

アンチゴライトの非弾性的性質 Viscoelastic property of antigorite

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Seismological data reveals the structure and dynamics combined with mineral physics. For example, the velocity structures from observations are interpreted using the elastic properties of constituting minerals obtained from the laboratory measurements. Because the minerals in the earth is not perfect single-crystal but they contain a certain amount of defects (vacancy, dislocation, grain boundary), the viscoelastic relaxation is taken place by the viscous motion of the defects during the propagating the seismic waves with the frequency of 10^{-4} -10 Hz. Serpentine can be considered to be one of the candidate for the source of the fluid in the wedge mantle. In the present study, therefore, we examine the viscoelastic property of serpentine (antigorite) under uppermost mantle conditions by means of high pressure experiments.

Fine-grained polycrystalline antigorite (a few micrometer of grain size) sintered at 3 GPa and 550 degree C for 4 hours was used as a starting material for the attenuation experiment. We conducted the experiments by using D-DIA press with a short-period cyclic loading system, which was recently installed at BL04B1, SPring-8, Japan. D-DIA, which is a single stage of six-anvil compression device, applied pressure by forcing each of the six anvils to advance on the cubic pressure medium with a main ram. After pressure reaching to the target value of 1 GPa by the pumping the main ram, a sinusoidal stress and strain was applied by advancing and withdrawing the upper and lower anvils operated by the short-period cyclic loading system with the frequency between 0.01-2 Hz at 1 GPa and 500-750 degree C. At high temperature (>650 degree C), dehydration is expected. The strain was monitored directly from X-ray radiography of sample located in the pressure medium through the anvil gap during cyclic loading. In the present study, single crystal of forsterite was placed next to the sample along the stress axis of the sample and it can be used as the standard to estimate the stress by recording the X-ray radiography images displaying the lengths of standard and sample simultaneously.

The time lag of strain of sample against that of standard provided us the quality factor, Q , to be 5.4, 4.8 and 4.4 for the periods of 5, 10 and 20 s, respectively, at 600 degree C. Present preliminary results shows the temperature dependence of Q^{-1} . At 500 degree C, Q^{-1} s are ~ 0.5 log unit lower than those at 600 degree C. The present values is ~ 2 order of magnitude lower than that of olivine aggregates. The shear modulus was estimated to be 15-25 GPa in our experimental condition, which is much smaller than the shear modulus without attenuation (38.5 GPa). The large reduction in shear modulus due to attenuation was previously reported in the case of olivine.