Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SIT41-02 Room:302 Time:May 20 09:15-09:30

Viscosity structure model around 410-km discontinuity: mineralogical approach

KAWAZOE, Takaaki[1*], Yu NISHIHARA[2], Tomohiro OHUCHI[1], Masayuki NISHI[1], Kiyoshi FUJINO[1], Yuji HIGO[3], Ken-Ichi FUNAKOSHI[3], Tetsuo IRIFUNE[1]

[1]Ehime University, Geodynamics Research Center, [2]Ehime University, Senior Research Fellow Center, [3]Japan Synchrotron Research Institute

The 410-km seismic discontinuity has been attributed to the pressure-induced phase transformation from olivine to wadsleyite in an olivine component of mantle peridotite. The phase transformation may induce abrupt change in viscosity at 410 km depth, and the viscosity discontinuity may play an important role in the dynamics of the upper mantle and the mantle transition zone. Attempts have been made to determine viscosity structure of deep mantle by geophysical observations (e.g., aisostasy data of post-glacial rebound and gravity anomaly observations), however, the obtained viscosity-depth profile has been controversial. On the other hand, the viscosity-depth profile of deep mantle can be determined based on experimental data of a deformation experiment at high pressure and temperature. Recently, we made technical developments in the deformation experiment adopting new technique for high-pressure generation, and achieved viscosity measurement at pressure-temperature conditions of the upper part of the mantle transition zone. In order to determine the viscosity at the upper part of the mantle transition zone, we conducted in situ stress-strain measurement of wadsleyite at 13-14 GPa, 1400-1700 K and strain rates of 3.1-15 x 10^{-5} s^{-1} using a deformation-DIA apparatus at BL04B1 beamline of SPring-8. We found that water enhanced plastic deformation of wadsleyite and water dependence of wadsleyite creep strength was larger than that of olivine. Based on the experimental result, viscosity decreases at the 410 km boundary at moderate water content while little viscosity contrast exists at dry condition. Moreover, these experimental results suggest that heterogeneity in water at the mantle transition zone leads large viscosity heterogeneity at the upper part of the mantle transition zone.

Keywords: 410-km discontinuity, wadsleyite, viscosity, creep strength, water, deformation experiment