

Estimation of chemical composition of mantle transition region by elastic velocity measurements of mantle mineral

Yuji Higo[1]; Toru Inoue[1]; Tetsuo Irifune[1]; Ken-ichi Funakoshi[2]

[1] GRC, Ehime Univ.; [2] JASRI

Seismic velocity data has high quality information about the structure of the earth. Combining seismic velocity data with elastic velocity data of mineral, we can clarify composition and condition in the earth. It is widely accepted that 410, 520 and 660 km seismic wave velocity discontinuities are responsible for high-pressure phase transitions of olivine. Ringwoodite (high pressure polymorph of olivine) and majorite (high pressure polymorph of pyroxene and) are considered to be the most abundant mineral at depths between 520km and 660km in the mantle transition region, and it is important to accurately determine the elastic wave velocities in order to discuss the mineralogy and composition of the mantle transition region. In this study, I have developed ultrasonic measurement system and measured the elastic wave velocity of ringwoodite and majorite at high pressure and high temperature.

In-situ X-ray experiments were performed using Kawai-type high-pressure apparatus SPEED-1500 at SPring-8. The unit cell constants of pressure marker (NaCl, Au) and sample were measured for estimation of pressure. A X-ray radiography was used in this study for direct measurement of sample length at high pressure and high temperature. The ultrasonic signals were generated and received by a LiNbO₃ transducer (10degree; Y-cut), which can produce both longitudinal and shear waves at the same time.

We have successfully measured elastic wave velocities of ringwoodite and majorite around 18GPa, 1700K that correspond to mantle transition condition. The results on the ringwoodite sample were consistent with those of earlier studies at lower pressure/temperature conditions, whereas the velocities of majorite with the complex chemical composition were substantially lower than the earlier estimates based on the measurements for simpler compositions under lower P/T conditions. The detail of elasticity of ringwoodite and majorite will be introduced.