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Structural variations induced by thermal treatment in lead feldspar ($PbAl_2Si_2O_8$)

Mario Tribaudino,[1] Piera Benna,[1,2] and Emiliano Bruno[1,2]

[1] Dipartimento di Scienze Mineralogiche e Petrologiche, Via Valperga Caluso 35, I-10125 Torino, Italy
[2] Centro di Studi sulla Geodinamica delle Catene Collisionali (C.N.R.), Via Accademia delle Scienze 5, I-10123 Torino, Italy

Abstract

Lead feldspar single crystals were annealed at T = 1050 and 1000 °C, starting from a disordered metastable configuration (PbF_H, Q_{od} = 0) and from an ordered configuration (PbF_L, Q_{od} = 0.89). Single-crystal data collection and refinement in space group $I2/c$ show that the degree of Al-Si order increases to Q_{od} = 0.42 after annealing the disordered PbF_H at 1050 °C and decreases to Q_{od} = 0.70 after annealing the ordered PbF_L sample at 1000 °C. This suggests that the equilibrium Q_{od} is between 0.70 and 0.42 for temperatures between 1000 and 1050 °C, where anorthite or strontium feldspar are almost completely ordered. A residual in the difference-Fourier map because of positional disorder was observed near the Pb site in all the refined crystals. The average y/b_{Pb} coordinate changes with increasing Al-Si disorder, as Pb approaches the glide plane. A significant decrease in the intensity of b-type reflections was consequently observed. A spontaneous strain, with the main axis almost parallel to the a axis, is associated with Al-Si ordering. Pb polyhedral deformation related with Q_{od} accounts for the observed strain. A calibrating equation, $Q_{od} = [(8.427(2) - a) / 0.048(3)]^{1/2}$, has been calculated and applied to the unit-cell parameters obtained from subsequent thermal treatments and from Bruno and Facchinelli (1972) to define the evolution of the Q_{od} vs. the treatment temperature. The thermal behavior of the Q_{od} could then be bracketed, suggesting T_c between 1150 and 1200 °C for the $I2/c$-$C2/m$ phase transition induced by the Al-Si order-disorder process.