Solubilities of ferric iron and aluminum into major constituent minerals in the lower mantle

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Solubilities of ferric iron and aluminum into major constituent minerals were studied by a laser-heated diamond anvil cell combined with synchrotron X-ray radiation and analytical electron microscopy.

The analyzed results indicate that ferric iron and aluminum predominantly incorporate into MgSiO3 perovskite (Mg-Pv) as Fe(3+)AlO3 component when Mg-Pv and CaSiO3 perovskite (Ca-Pv) coexist.

The maximum solubility of FeAlO3 in Mg-Pv increases with pressure and the substitution Mg + Si = Fe(3+) + Al becomes predominant, while the substitution Si = (Fe3+, Al) or Mg + Si = 2Al also partly occurs at low pressures around 30 GPa. The orthorhombic distortion in Mg-Pv increases with the FeAlO3 incorporation. Further, the effects of the FeAlO3 incorporation in Mg-Pv on the physical properties of Mg-Pv are discussed.