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# Seismic Velocities of Serpentinized Peridotites from the Happo Ultramafic Complex

Tohru Watanabe[1*], Yuto Shirasugi[1], Hideaki Yano[1], Katsuyoshi Michibayashi[2]

[1]University of Toyama, [2]Shizuoka University

Serpentines play key roles in subduction zone processes including transport of water and slab-mantle coupling. Seismic properties of serpentinized peridotites are essential for seismological mapping of serpentinized regions, which leads to our good understanding of subduction zone processes. In order to understand the influence of serpentinization on seismic properties of peridotites, compressional and shear wave velocities of serpentinized peridotites were measured, and petrofabrics were examined by optical microscopy and SEM-EBSD.

Three serpentinite mylonite samples were collected from the Happo ultramafic complex. The volume fraction of antigorite varies from 39 and 83 %. Sample HPS-M (Atg:39%) shows olivine porphyroclastic texture with olivine neoblasts (~0.1 mm) and thin antigorite grains. Olivine grains show a distinct alignment of c-axes subparallel to the lineation, while antigorite grains are almost randomly oriented. In Samples HKB-D (Atg:60%) and HKB-B (Atg:83%), major axes of antigorite grains are parallel or subparallel to the foliations. CPO data of antigorite shows a strong alignment of b-axes parallel to the lineation and c-axes normal to the foliation plane. A c-axes girdle normal to the lineation is also seen, which reflects the weak folding of foliation. Olivine grains are intensively elongated parallel to the foliations and have well-developed subgrain structures. They show a distinct alignment of c-axes parallel to the lineation.

Velocity measurements by the pulse transmission technique (Central frequency=2 MHz) were conducted at room temperature and confining pressures of up to 180 MPa, at which the influence of pores on velocities is sufficiently small. The fastest compressional wave velocity is observed in the direction parallel to the lineation, and the slowest in the direction normal to the foliation. The shear wave oscillating parallel to the foliation has higher velocity than that oscillating normal to the foliation. As the antigorite content increases, the mean velocity decreases and both azimuthal and polarization anisotropies are enhanced. The compressional wave velocity increases in the direction parallel to the lineation, while it decreases in the direction normal to the foliation.

The compressional wave velocity of antigorite is slowest (~5.6 km/s) in the c-axis direction, and fastest (~8.9 km/s) in the a- and b- directions (Bezacier et al., 2009). Mean velocities are governed by the amount of antigorite, while the strength of velocity anisotropy is primarily governed by the alignment of antigorite grains. The alignment of antigorite grains leads to the increase in compressional wave velocity in the direction parallel to the lineation and the decrease in the direction perpendicular to the foliation.

Before serpentinization, the alignment of olivine grains governs seismic velocities of mantle peridotites. Once serpentinization begins, antigorite grains intrude into olivine grains and also develop in grain boundaries. They are almost randomly oriented, and reduce velocities in all directions to weaken the seismic anisotropy due to CPO of olivine. As serpentinization (plus deformation) progresses, most c-axes of antigorite grains become aligned perpendicular to the

shear plane and the b-axes parallel to the flow direction. The compressional wave velocity increases in the flow direction and decreases in the direction normal to the shear plane. The shear wave velocity also decreases in the direction normal to the shear plane, though its polarization anisotropy is not significant. A strong polarization anisotropy is expected in shear waves propagating parallel to the shear plane. A serpentinized region is characterized by these seismic anisotropies.

Keywords: Seismic velocity, serpentinite, antigorite, water, wedge mantle