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Sound velocities and elastic properties of γ-Mg_2SiO_4 to 873 K by Brillouin spectroscopy

JENNIFER M. JACKSON,* STANISLAV V. SINOGEIKIN, AND JAY D. BASS

Department of Geology, University of Illinois, Urbana, Illinois 61801, U.S.A.

ABSTRACT

The sound velocities and single-crystal elastic moduli of spinel-structured γ-Mg_2SiO_4 were measured to 873 K by Brillouin spectroscopy using a new high-temperature cell designed for single-crystal measurements. These are the first reported acoustic measurements of γ-Mg_2SiO_4 elasticity at high temperatures. A linear decrease of elastic moduli and sound velocities with temperature adequately describes the data. The adiabatic bulk modulus, K_S, shear modulus, μ, and respective temperature derivatives for γ-Mg_2SiO_4 are: K_S = 185(3) GPa, μ = 120.4(2.0) GPa, $(\partial K_S/\partial T)_P$ = –0.024(3) GPa/K and $(\partial \mu/\partial T)_P$ = –0.015(2) GPa/K. Extrapolation of our data to transition zone pressures and temperatures indicates that the shear and compressional impedance contrasts associated with β- → γ-$(Mg,Fe)_2SiO_4$ transition are sufficient to produce an observable discontinuity at 520 km depth, even with a moderate (30–50%) amount of olivine.