The petrogenesis of amazonite-bearing pegmatites in the Georgeville area, Nova Scotia

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A series of pegmatite pods and subvertical dykes occur within, and proximal to, the (580 ± 2.2 Ma) Georgeville pluton, along the exposed coastline in the northern Antigonish Highlands, Nova Scotia. Dykes have variable orientation and sizes, ranging from 0.5 m to 10 m in length. Dykes range in composition from simple quartz-feldspar types to mineralogically complex pegmatites that contain amazonite, topaz, zinwaldite, and Sn, Ta, and Nb oxides. One of the most complex pegmatites in the region was selected for study in order to investigate the genetic relationship of the dyke to the nearby alkali feldspar granite, to determine the internal evolution of the pegmatite, and to estimate the physical and chemical properties of the pegmatite-forming fluid.

Twelve samples were taken at 1 m intervals along the strike of the dyke and prepared for polished thin sections. Petrographic and mineralogical analyses were done by transmitted and reflected light microscopy. Albite crystallized primarily in the wall zone but is also present in the intermediate zones and has an An content of 0. Quartz also crystallized in the wall zone and forms a mosaic along the contact of the greywacke host and the pegmatite. Columbite-tantalite, zircon, and k-feldspar were analyzed with the electron microprobe. Columbite-tantalite compositions vary systematically from ferrocolumbite with Mn/(Mn+Fe)=0.15 and Ta/(Ta+Nb)=0.33 to manganocolumbite with a Mn/(Mn+Fe)=0.62 and Ta/(Ta+Nb)=0.22. X-ray diffraction data verified the presences of beryl and topaz. Optical spindle stage measurements indicate a fluorine content of 19.1 wt% in topaz. Pale green muscovite is found mainly as a secondary mineral. Accessory zircons range from 5% Hf (wt. %) with a Zr/Hf ratio of 21, to 20% Hf (wt%), with a Zr/Hf ratio of 4. Two dark micas were identified in the dyke, annite and zinwaldite. Annite was found in the wall zone, and zinwaldite was found in the intermediate zones. Both were identified by electron microprobe analysis, and were compared to previous work from other similar pegmatites. Whole-rock analyses using XRF were completed, and the data were used to compare with the granites of the Georgeville Pluton. Trace element concentrations were determined using ICP-MS and was also compared to the nearby granite. F, Nb, Th, Cs, and Sn were found to be enriched in the pegmatite relative to the granite. Elevated concentrations of Ba and Co are believed to be due to contamination by host sediments.

The rare-element pegmatite dyke can be classified as a Nb-Y-F pegmatite on the basis of geological affiliation and geochemical features. The pegmatite crystallized from a F-rich fluid that segregated from the Georgeville granite. High concentrations of F and high field strength elements such as Zr, Y, Nb, and Sn may be the result of extreme fractionation of the granitic melt, or due to the strong partitioning of these elements into an immiscible hydrous silicate fluid that segregated from the Georgeville pluton during the later stages of crystallization. Experiments are being conducted to test these models.