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High-pressure phase transitions in $Ca_{0.2}Sr_{0.8}Al_2Si_2O_8$ feldspar

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ABSTRACT

A synthetic feldspar of composition $Ca_{0.2}Sr_{0.8}Al_2Si_2O_8$ ($An_{20}SrF_{80}$) (space group $I\bar{1}$ at room condition, $Q_{od} = 0.88$) was investigated using in situ high-pressure single-crystal X-ray diffraction. Unit-cell parameters were measured as a function of pressure to 7.7 GPa at room *T*. Two reversible phase transitions were observed in the investigated pressure range. A first-order triclinic $I\bar{1}$ to monoclinic $I2/c$ phase transition was observed at $P \sim 4.3$ GPa. Several cycles through the transformation were made to constrain the hysteresis (~0.3 GPa). The discontinuous character of the transition is especially noticeable in the behavior of the γ angle, which increases from 90.55° to 91.04° before P_{tr}. The Murnaghan EoS parameters obtained for the volume are: $V_0 = 1393.97(6)$ Å^3, $K_0 = 88.7(5)$ GPa, $K' = 1.3(3)$ for the triclinic $I\bar{1}$ phase and $V_0 = 1396.9(1)$ Å^3, $K_0 = 89.4(9)$ GPa, $K' = -1.7(6)$ for the monoclinic $I2/c$ phase whose high-*P* behavior appears, therefore, linear in the pressure range of its stability. The axial compressibility scheme is $\beta_a > \beta_c > \beta_b$ for both phases, in good agreement with previous observations for other feldspars. A similar displacive ferroelastic $I\bar{1}$-$I2/c$ phase transition was observed for the same sample with increasing temperature. At $P \sim 7.3$ GPa a large discontinuity in the unit-cell parameters indicates a further transition from monoclinic $I2/c$ phase to monoclinic-II phase. This transformation is strongly first order with a volume change of about 1.7%.