In-situ Measurement of the Rheology of Silicate Garnets at High Pressure	X17B1

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We have examined the rheological properties of silicate garnets using the DIA type cubic anvil apparatus (SAM-85) at the X17B1 beam line. The mechanical data of deformation are collected from the shape change of diffraction peaks. This method was devised by Weidner *et al.*[1,2] at this beam line. We then observe the microstructures of recovered samples by TEM to understand the mechanisms of deformation processes. Using this experimental method, it is possible to observe the rheological behavior of mantle minerals under mantle conditions. Here we report the results for four garnets. They are Py_{100}, $Py_{50}Mj_{50}$, $Py_{23}Al_{48}Gr_{28}Sp_1$ and $Py_{68}Al_{18}Gr_{14}Sp_1$. The first two samples are synthetic garnets, and last two samples are garnets from natural rocks. Experimental conditions are 9 GPa confining pressure and temperatures up to 860°C. Significant compositional effects of strength at all temperature range were observed for these samples. $Py_{50}Mj_{50}$ and $Py_{68}Al_{18}Gr_{14}Sp_1$ were considerably stronger at higher temperature than the other samples. Natural samples suggest that yield strength of garnet increases with increasing pyrope content. But synthetic pure pyrope is weaker than $Py_{23}Al_{48}Gr_{28}Sp_1$. This weakness may be caused by new phase occurred between pyrope grains during experiment or minor glass phase in starting synthesized pyrope. TEM observation supports the first effect. Our result shows that the rheological behavior of silicate garnet depend greatly on it's composition.

References:
[1] D.J.Weidner, Y.Wang, NSLS Activity Report, p310 (1992);
[2] D.J.Weidner, Y.Wang, M.T. Vaughan, Science, 266, p419-422, (1994)