Seismic anisotropy under high pressure conditions of harzburgite collected from Oman Drilling Project Phase II

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The Oman ophiolite interpreted as ancient oceanic lithosphere has been drilled recently, and core samples of harzburgite were collected from mantle section (Oman Drilling Project). These compressional wave velocity of three orthogonal directions (X, Y and Z axis) was measured under ambient condition onboard D/V Chikyu. Velocity of Z axis was lower than that of orthogonal directions (X and Y axis), showing approximately 4% of anisotropy. Although anisotropy caused by preferred orientation of olivine was observed at oceanic mantle, olivine in harzburgite collected from ophiolite is almost transformed to serpentine, implying that anisotropy of core samples is caused by preferred orientation of pyroxene. In addition, the preferred orientation of cracks also causes anisotropy, which is sensitive to the type of pore fluid (Anderson et al., 1974). However, the dominant factor of anisotropy is unclear because both effects are included in the measurement under the ambient condition. In this study, we measured elastic wave velocity of harzburgite under high confining pressure where most pores are closed, and determine a dominant factor causing seismic anisotropy.
Harzburgite collected from Hole BA1B and BA3A were selected as the experimental samples. Density and porosity of these samples are 2.60 to 2.64 g/cm^{3}and 0.5% to 1.0%, respectively.Intra-vessel deformation and fluid flow apparatus at Hiroshima University were used to conduct the measurements under high confining pressure of up to 200 MPa. Two loading cycles were applied to each specimen to measure velocity successively under both dry and wet conditions. In wet condition, pore pressure was set at 10 MPa using a syringe pump.Both compressional and shear wave velocity ($V_P$andV_S) on two orthogonal directions (Y and Z axis) were measured from the pulse transmission method with the amplitude and the frequency of a trigger wave of 5 V and 2 MHz, respectively.
In the preliminary results at 200 MPa of confining pressure under dry conditions, harzburgite collected from Hole BA3A shows V_P = 5.86 km/s and V_S = 3.03 km/s on the direction of Y axis, and V_P = 5.49 km/s and V_S = 2.95 km/s on the direction of Z axis. Anisotropy under high confining pressure indicates 6.5% and 2.7% for compressional and shear wave velocity, respectively. Therefore, the preferred orientation of minerals is likely to be a dominant factor.

Keywords: Oman Drilling Project, Harzburgite, Anisotropy, Preferred orientation, Pyroxene, Crack

