American Mineralogist, Volume 88, pages 1312–1317, 2003

Compressional and shear wave velocities of ringwoodite γ-Mg_2SiO_4 to 12 GPa

BAOSHENG LI*

Mineral Physics Institute, State University of New York at Stony Brook, Stony Brook, New York 11794-2100, U.S.A.

ABSTRACT

Compressional and shear wave velocities of ringwoodite (γ-Mg_2SiO_4) were measured on a polycrystalline specimen to 12 GPa at room temperature using ultrasonic interferometry techniques. Velocity measurements at ambient conditions yielded V_p = 9.86(3) and V_s = 5.78(2) km/s. Finite strain analysis of the high pressure velocity data yields K = 185(2) GPa, G = 120(1) GPa, K' = 4.5(2), and G' = 1.5(1) for the elastic moduli and their pressure derivatives, respectively. The velocities and elastic moduli at ambient conditions are indistinguishable from aggregate properties of polycrystalline ringwoodite calculated using single crystal elastic constants (C_{ij}). Comparison of the current results on pressure derivatives of bulk and shear moduli with previous acoustic data on iron free ringwoodite to 3 GPa and iron bearing sample to 16 GPa indicated that the discrepancy can be explained by the pressure range of the experiments rather than iron content. Current results suggest that ringwoodite and wadsleyite posses very similar pressure dependence in elastic properties to the transition zone depth. In a pyrolite mantle with 1400 °C adiabatic foot temperature, the wadsleyite to ringwoodite phase transition is characterized as a seismic reflector spreading about 20 km in width with a density jump of 2.1% and impedance jumps of 2.4% and 3.1% for P and S waves near 520 km depth, which is consistent with seismic observations in long period data.