Structural studies of FeAlO3 at high pressure and temperature

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It is known that aluminum content in MgSiO3 perovskite greatly affects its bulk moduls. According to Gramsch & Prewitt (2002), both a garnet phase and a perovskite phase of FeAlO3 are stabilized at high pressure and temperature. The existence of FeAlO3-perovskite suggests that the system of MgSiO3-FeAlO3 is possibly important at lower mantle conditions. Although they reported lattice parameters of both phases at high pressure, details seem to be still controversial.

We synthesized FeAlO3 with a defect spinel structure as a starting material. High pressure and high temperature experiments were performed at several pressure-temperature conditions up to 50 GPa and 2000C by using a diamond anvil cell and a laser heating technique with a Nd-YAG laser. After those experiments, we performed synchrotron x-ray diffraction experiments at BL13A in PF.

Below about 1200C at all pressure range in this study, FeAlO3 was dissociated into Al-bearing hematite and Fe-bearing corundum. Above 25GPa and higher temperatures than about 1500C, we obtained FeAlO3-perovskite. The FeAlO3-perovskite could be indexed as orthorhombic and the perovskite structure was preserved in decompression process to atmospheric pressure. The cell parameters were a=4.930(38)A, b=5.026(24)A, c=7.156(29)A, V=177.3(29)A^3 at an ambient condition. We also obtained the bulk modulus of K0=214(7)GPa with K"=4 being fixed.

We could observe a garnet phase of FeAlO3 only in single experiment performed at about 18GPa and 1300C (tetragonal, a=11.52(17)A, c=11.29(14)A at 18GPa and a room temperature). This suggests the possibility of either a narrow stability field or a metastable phase of FeAlO3-garnet. At higher temperature than about 1500C below about 25 GPa, FeAlO3 was dissociated into Al-bearing magnetite (or its high pressure phase with CaMn2O4 structure) and Fe-bearing corundum.