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蛇紋岩の地震波速度-アンチゴライト粒子形状の影響
Seismic velocities of serpentinites - Influence of geometry of antigorite grains

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Serpentinites play key roles in subduction zone processes including transportation of water, seismogenesis, slab-mantle coupling, and exhumation of high-pressure rocks. Geophysical mapping of serpentinized regions leads to further understanding of these processes. Direct study of serpentinites is critical to the interpretation of indirect geophysical observations.

Determination of elastic constants of antigorite (Bezacier et al., 2010) has enabled us to calculate Voigt and Reuss bounds of seismic velocity in serpentinites. There is, however, considerable difference between two bounds due to strong elastic anisotropy of antigorite. Seismic velocity in serpentinites cannot be properly constrained by these bounds that consider mineral composition and orientation of crystal grains. Geometry of antigorite grains (thin plate), which is not considered in Voigt and Reuss bounds, should be taken into account for a better constraint (Watanabe et al., 2011).

We calculated seismic velocity in serpentinites by using a differential effective medium method (DEM). An antigorite grain is treated as a spheroidal inclusion, and embedded in a homogeneous matrix. Strain in the matrix are disturbed by introducing an inclusion, and evaluated by Eshelby's method. Elastic constants of the composite material can be calculated by differentiating the elastic energy with respect to strain. Nishizawa and Yoshino (2001) calculated seismic velocity in mica-rich rocks by embedding spheroidal inclusions with an identical orientation in an isotropic matrix. We modified their method and applied it to the case where spheroidal inclusions with different orientations are embedded in an anisotropic matrix.

Decreasing aspect ratio of an spheroidal inclusion, seismic velocity in serpentinites decreases and approaches to Reuss bound. When spheroidal inclusions are aligned, seismic anisotropy is enhanced with smaller aspect ratio. Seismic velocity calculated by using orientations of crystal grains reasonably reproduces that measured in laboratory. The velocity calculation considering the geometry of antigorite grains is promising for a good prediction of seismic velocity in serpentinites.

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