High-pressure behavior of synthetic $Na_{0.884}Fe^{2+}_{0.199}Mg_{0.475}Si_{2.442}O_6$ clinopyroxene

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Most clinopyroxenes of the Earth's crust and upper mantle contain only tetrahedrally coordinated silicon. However, some high-pressure experiments [1-3] demonstrate the capability of clinopyroxenes to accommodate ^{VI}Si. This suggests that the stability field of such minerals may be expanded to the lowermost upper mantle and transition zone. The first synthesis of the $Na(Mg_{0.5}Si_{0.5})Si_2O_6$ pyroxene at 10 and 15 GPa and its unit-cell parameters measured by X-ray single-crystal diffraction were reported in [1]. The stability field of Na-pyroxene and the pyroxene/garnet transition was studied in [4]. Here we report the high-pressure behaviour of a Fe-bearing Na-pyroxene, $Na_{0.884}Fe^{2+}_{0.199}Mg_{0.475}Si_{2.442}O_6$, up to 30 GPa at room temperature by synchrotron X-ray single-crystal diffraction.

The diffraction pattern of a crystal, loaded in a diamond anvil cell at ESRF (ID09A), can be indexed with the following monoclinic unit cell (space group $C2/c$): a = 9.5059(9), b = 8.6667(2), c = 5.2715(7) Å, β = 108.04(9)°, V = 413.1(6) Å^3. The lattice parameters decrease gradually with pressure reaching a = 9.0339(14), b = 8.056(17), c = 4.9585(7) Å, β = 105.47(7)°, V = 347.9(4) Å^3 at 30 GPa. No amorphization or phase transitions were detected in the studied pressure range.

The variation of the unit-cell volume is rather smooth and can be described with a third-order Birch-Murnaghan equation of state giving a bulk modulus of K_0 = 124(4) GPa and K' = 3.7(3) in the same range.

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