An investigation of tourmaline from Canadian porphyry deposits

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The Targeted Geoscience Initiative-5 (TGI5) Program aims to develop innovative vectors for exploration of buried ore deposits. In conjunction with the Geological Survey of Canada, the focus of this TGI5 project is to address the potential of tourmaline as an indicator for porphyry systems. Tourmaline, as a common accessory mineral phase in porphyry systems, has been proposed to be an efficient indicator of porphyry-style mineralisation. The tourmaline supergroup is comprised of alkali, borosilicate hydroxide minerals, whose complex structure permits the incorporation of a wide-range of elements including alkali and alkaline-earth metals (Na, Ca, K, Rb), transition metals (Fe, Ni, Cr, Mn, Cu, Zn), halogens (F, Cl, Br) and high field strength elements (REE, Hf, Zr, Ti, Nb, Ta). When precipitating from solution, many of these elements are structurally incorporated with partition coefficients close to unity. Tourmaline, therefore, has the potential to record physiochemical changes in fluids throughout its crystallisation. This project uses a variety of techniques (scanning electron microscopy equipped with energy dispersive X-ray spectroscopy, laser-ablation inductively coupled plasma mass-spectrometry, Raman spectroscopy) to characterise and understand the textural, chemical, and geological relationships of tourmaline within selected Canadian porphyry (Cu-Au, Cu-Mo-Au) deposits (e.g., Casino, YT; Schaft Creek, BC; Woodjam North, BC). Tourmalines at these locations display three major textural types: (1) disseminated, (2) vein, and (3) breccia, all of which are associated, to varying degrees, with Cu-mineralisation. Tourmaline also exhibits variable growth histories, including oscillatory and patchy zonation, which records the evolution of geological processes during its formation. In combination, these characteristics that develop in mineralised porphyry systems will help to define a baseline for using tourmaline as an effective indicator in surficial exploration.