

## Examining the relationship between trace-element characteristics and the cathodoluminescence colour exhibited in apatite from Devonian felsic intrusions of New Brunswick, Canada

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New Brunswick is a part of the Canadian Appalachians and contains two suites of Devonian-aged felsic intrusions. However, just those associated with the crustal thickening processes of the Acadian orogeny, and post-Acadian uplift, are mineralized with granophile elements. These intrusions geochemically define affinities ranging from primitive to highly evolved A-, S-, and I-types granitoids. The geochemical characteristics of apatite grains from thirty-one of the Late Silurian to Late Devonian intrusions were studied in situ by electron probe microanalysis (EPMA) and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). In addition, the texture of the crystals was imaged and studied using a cathodoluminescence (CL) imaging system at the University of New Brunswick. The results established unique trace-element characteristics in apatite from each of the intrusions believed to reflect host magma evolution history.

The CL-imaging study indicated yellow, shades of blue, and purple as the three main colours of CL emission among the studied apatite grains. Interestingly, these three colours have distinctly different trace element compositions. For example, the light blue luminescing apatite grains have the highest Eu contents, whereas yellow CL apatite grains have the highest Mn. The apatite grains also have characteristically different rare-earth element content, which increases from the yellow to dark blue and reach their highest values in the light blue luminescing apatite. A further examination of CL was completed with the collection of detailed CL spectra at the University of Regina, confirming the result of the trace element studies. Apatite with yellow CL emission show a distinctive peak at about 570 nm, that has been previously attributed to elevated Mn<sup>2+</sup> in these apatite grains. Blue-shaded apatite CL displays a characteristic peak at about 400–500 nm reflecting the incorporation of variable amounts of Eu<sup>2+</sup> and Ce<sup>2+</sup> as the main causes of CL in the studied apatite grains. Interestingly, the shape of the collected spectra clearly reflects the geochemical conditions of the parent rock. For example, a purple apatite from the Nicolas Denys granodiorite display almost flat spectra with only weak peaks at about 400 and 600 nm. This may indicate hydrothermal alteration and/or secondary fluid interaction that have modified the CL-emission spectra for apatite within this intrusion. Results of this study display a direct relationship between the trace-element content and the colour of the CL emission in apatite and have proven LA-ICP-MS as a valuable resource in studies of CL emission colour in this and other minerals.