Geophysical Research Abstracts
Vol. 14, EGU2012-9294-2, 2012
EGU General Assembly 2012

Thermal expansion investigation of tourmaline-group minerals

G. Hovis (1), B. Scott (1), C. Altomare (1), and G. Tomaino (2)

(1) Lafayette College, Geology and Environmental Geosciences, Easton, Pennsylvania, United States (hovisguy@lafayette.edu), (2) Specialty Minerals Incorporated, 640 13th Street, Easton, Pennsylvania, United States

In recent years one aim of this laboratory has been the characterization of thermal expansion in various mineral groups with an eye toward evaluation of the extent to which chemical composition affects expansion behaviour. We have undertaken studies on various mineral series including alkali feldspar, plagioclase, Ba/K-feldspar, Rb/K feldspar, nepheline/kalsilite minerals of various excess Si contents, and F/Cl/OH apatite. We turn our attention now to the tourmaline mineral system, which is of interest because of its wide variation in chemical composition, as well as its structural complexity. We have obtained multiple chemically-characterized tourmaline specimens from the U.S. National Museum of Natural History and also from George Rossman. Six specimens have been investigated so far, including elbaite, rossmanite, uvite, buergerite, schorl, and foitite. High-temperature X-ray powder diffraction measurements have been made from room temperature to 1000 °C at 75° intervals. X-ray peak positions were corrected utilizing NIST SRM 640a silicon as an internal standard. Peaks were indexed manually based on data in the literature; unit-cell dimensions were computed utilizing the software of Holland and Redfern (1997, Mineralogical Magazine).

V-T relationships are generally linear, or close to it, up to the breakdown temperatures of all specimens. Coefficients of thermal expansion have been computed as $(\Delta V/\Delta T)*(1/V_{0C})$, where V_{0C} is the extrapolated volume intercept at 0 °C based on the various linear V-T relationships. Among the six specimens, all except foitite give thermal expansion coefficients between 23 and 26 x 10^{-6} deg^{-1}. Foitite has a flatter V-T slope and thus expands less, giving a thermal expansion coefficient of 18 x 10^{-6}. Based on the initial data, the relative uniformity of expansion behaviour in this system implies that any volumes of mixing in this system will be essentially constant with temperature, recognizing that this conclusion is based on the study of relatively few compositions so far.

Each X-ray experiment, from room temperature to 1000 °C, was conducted in air over the course of a 12- to 24-hour period. Those specimens containing ferrous iron as a major component, namely foitite and schorl, began breakdown at temperatures in the 550 to 625 °C range, presumably related to the oxidation of Fe. Buergerite, a Na-Fe-Al-bearing OH-absent tourmaline in which Fe is in its ferric state, did not break down until significantly higher temperatures (800 °C). Uvite, with little Fe but abundant Mg, did not break down until about 925 °C. Elbaite and rossmanite, which are OH-bearing Li-Na-Al and Li-Al tourmalines, respectively, containing little/no Fe and Mg, began breakdown around 700 °C, presumably due to dehydration.

We thank the Earth Sciences Division of the U.S. National Science Foundation for support of this research via grant EAR-1019809, and also the Lafayette College EXCEL program, which supports undergraduate research. Our sincere thanks also go to Jeff Post, Mike Wise, Paul Powhat, and Cathleen Brown of the Smithsonian Institution and George Rossman of the California Institute of Technology for providing well-characterized specimens.