An Analysis of Apatite Chemistry in Garnet Porphyroblasts and in the Matrix of Metamorphic Rocks

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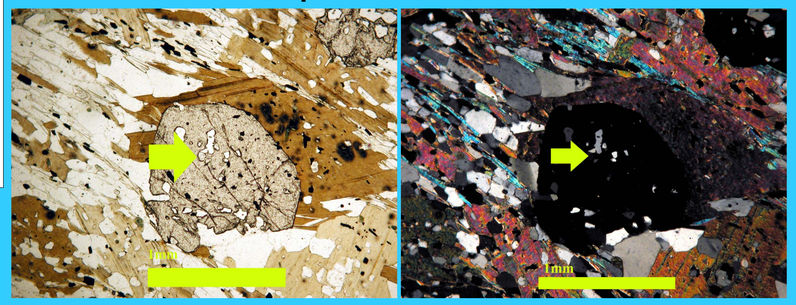
Introduction

There is a relatively small amount of data available relating to apatite chemistry in metamorphic rocks. In this paper I will attempt to analyze apatite in garnet porphyroblasts and in the matrix of metamorphic rocks to determine if petrographic location has and effect on the chemistry of the apatite. The analysis will focus mostly on apatite's halogen end members fluorine and chlorine. In order to accurately assess any measured difference the relative timing of garnet growth must also be determined.

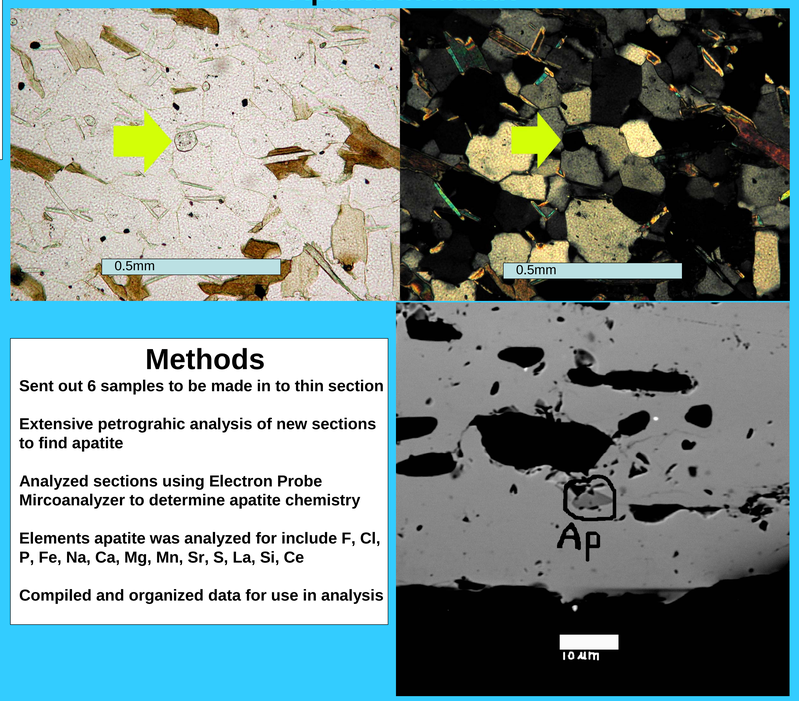
Background

The samples for this study were collected for another University of Maryland undergraduate research project in Coos Canyon, Maine. The rocks exposed at Coos Canyon are part of the Perry Mountain Formation. The Perry Mountain Formation is part of the Silurian clastic wedge, which was deposited on top of a very thick Late Ordovician clastic sequence in the Merrimack Synclinorium (Osberg et al. 1968; Bock et al. 2004) The rocks found here are bedded quartzite and sillimanite schist containing garnet (up to 0.5 cm diameter) porphyroblasts sharply interbedded with light gray plagioclase-quartz granofels and granular to vitreous light-gray quartzite (Burton et al. 2000).

Apatite in Garnet



Apatite in Matrix



Methods

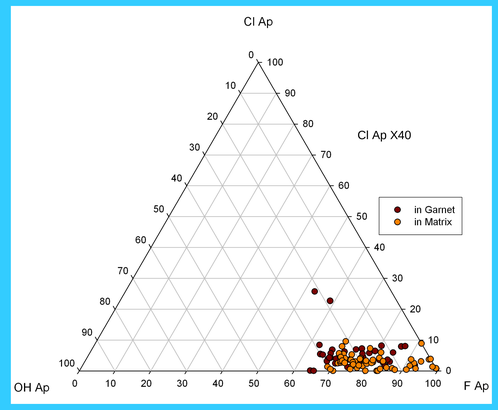
Sent out 6 samples to be made in to thin section

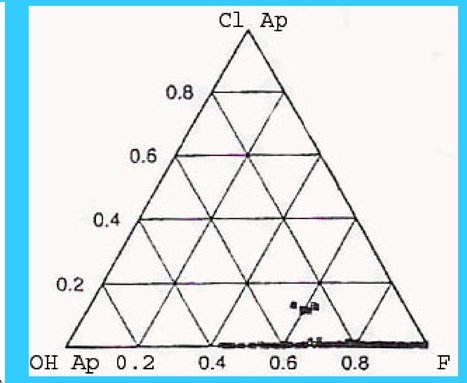
Extensive petrograhic analysis of new sections to find apatite

Analyzed sections using Electron Probe Mircoanalyzer to determine apatite chemistry

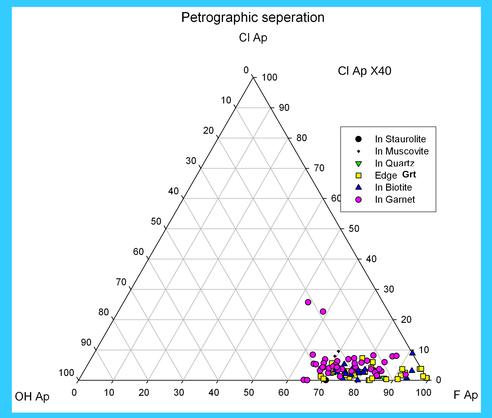
Elements apatite was analyzed for include F, Cl, P, Fe, Na, Ca, Mg, Mn, Sr, S, La, Si, Ce

Compiled and organized data for use in analysis





Ternary plot of apatite chemistry after Spear and Pyle 2002



Conclusions

Apatite chemistry does not varie as a function of petrographic location

Apatite grains that are inclusions in garnet porphyroblasts are not shown to have different chemistry than grains located in the matrix

It is unknown whether this is true for apatite in other metamprphic rocks

Apatite of the Perry Mountain Formation is dominated by the F Ap component

Accuracy and Precision

In any scientific study before you can attempt to draw any conclusions it is important to assess the accuracy and precision of the data that has been collected. Accuracy is a measure of how close the measured results that were obtained are to the actual values which are determined with the use of standards. In this study standards were used to calibrate the probe. From these standards error can be measured. If the error in a measurement was found to be above an acceptable level the data was discarded. Doing this ensures that the data is accurate. As a measure of accuracy, for each probe session, I measured the composition of Durango Apatite. Durango Apatite has the accepted value of 3.53 weight % F and 0.41 weight % Cl. The Durango Apatite was analyzed 25 times by the probe and yielded 3.58 weight % F and 0.44 weight % Cl.

Precision is a measure of how close one data point is to itself if analysis is repeated. We periodicly repeated analysis on some of the data points to enusre that the measurments we were taking were precise

References

Bock, B., et al., 2004, Scale and timing of Rare Earth Element redistribution in the Taconian foreland of New England: Sedimentology, v. 51, pp. 885-897

Burton et al. 2000, Bedrock Geologic Map of the Hubbard Brook Experimental Forest, Grafton County, New Hampshire: USGS Open Report

Osberg, P. H., Moench, R. H., and Warner, J. (1968) Stratigraphy of the Merrimack synclinorium in west-central Maine. In E-an Zen *et al.,* Eds., Studies of Applachain Geology: Northern and Maritime, p. 241-253. Wiley-Interscience, New York.

Spear, F. S. and Pyle, J. M., 2002, Apatite, Monazite, and Xenotime in Metamorphic Rocks: Reviews in Mineralogy and Geochemistry, v. 48, pp. 293-335