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Order-disorder kinetics in orthopyroxene with exsolution products

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ABSTRACT

The equilibrium behavior and kinetics of the Fe-Mg intracrystalline exchange reaction in an orthopyroxene sample containing exsolution products were studied by X-ray diffraction (XRD). Isothermal annealing experiments were performed on an orthopyroxene crystal from the Johnstown diogenite, which shows coherent (100) augite lamellae and Guinier-Preston zones. The kinetic experiments were carried out at 700, 800, and 850 °C until Fe-Mg exchange equilibrium was reached. Oxygen fugacity was controlled by the WI buffer. Equilibrium conditions were also confirmed by "reversal" experiments. After each annealing run single-crystal XRD data were collected, and the orthopyroxene phase (*Pbca*) was refined after subtraction of the contribution of the exsolved *C*2/*c* phase to the observed structure factors. The fraction of augite was ~2%. The low values of the disordering rate constants K^+, calculated using Mueller's equation, and the surprisingly high value of the activation energy (102.3 kcal/mol) for the Fe-Mg disordering reaction are ascribed to the presence of exsolution products in the orthopyroxene. Exsolution products seem not to affect the equilibrium behavior.