

Al₂O₃ solubility in orthopyroxene coexisting with spinel + quartz and sapphirine + quartz in the Mg₃Al₂Si₃O₁₂ system

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High pressure experiments were carried out to determine Al₂O₃ solubility in orthopyroxene in equilibrium with assemblages of spinel + quartz and sapphirine + quartz in the Mg₃Al₂Si₃O₁₂ (pyrope composition) system at pressures 0.7 to 2.2 GPa and temperatures 1100C to 1400C.

The phase boundary of the univariant reaction: 2MgAl₂O₄ (Spl) + SiO₂ (Qtz) = Mg₂Al₄SiO₁₀ (Spr) locates within a certain pressure between 1.5 and 1.75 GPa at 1300C. Solubility of Al₂O₃ in orthopyroxene increases with increasing temperature and decreases with pressure. Orthopyroxene behaves as Mg₂Si₂O₆-MgAl₂SiO₆ binary regular solution.

High pressure experiments were carried out to determine Al₂O₃ solubility in orthopyroxene in equilibrium with mineral assemblages of spinel + quartz and sapphirine + quartz: MgAl₂SiO₆ (Opx) = MgAl₂O₄ (Spl) + SiO₂ (Qtz), and 2MgAl₂SiO₆(Opx) = Mg₂Al₄SiO₁₀ (Spr) + SiO₂ (Qtz) in the Mg₃Al₂Si₃O₁₂ (pyrope composition) system at pressures 0.7 to 2.2 GPa and temperatures 1100C to 1400C. Run times were 2-270 hours.

Starting materials used in this study were the mineral mixture of olivine + cordierite + spinel sintered at 1 atm and 1300C, pyrope garnet synthesized at 3.0 GPa and 1300C, and glass. Pulverized materials (about 5-10 microns) were put into graphite capsules in the BN sleeve, which was situated in the talc+Pyrex glass pressure transmitting medium. All experiments were conducted under dry condition. Pressure calibrations were carried out by the quartz-coesite transformation at 1000C, and Bi(1)-Bi(2) transition at room temperature. Temperatures were monitored by Pt-Pt13%Rh thermocouple.

The assemblage of orthopyroxene + spinel + quartz was stable at 1.5 GPa and 1300C. At 1.75 GPa, the stable assemblage changed to orthopyroxene + sapphirine + quartz. This indicates that the phase boundary of the univariant reaction: 2MgAl₂O₄ (Spl) + SiO₂ (Qtz) = Mg₂Al₄SiO₁₀ (Spr) locates within 1.5 and 1.75 GPa at 1300C. Solubility of Al₂O₃ in orthopyroxene increases with increasing temperature and decreases with pressure. Orthopyroxene behaves as Mg₂Si₂O₆-MgAl₂SiO₆ binary regular solution.