Application of portable X-ray fluorescence (pXRF) analyses to discriminate felsic units and hydrothermal alteration in the Murray Brook volcanogenic massive sulphide deposit, New Brunswick, Canada

MAIARA TONIAZZO BRAGA AND DAVID R. LENTZ

Department of Earth Sciences, University of New Brunswick, Fredericton, New Brunswick E3B 5A3, Canada <Mgirardi@unb.ca>

The Middle Ordovician Murray Brook volcanogenic massive sulphide deposit located in northeastern New Brunswick represents a significant base-metal resource in the Bathurst Mining Camp. The deposit occurs within the California Lake Group and is hosted by altered sedimentary rocks of the Charlotte Brook Member, in the lower part of the Mount Brittain Formation. Due to the complicated metamorphic and deformation history of the deposit, in addition to hydrothermal alteration, questions remain as to the origin of these rocks. To shed some light on this, the Olympus VANTA portable X-ray fluorescence (pXRF) spectrometer was used to rapidly obtain trace element compositions of these rock units.

Four hundred twenty-seven samples from four drill cores that intersect the hanging wall, the massive sulphide body, and the footwall were described and analyzed. Each sample was measured four times at two different positions using the 50kV benchtop configuration with a total integration time of 720 seconds. Rigorous QA/QC was performed to calculate calibration correction factors using nine Certified Reference Materials and silica blanks during each analytical run. This will help to mitigate daily variance and equipment drift, and to obtain the correction factors for each element, supporting precision during statistical analysis. The relative standard deviation (RSD%) for most of the elements obtained shows that the pXRF data are very reliable.

To graphically discriminate rock types, the elements Al, Ti, Zr, Nb, Y, Cr, V, and Th were selected, since these elements are relatively immobile during hydrothermal alteration. In order to represent various alteration types, the indices known as AI (Ishikawa) and CCPI (chloritecarbonate-pyrite) were modified to be used with the pXRF data in this study. Specifically, AI = 100(K/(K+Ca)) and CCPI = 100((Fe+Mn)/(Fe+Mn+Ca +K)). The alteration box plot (AI versus CCPI) shows that at least 80% of the samples fall in the "Most Altered" field (sericite-chlorite-pyrite), which coincides with observations in both hanging wall and footwall. The AI index displays the majority of relatively high values (60–90) in these altered rock units compared to the CCPI index (50–90). A late iron-carbonate alteration that overprints earlier alteration types was also detected. Plots of SiO_2 versus Al_2O_3 and SiO_2 versus TiO_2 suggest that sedimentary rocks with <60% SiO_2 have undergone hydrothermal alteration involving silica loss. Detailed field observations combined with this technology could offer quick and precise information to discriminate these strongly altered and deformed rocks.

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