Water solubility in aluminous bridgmanite at high pressures

Jiuhua Chen[1,2], Martha G Pamato[3], Toru Inoue[4], Sho Kakizawa[4], Bin Yang[1], Yangting Lin[5], Tomoo Katsura[3], Takaaki Kawazoe[3] and Bingbing Liu[6], (1)HPSTAR, China; (2)Florida International University, USA; (3)Bayerisches Geoinstitut, Germany; (4)Ehime University, Japan; (5)Institute of Geology and Geophysics, China; (6) Jilin University, China

Abstract: We have conducted a sequence of high pressure experiments to study water solubility in aluminous bridgmanite as a function of pressure at 1900^{o}C. The experimental pressures were generated using multi-anvil presses up to 33 GPa. The starting material for these experiments was a mixture of oxides ($Mg(OH)_2$, Al_2O_3 and SiO_2) with equivalent of about 5 mol % of Al_2O_3 and 15 wt % of H_2O. The structure and composition of the bridgmanite sample after high P/T syntheses were examined using x-ray diffraction (XRD) and electron probe microanalysis (EPMA). Water concentration in the sample was measured using secondary ion mass spectroscopy (SIMS) and Fourier transform infrared spectroscopy (FTIR). The measurements yield that the aluminous bridgmanite with about 2 wt% of Al_2O_3 may take as much as 0.13 wt % of H_2O at the P/T condition of the top of the Earth's lower mantle and this solubility increases significantly with pressure (water fugacity). Depending on the hydration mechanisms and availability of aluminum content in the mantle, the water solubility in aluminous bridgmanite may reach a maximum value of 1 to 2 wt %. Details of the predicted variation in the water solubility as a function of depth will be discussed. The experimental result indicates that the capacity of water reservoir of the lower mantle can be as large as six oceans of water.