American Mineralogist, Volume 84, pages 120–129, 1999

High-temperature in situ structural investigation on lead feldspar

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Abstract

Single-crystal X-ray diffraction was performed in situ at T = 20, 230, 465, and 700 °C on a partially ordered lead feldspar ($PbAl_2Si_2O_8$, $I2/c$, a = 8.402, b = 13.043, c = 14.308 Å, β = 115.30°, V = 1417.6 Å^3; Q_{od} = 0.71). The unit-cell expansion (1.26×10^{-5} °C^{-1}) is close to that observed for other feldspars, sanidine in particular, and occurs predominantly along a*. The electron-density at the Pb site evolves with temperature toward a bean-like configuration close to that observed in disordered lead feldspar. The average Pb position approaches the c-glide plane with increasing temperature. Consequently the intensity of the b-type reflections reduces dramatically without evidence of an increase of Al-Si disorder. The evolution of atomic displacement parameters of the Pb atom with temperature supports the view that at room temperature Pb shows considerable positional disorder. Dark-field in situ TEM observations show that b antiphase domains (APD) persist unchanged in shape and size up to T = 690 °C. No diffuse component appears in b-type reflections in SAD patterns up to 935 °C, showing that the above changes in the Pb configuration do not affect the APD. The results suggest that, at $T > 700$ °C, Pb reaches the glide plane assuming a configuration that may favor the Al-Si disorder.