

Kinetics of Fe-oxidation/deprotonation process in Fe-rich phlogopite under isothermal conditions

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ABSTRACT

The kinetics of the Fe-oxidation/deprotonation process in a natural Fe-rich phlogopite from Mt. Vulture (Potenza, Italy) was studied under isothermal conditions by in situ high-temperature single-crystal X-ray diffraction. Isothermal annealing experiments were performed at five temperatures in the range 640–750 °C on five crystals with similar chemical composition and lattice parameters. The Fe-oxidation/deprotonation process at high temperature occurs with a reduction of unit-cell parameters and cell volume. The changes in unit-cell parameters measured at high temperature and during cooling show that the same degree of Fe-oxidation/deprotonation process was achieved at all temperatures. Changes in unit-cell parameters with temperature and time show that the kinetics of Fe-oxidation/deprotonation in phlogopite follows an exponential law, and the temperature dependence follows the Arrhenius relation. A kinetic analysis was performed and good agreement was obtained with the one-dimensional diffusion model. An apparent activation energy of 195(4) kJ/mol was determined.

Keywords: Trioctahedral mica, kinetics, deprotonation, single-crystal X-ray diffraction, high temperature