Water reservior in Earth's lower mantle

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A sequence of high pressure experiments were conducted to study water solubility in aluminous bridgmanite as a function of pressure at 1900ºC. The experimental high pressures were generated using multi-anvil presses at Bayerisches Geoinstitut (BGI) for pressures up to 28 GPa and at Geodynamics Research Center (GRC) for pressures above 30GPa. 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. At the bottom of Earth's lower mantle, bridgmanite may take nearly a couple of weight percent of water according to simple extrapolation of the experiment result, indicating that the capacity of water reservoir of the lower mantle can be as large as a few to ten oceans of water.