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Compression of albite, $NaAlSi_3O_8$

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Abstract

The structure and equation of state of low albite, $NaAlSi_3O_8$, has been determined using high-pressure single-crystal X-ray diffraction to a maximum pressure of 9.43 GPa. Low albite remains triclinic in space group $C\bar{1}$ over the entire pressure range and no phase transitions were observed although the evolution of the unit-cell parameters and volume exhibit some unusual features at pressures above 4 GPa. A third-order Birch-Murnaghan equation of state fit to 6 *P*-*V* data points up to 3.4 GPa has K_0 = 54.2(7) GPa and K' = 5.3(6). At higher pressures the volume-pressure curve exhibits $d^2V/dP^2 < 0$ and the entire *P*-*V* data set can be approximated with a fourth-order Birch-Murnaghan equation of state with K_0 = 52.3(9) GPa, K_0' = 8.8(6), and K_0'' = –2.8(2) GPa^{-1}.

The anisotropy of the compression of albite is typical of that of feldspars with 65% of the volume compression accounted for by the compression of the (100) plane normal. This is due to the closing-up of the crankshaft chains of tetrahedra that are characteristic of the feldspar structure. Single-crystal X-ray intensity data sets collected at 6.4, 8.4, and 9.4 GPa also show that the four-membered rings of tetrahedra within the structure undergo significant shear at high pressures. Changes in the rate of shear of the four-membered rings with pressure are associated with changes in the variation of the unit-cell angles with pressure.