Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SMP44-02 Room:102A Time:May 20 09:15-09:30

X-ray diffraction analysis of pyrope melts at high pressures

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Silicate melts play important roles in the chemical evolution of the planetary mantle and crust. Density and viscosity are important physical properties to control the migration of silicate melts, which are strongly related to structure of silicate melts. Thus the structural studies of silicate melts are fundamental to understand magma related processes in the planetary interior. Here we report the results of X-ray diffraction analysis of $Mg_3Al_2Si_3O_{12}$ (pyrope) melts at high pressures.

Static structure of pyrope melts has been studied by in situ x-ray diffraction experiments using synchrotron radiation at Photon Factory, KEK, Japan. X-ray diffraction patterns were acquired just above the melting temperature to about 5.5 GPa by energy-dispersive x-ray diffraction method and were analyzed by Fourier method.

The radial distribution functions show the decrease of the peak intensity that is related to the 4-fold coordinated Al-O and Si-O. This is explained by the decrease of the 4-fold coordinated Al and the increase of highly-coordinated Al with pressure. Pyrope includes large amount non-bridging oxygen and high field strength element Mg. Thus Al in the pyrope melt takes highly coordinated state at relatively low pressures.

Keywords: magma, synchrotron radiation, high pressure