

Compressional and Shear Wave Velocities of an Antigorite Rock at 1 GPa up to 550C

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Serpentines play key roles in the water transportation, the slab-mantle coupling and the generation of slab earthquakes. Geophysical mapping of serpentized regions is important for understanding of subduction zone processes. There are three major forms of serpentine: antigorite, lizardite and chrysotile. Antigorite is stable up to 600C at 1 GPa, while lizardite and chrysotile are stable below 300C. Watanabe et al. (2007) showed that High-T type (containing antigorite) serpentized peridotites have distinctive higher velocity and lower Poisson's ratio than Low-T type (containing lizardite and/or chrysotile) with the same density. Seismological observations on warm subduction zones like SW Japan should be interpreted on the basis of antigorite properties. However, our knowledge on elastic properties of antigorite is still lacking. We have measured compressional and shear wave velocities on an antigorite rock at 1 GPa up to 550C.

The rock sample is mostly composed of antigorite and grains are well aligned. The lineation is interpreted to be parallel to crystallographic b-axis, and cleavages normal to c-axis. Measurements were made with various directions of propagation and oscillation. Reflecting the crystallographic structure, the sample shows strong anisotropy of velocity. The fastest direction of compressional wave is the b-axis direction (8.39(4) km/s at 550C), and the slowest the c-axis direction (5.78(6) km/s at 550C). No significant temperature dependence of V_p is observed in the b-axis direction, while V_p decreases by 3.3% from room temperature to 550C in the c-axis direction. Shear wave velocity propagating in the c-axis direction at 550C is 3.15(5) km/s and 3.44(3) km/s for oscillating parallel to the a- and b-axes, respectively.

We have estimated elastic moduli of an antigorite single crystal from measured velocities on the assumption of orthorhombic symmetry of elasticity, and then calculate isotropic compressional and shear wave velocities of a randomly-oriented antigorite polycrystalline aggregate by Voigt-Reuss-Hill average. Compressional and shear wave velocities at 1GPa and 550C are calculated to be 6.8#0.1 km/s and 3.46(2) km, resulting in V_p/V_s of 1.96(4). This value is higher than that of dunite (1.75(5)), but lower than that of Low-T type serpentinites (2.1).