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Equation of state of MgSiO$_3$ post-perovskite phase

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Super Earths which have a few times of Earth's mass were found in the extra solar system. MgSiO$_3$ post-perovskite is a most fundamental silicate phase in such huge terrestrial planets. Thus, the compression behavior of MgSiO$_3$ at multi-megabar pressure is important to understand the Super Earth's interior. Here we report the compression behavior of MgSiO$_3$ post-perovskite phase up to 290 GPa.

Mg$_2$SiO$_4$ olivine powder mixed with 5 wt.% Au powder was used as a starting material, and MgSiO$_3$ glass powder used as the thermal insulator. We used a symmetric-type diamond anvil cell with the diamond anvils of culet size of 35 and 100 um for high pressure generation. The olivine pellet was coated by thin (150-200 nm) gold layers by conventional sputtering method and loaded into a sample hole that had been drilled in a precompressed tungsten gasket. Sample was annealed by the double-sided laser heating system with fiber laser at each pressure condition to minimize the deviatoric stress in the sample. The unit cell volume of the sample was determined by the synchrotron X-ray diffraction experiment at the SPring-8 BL10XU beamline, Japan. The experimental pressure was determined by the third order Birch?Murnaghan equation of state of gold as reported by Tsuchiya (2003).

MgSiO$_3$ post-perovskite phase was compressed up to 290 GPa. at 290 GPa, the cell parameters are a=2.341(3) A, b=7.570(11) A, c=5.823(3) A, and volume is V=103.19(46) A^3. This volume agrees with the volumes that estimated from ab initio calculations (Tsuchiya et al., 2005; Oganov and Ono, 2004) within 1 %.

Keywords: post-perovskite, Super Earth