## Effect of pore water on elastic wave velocity of serpentinites and implication for serpentinization at outer-rise region

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Recent geophysical surveys at outer-rise regions observed the seismic velocity reduction reaching mantle (e.g., Fujie et al., 2013; Shillington et al., 2015). This is interpreted as seawater could penetrate along outer-rise faults that cut through the oceanic crust, thereby reaching the oceanic mantle and promoting serpentinization (Ranero et al., 2003; Lefeldt et al., 2009). The experiment in laboratory indicated that seismic velocity of peridotite decreases with increasing the degree of serpentinization (Christensen, 2004). The observed velocity is compared with the experimental results, and the degree of serpentinization in mantle is estimated. However, the crack in serpentinite is generated with serpentinization involved with volume expansion (Macdonald and Fyfe, 1985), and it would be filled with water. In this study, we examined the effect of pore water on elastic wave velocity of serpentintie having various porosity, and re-evaluated serpentinizaiton at outer-rise region. The samples were collected from Mineoka Belt in Japan, and dredged from deep seafloor at South Mariana Trench and Tonga Trench. They are low-temperature serpentinite composed of lizardite and chrysotile. Based on petrographic analyses, the degree of serpentinization of those sample was 86-100 %. Porosity was measured by the gas expansion method beads on the isothermal gas equations, and porosity of the samples from Mineoka Belt was 0.3-4.4 % and from deep seafloor were 9.6-27.6 %. Intra-vessel deformation and fluid flow apparatus at Hiroshima University were used to measure the elastic wave velocity. Elastic wave velocity was measured from the pulse transmission method. The experiments were performed under dry and wet conditions, which were controlled on 10 MPa of pore pressure. Confining pressure was up to 200 MPa, and temperature was room temperature. Elastic wave velocities increased with increasing confining pressure, and the velocity at 200 MPa under dry conditions were corresponded with the relationship between density and velocity based on Christensen (2004). Under wet conditions, P wave velocity at low and high confining pressure was 8 % and 3 %, respectively, faster than that under dry conditions. This would suggest that bulk modulus of the rock increased because the pore was filled with water. On the other hand, although S wave velocity of low-porosity samples do not observe the effect of the pore water, at high porosity samples, that was 7 % slower than that under dry conditions. This would imply that although the effect on pore water is not sensitive to shear modules, S wave velocity was reduced because of increasing density. The previous studies proposed that seismic velocity reduction at uppermost mantle is corresponded with 20 % serpentiniizaiton. However, if porosity of serpentinite is 10 % and the pore is filled with water, serpentinization is estimated to 15 %, and less than the previous estimates. Therefore, to evaluate the distribution and the ratio of serpentinite in mantle, porosity in the rock must be exactly understood.

Keywords: Serpentinite, Pore fluid, Elastic wave velocity, Outer-rise region