Title: Elasticity of polycrystalline β-Mg_2SiO_4 containing 0.73 wt.% H_2O to 10 GPa and 600 K by ultrasonic interferometry technique combined with synchrotron X-radiation.

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Abstract

The acoustic wave velocities of a dense (99.9% theoretical density) synthetic polycrystalline specimen of wadsleyite (β-Mg_2SiO_4) containing 0.73 wt.% (7300 ppm) of H_2O were determined to 10 GPa and temperatures to 600 K by ultrasonic interferometry, in a 250-ton hydraulic multi-anvil DDIA-type high pressure device inter-phased with energy dispersive X-ray diffraction and X-radiographic systems on Beamline 6-BM-B at the Advanced Photon Light Source in Chicago. Finite strain analysis of elastic bulk (K) and shear (G) moduli yielded $K_{so} = K_s$ = 160.5(1) GPa, G_o = 99.1(2) GPa and $(\partial K_s/\partial P)_T$ = 4.38(2), and $(\partial G/\partial P)_T$ = 1.38(3) for the bulk and shear moduli and their pressure derivatives respectively. Compared to the anhydrous phase, hydration of the wadsleyite leads to a 5.6 % decrease in the bulk modulus and a 13.8% decrease in the shear modulus at ambient pressure and temperature. The pressure derivatives of the elastic moduli are in excellent agreement within the mutual uncertainty of the Brillouin scattering data [$(\partial K_s/\partial P)_T$ = 4.1(1); $(\partial G/\partial P)_T$ = 1.4(1)] for single crystal wadsleyite with 0.84 wt.% H_2O to 12 GPa at 300 K reported by *Mao et al. (2008)* and are also indistinguishable from those of the anhydrous phase. The temperature derivatives of the elastic moduli obtained from linear regression of the entire P-T-Ks and P- up to X_{Fe} = 0.09 shows decreases in the magnitudes of $(\partial K_S/\partial T)_P$ and $(\partial G/\partial T)_P$ of 60% and 27%, respectively. We discuss the implications of the new data on the olivine content of the Earth's mantle. TG data are: $(\partial K_S/\partial T)_P = -0.7(2) \times 10^{-2}$ GPa/K and $(\partial G/\partial T)_P = -1.1(1) \times 10^{-2}$ GPa/K. Comparison of these new temperature derivatives of the elastic moduli with those of anhydrous wadsleyite