Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SIT042-08 Room: 101 Time: May 25 11:15-11:30

Phase relations in (Mg0.93,Fe0.07)SiO3 to 24 GPa: implications for seismic velocities of subducted harzburgite

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Phase relations in (Mg0.93Fe0.07)SiO3 was studied at pressures between 18 and 24 GPa and at a temperature of 1773 K. Experiments were carried out using a Kawai-type apparatus and tungsten carbide anvils with truncated edge length of 2.5 mm. The starting material was a synthetic pyroxene with (Mg0.93,Fe0.07)SiO3 composition prepared using a room-pressure furnace. Samples with compositions of MgSiO3 and Mg2SiO4 were also put into the cell assembly for comparison to observe effect of iron and for an internal pressure standard. According to the experimental results in (Mg0.93,Fe0.07)SiO3, akimotoite is stable in a very narrow pressure range less than 0.5 GPa at pressure of about 22 GPa, whereas ringwoodite+stishovite is stable in wide pressure range from 19 to 22 GPa. In contrast, akimotoite is stable over a wide pressure range of about 3GPa in MgSiO3. However, iron does not affect the phase transition pressure from akimotoite to perovskite and that from pyroxene to wadsleyite+stishovite. The akimotoite-perovskite transition pressure is lower than that of post-ringwoodite transition in Mg2SiO4, which is consistent with a result by thermodynamic calculation based on newly obatained heat capacity measurements. Phase relations in (Mg0.93,Fe0.07)SiO3, a representative composition of pyroxene in harzburgite of oceanic lithosphere, has important implications for phase relations in harzburgite and the dynamic behavior of subducted stagnant slabs in the mantle transition zone.

Keywords: phase relations, effect of iron, harzburgite, mantle transition zone