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A new high-pressure phase transition in clinoferrosilite: In situ single-crystal X-ray diffraction study

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Abstract

Synchrotron-based high-pressure single-crystal X-ray diffraction experiments were conducted on synthetic pure clinoferrosilite, $Fe_2Si_2O_6$, at room temperature to a maximum pressure of 45 GPa. In addition to the previously described $P2_1/c \rightarrow C2/c$ phase transition between 1.48 and 1.75 GPa (Hugh-Jones et al. 1994), we observe further transition between 30 and 36 GPa into the high-pressure $P2_1/c$ phase (HP-$P2_1/c$). The $C2/c \rightarrow$ HP-$P2_1/c$ transition is induced by rearrangement of half of the layers of corner-sharing SiO_4 tetrahedra into layers of edge-sharing SiO_6 octahedra. The new configuration of ^{VI}Si layers suggests a possibility of a progressive transformation of the pyroxene into an ilmenite-type structure. The persistence of metastable pyroxene up to pressures higher than expected and its feasible direct transformation to ilmenite are of special interest for understanding the dynamics of cold-subducting slabs. We report on structural and compressibility features of both high-pressure phases as well as address thermal stability of HP-$P2_1/c$.

Keywords: Pyroxene, single-crystal X-ray diffraction, high-pressure, high-temperature, phase transitions