

Equation of state of γ -tricalcium phosphate, γ -Ca₃(PO₄)₂, to lower mantle pressures

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ABSTRACT

The γ -tricalcium phosphate phase (γ -TCP), γ -Ca₃(PO₄)₂, is a high-pressure polymorph of tricalcium phosphate with a potential important implication as the reservoir of rare-earth elements and very large lithophile elements in the deep mantle. In situ synchrotron X-ray diffraction measurements of the γ -TCP phase have been carried out using a diamond-anvil cell to 40.29 GPa at room temperature, with a methanol-ethanol mixture as the pressure medium. The pressures in the measurements have been determined by using gold metal as the internal pressure calibrant. The third-order Birch-Murnaghan equation of state fitted to the experimentally defined unit-cell parameters suggests for the γ -TCP phase a density of $\rho_0 = 3.461(1)$ g/cm³, an isothermal bulk modulus of $K_T = 100.2(13)$ GPa, and first pressure derivative of $K'_T = 5.48(16)$. When K'_T is fixed at 4, the derived K_T is 113.1(12) GPa.

Keywords: γ -Ca₃(PO₄)₂, equation of state, synchrotron X-ray diffraction, high pressure