of 3.5% and 4.0% yields 53% and 60% olivine contents, respectively, assuming an isochemical mantle model of the Earth. The results suggest that a hydrous mantle transition zone with a pyrolite model composition could explain the 410 km seismic velocity jump.

**Keywords:** Hydrous wadsleyite, elasticity, high pressure and high temperature, ultrasonic interferometry, in situ