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Elastic wave velocities of mantle minerals at high pressure

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It is widely accepted that olivine is the most abundant mineral in the Earth's upper mantle. The elastic property changes associated with the phase transformations to its high-pressure polymorphs are very important parameters to constrain the composition of the mantle transition zone. In this study, we measured the elastic wave velocity of iron-bearing Ringwoodite (Mg0.8Fe0.2)2SiO4 and Majorite (Mg0.9,Fe0.1)SiO3, (Mg0.8,Fe0.2)SiO3. The specimen was hot-pressed at 18 GPa and 1273K in a 2000-ton Uniaxial Split Sphere Apparatus (ORANGE-2000: GRC). The recovered polycrystalline specimen was characterized by x-ray diffraction, EPMA, ultrasonic techniques, and the density was determined by Archimedes'method, and found to be single-phase and fine-grained. High-pressure ultrasonic measurement was carried out in a 1000-ton Uniaxial Split-Cylinder Apparatus (USCA-1000: SUNY) at pressures up to 13 GPa at room temperature using ZnTe as an internal pressure marker. The sample was surrounded by lead to minimize the deviatoric stress. Also in this experiment, the travel times of the Al2O3 buffer rod were used for pressure calculation. The travel times of the buffer rod under the same cell geometry have been calibrated as a function of sample pressure by the thermal equation of state of NaCl using in-situ X-ray diffraction techniques. Bulk modulus (K) and shear modulus (G) and those pressure derivatives (K'),(G') of Ringwoodite are obtained by fitting the current experimental data to 13 GPa using third-order finite strains equations, yielding K=181 GPa, K'=5.4 and G=113 GPa, G'=1.6. The results of Majorite will be presented.