J057-P003 Time: May 28 17:00-18:30

P-wave anisotropy in Horoman peridotite at high pressure up to 1.0 GPa

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Anisotropy of compressional-wave velocity (Vp) in natural peridotite was measured up to 1.0 GPa with a piston-cylinder-type high-pressure apparatus with a 34-mm borehole diameter and 80-mm in cylinder thickness. Rock specimen measured is dunite with strong foliation and lineation, collected from the Horoman complex, Hidaka belt, Japan. We measured velocities along X-, Y-, and Z-axis of the rock sample with 14mm diameter and 12mm length. The X-axis is defined as the direction parallel to both lineation and foliation, the Y-axis perpendicular to the lineation and parallel to the foliation, and Z-axis perpendicular to both lineation and foliation. In addition, we made simultaneous measurement of three-direction velocities using a cubic specimen ca.10 mm long (see details in Kitamura in this volume). The samples were oven-dried for 24-hours before high-pressure measurements. Each rock specimen was located in a center of the high-pressure talc cell. Piezoelectric transducers of $LiNbO_3$ were placed on both ends of each core specimen or six planes of a cubic specimen. The pressure medium used was talc polycrystalline with graphite heater. Temperature is monitored with Pt-Rh13 thermo-couple, placed on one end of the rock specimen. Measurements of Vp were made with the pulse transmission technique. High-voltage pulse was input into the $LiNbO_3$ transducer to produce compressional-waves. The compressional-waves were received by another transducer and converted into electrical waveforms detected by an oscilloscope. The raw waveform data are stored on hard disks for later determination of Vp measurement. Because the travel time 'ts' includes a time transmitted through lead lines and a time to convert an electric to mechanical signal, we measured travel time 't0' without rock specimen, and the 't0' has been subtracted from the 'ts' value. The ts - t0 value is a true travel time throughout the rock sample. The electrical waveforms were measured 4096 times for each pressure-temperature condition, and the Vp values reported here were represented by the average values. Errors in ultrasonic velocity measurements are less than 0.09km/s.

Compressional experiments with the core specimens shows that Vp increases rapidly as pressure increase up to ca 0.3, 0.4 and 0.2 GPa for X, Y and Z directions, respectively. They are nearly constant at higher pressures above 0.6. The Vp values at 1.0 GPa are 8.63 km/s, 7.71 km/s, 7.98 km/s for X, Y and Z directions. Compressional experiments with the cubic specimen show that Vp increases rapidly as pressure increase up to ca 0.5GPa for three directions and are nearly constant at higher pressures above 0.6 GPa. At 1.0 GPa it is 8.60 km/s, 7.70 km/s, 7.91 km/s for X, Y and Z directions, respectively. The Vp values measured for the core and cubic specimens are within an error at higher pressure above 0.7 GPa. We calculated Vp-anisotropy value for the core and cubic specimens. They are nearly constant at higher pressure above 0.6 (ca.11%) whereas Vp-anisotropy fluctuated in a pressure range form 1 atom to 0.5 GPa. The present results show that Vp and Vp-anisotropy at lower pressure below 0.6 GPa is significantly lower than those measured at higher pressures. Vp and Vp-anisotropy determined at pressure at 1.0 GPa probably represent elastic properties of dunite in the upper most lithospheric mantle.