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Single-crystal in situ high-temperature structural investigation on strontium feldspar

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ABSTRACT

A single crystal of ordered strontium feldspar ($SrAl_2Si_2O_8$) was used for in situ X-ray intensity data collection at T = 20, 160, 330, 510, and 670 °C. The crystal was synthesized from the melt and thermally treated at T = 1450 °C for 146 h (a = 8.379, b = 12.963, c = 14.245 Å, β = 115.46 °, V = 1397.0 Å^3; Q_{od} = 0.82). At room temperature 1517 reflections of a-type and 988 reflections of b-type with $F_o \geq 2\sigma(F_o)$ were observed with R = 4.0% for refinement in space group $I2/c$. The dimensions of the tetrahedra do not change significantly with increasing temperature implying that the Al-Si configuration remains unchanged throughout the experimentally investigated temperature range. The Sr-coordination polyhedron expands regularly with temperature. The linear coefficient of volume expansion ($\alpha_v = 1.69 \times 10^{-5}$ /°C) is close to that observed for the other feldspars. The thermal expansion ellipsoid shows a remarkable anisotropy and the main expansion occurs close to a*, as observed in the other monoclinic K-, Ba-, and Pb-feldspars. The variation along a* is related to the flexing of the double-crankshaft chains in response to the expansion of the Sr-polyhedron. As in Pb-feldspar, a progressive displacement of the non-tetrahedral cation towards the c-glide plane with increasing temperature is observed. However, in Sr-feldspar, the temperature increase does not cause the atoms of the M polyhedron to approach $C2/m$ symmetry. These results suggest that the atoms of the Sr-polyhedron retain $I2/c$ symmetry at elevated temperatures and the Sr-polyhedron does not assume a configuration that may significantly favor Al-Si disorder.