Rheological Study of Hydrous γ-Phase Using *in situ* X-ray Diffraction

X17B1

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Water influences rheological properties of minerals. Especially, γ-Mg_2SiO_4, which is a high pressure polymorph of olivine, can accommodate a few wt% H_2O in the crystal structure. It is important to examine the rheological property of hydrous γ-phase because γ-phase is the most abundant mineral in the mantle transition zone.

Hydrous γ-phase was synthesized at a pressure of 19 GPa and a temperature of 1300°C using the MA-8 type apparatus (USSA-2000) at SUNY, Stony Brook. The composition of the recovered sample was measured by EPMA and the H_2O content was measured by SIMS. The present hydrous γ-phase includes about 2 wt% H_2O.

Using a T-Cup[1], which is a new high-pressure apparatus for *in-situ* X-ray studies, embedded in SAM-85 at the X17B1 beam line, we studied the temperature-time dependence of microscopic deviatoric stress using the method developed by Weidner[2]. Pressure was increased to approximately 19 GPa at room temperature, and then heated to 400°C, 600°C, 800°C and finally 1000°C. At each temperature, the data was collected every 60 s for 40 to 80 min. We analyzed the microscopic strains from peak broadening for the (311) diffraction line.

At 400°C, the microscopic strain was approximately 0.017, and slightly decreased with time. At 600°C and 800°C, those are approximately 0.01 and 0.005, respectively, and the strain was completely relaxed at 1000°C. The above results shows that the microscopic strain remains at even 800°C. Comparing with our previous studies of olivine, hydrous γ-phase is much stronger than olivine. We will continue to do this type of experiments of various minerals to clarify the rheology of the mantle transition zone.

References:

[1] D.J. Weidner, Y.B. Wang, M.T. Vaughan, C.C. Koleda and I.C. Getting: T-Cup: A New High-Pressure Apparatus for X-ray Studies, NSLS Activity Report, 140 (1995).

[2] D.J. Weidner, Y.B. Wang and M.T. Vaughan: Strength of Diamond, Science, 266, 419-422 (1994)