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High-pressure study on lead fluorapatite

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Abstract

The compressional behavior of a synthetic lead fluorapatite [$Pb_{9.35}(PO_4)_6F_2$] has been investigated in situ up to about 16.7 GPa at 300 K, using a diamond-anvil cell and synchrotron X-ray diffraction. We find that the compressibility of lead fluorapatite is significantly different from that of fluorapatite [$Ca_{10}(PO_4)_6F_2$], chlorapatite [$Ca_{10}(PO_4)_6Cl_2$], and hydroxylapatite [$Ca_{10}(PO_4)_6(OH)_2$]: lead fluorapatite is much more compressible, and elastically isotropic in the investigated pressure range. The pressure-volume data fitted to the third-order Birch-Murnaghan equation yield an isothermal bulk modulus (K_T) of 54.3(18) GPa and the pressure derivative (K_T') of 8.1(6). If K_T' is fixed at 4, the obtained K_T is 68.4(16) GPa, which is approximately only two-thirds of the isothermal bulk modulus of the calcium apatites.

Keywords: Lead fluorapatite, compressibility, synchrotron X-ray diffraction, isothermal bulk modulus, high pressure