Elastic wave velocities of serpentinites – influences of mineralogy and deformation

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Serpentinites play important roles in subduction processes, especially in the circulation of water. Seismological characterization of serpentinites is essential to good understanding of subduction processes. In order to build a data base for seismological mapping of serpentinites, we have investigated elastic wave velocities of serpentinites with different mieralogy and deformation textures.

Elastic wave velocities are measured by the pulse transmission technique. Serpentinite specimens were sampled in Hida outer-belt (Toyama, Niigata and Nagano prefectures). The central frequencies of ultrasonic transducers are 2MHz and 1MHz for the compressional and shear waves, respectively. The directional anisotropy of the compressional wave velocity and the polarization anisotropy of the shear wave are studied. While we here show preliminary results under the atmospheric pressure and the room temperature, our poster will include measurements with confining pressures up to 200MPa.

If specimens have no significant deformation textures, a specimen with higher serpentine content shows lower elastic wave velocities and higher Vp/Vs. A peridotite (Horoman, Hokkaido) shows Vp of 7.04-7.25 km/s, Vs of 4.17-4.41 km/s and Vp/Vs of 1.64-1.74. A specimen mostly composed of serpentine shows Vp of 4.98 km/s, Vs of 2.58 km/s and Vp/Vs of 1.93. A serpentinite specimen with 50% of olivine and pyroxene shows intermediate values: Vp=6.2 km/s, Vs=3.38km/s and Vp/Vs=1.84. The directional anisotropy is less than 5%.

Serpentinite schists show strong anisotropy of elastic wave velocities. The compressional-wave velocity Vp normal to the foliation is 3.5-5.1 km/s. It is lower than Vp parallel to the foliation by 25-50%. The strong polarization anisotropy of the shear wave is also observed (27-33%). Photomicrograph shows that most of serpentine crystals are aligned parallel to the foliation. This should be the cause of strong anisotropy. We imagine that the relationship between the anisotropy and the deformation textures can be applied to the estimation of deformation in serpentinite bodies from seisimological observations.