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High-pressure phase relation of $MnSiO_3$ up to 85 GPa: Existence of $MnSiO_3$ perovskite

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Abstract

The high-pressure phase relation of $MnSiO_3$ was examined up to 85 GPa and 2600 K using a laser-heated diamond-anvil cell combined with synchrotron radiation. $MnSiO_3$ garnet decomposes into a mixture of MnO with a rock-salt structure (B1) + SiO_2 stishovite at pressures higher than ~20 GPa and temperatures higher than ~1200 K. However, MnO (B1) + SiO_2 stishovite further transforms to a perovskite structure with increasing pressure. The phase boundary between these structures is positive in the pressure-temperature diagram. The triple point of garnet, MnO + SiO_2 and perovskite in the pressure-temperature diagram is ~20 GPa and 1200 K. $MnSiO_3$ perovskite is orthorhombic, and consistent with space group *Pbnm*, both at high pressure and high temperature and at high pressure and room temperature, but becomes amorphous during decompression. The refined cell parameters of $MnSiO_3$ perovskite at 85 GPa and 2600 K are a = 4.616(2) Å, b = 4.653(2) Å, c = 6.574(3) Å, and V = 141.2(2) Å^3. The a/b ratio increases (approaches 1) with pressure and temperature, while the $\sqrt{2}a/c$ ratio remains nearly constant (<1). This indicates that the orthorhombic distortion decreases and the structure tends toward a tetragonal perovskite with increasing pressure and temperature.

Keywords: $MnSiO_3$ perovskite, $MnSiO_3$ garnet, MnO with a rock-salt structure, laser-heated diamond anvil cell