

Abstract No. seam686

Trace and Rare Earth Element Concentration Variations in Potassium Feldspar Megacrysts

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Beamline(s): X26A

Introduction: Potassium feldspar megacrysts (3-20 cm long) are a prominent component of several of Earth's granitic intrusions. These crystals typically host mineral inclusions thought to have been trapped within the growing crystal, recording some portion of the crystallization history of the magma. Earlier workers (Vernon, 1986; Cox et al., 1996) used the electron microprobe to document concentric and oscillatory zoning in concentrations of minor elements (most typically barium) from the interior to the rim of potassium feldspar megacrysts. These variations might be evidence of fluctuations in magma composition as the megacryst grew.

Methods and Materials: In this study, high energy X-rays generated in the X-ray synchrotron at the National Synchrotron Light Source at Brookhaven National Laboratory were used to identify variations in concentrations of very low abundance trace and rare earth elements in megacrysts from the central lobe of the 400 million-year-old Lexington Batholith of central Maine. X-ray spectra were collected on several discrete points, and an X-ray map was collected of a large portion of a megacryst.

Results: The purpose of this experiment was to correlate high and low concentration events of an array of trace and rare earth elements, and to evaluate the magmatic processes that drove these events. Spatial variations in concentrations of some trace element and rare earth elements were documented during the experiment. Zoning in concentrations of these elements does not generally show the simple oscillatory pattern shown by barium concentration zoning.

Conclusions: Variations in concentrations of the trace and rare earth elements seem to document more complex processes than simple oscillatory variations in magma composition, and are under continuing investigation.

References:

R.A. Cox, T.J. Dempster, B.R. Bell, and G. Rogers, "Crystallization of the Shap Granite: Evidence from Zoned K-feldspar Megacrysts," Journal of the Geological Society of London, **155**, 625-635, 1996.

R.H. Vernon, "K-feldspar Megacrysts in Granites—Phenocrysts, not Porphyroblasts," Earth Science Reviews, **23**, 1-63, 1986.