Application of pXRF to Cu Grade Estimation and Igneous Stratigraphy Characterization: A case Study at the North Edge of the Eastern Gabbro, Coldwell Alkaline Complex, Canada

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Abstract

The current study is an evaluation of pXRF in the classification of igneous stratigraphy and the estimation of Cu grade at the north edge of the Eastern Gabbro of the Coldwell Alkaline Complex. The Midcontinent Rift-related Coldwell Complex, intruded into the Schreiber-White River Archean greenstone belt, which consists of low-grade metamorphic volcanic and sedimentary rocks. The Eastern Gabbro occurs along the outer margin of the Complex. It is a composite mafic-ultramafic intrusion involving three major distinctive magmatic series: the Fine Grained Series, the Layered Series and the Marathon Series. The Marathon Series hosts the majority of the Cu-PGE mineralization in the area, notably the Marathon Cu-Pd deposit. Mapping the distribution of the different gabbro units is a key to Cu-Pd exploration. However, in the field it is difficult to distinguish between the different series of gabbros, and in particular for the magnetite and plagioclase-rich augite melatroctolite in the Layered Series, and the magnetite melatroctolite in the Marathon Series. Differentiating them based upon petrography studies is nearly impossible due to their very similar petrographic features. Lithogeochemistry is a potential tool for their classification. Lab-based analytic techniques are costly and involve a time delay; instead, the small and low-cost pXRF is capable of obtaining real-time field data. Data quality from the pXRF was confirmed through a comparison of pXRF data to traditional lab-based analyses. The competency of the pXRF for Cu grade and S content estimation was evaluated by comparing down-hole pXRF and ICP-MS Cu and S variations of the same drill hole. Their similar variations and absolute concentrations indicate that the pXRF is able to quantify Cu grade down to around 100 ppm and S content down to 0.1wt%. The application of pXRF to lithogeochemical mapping consisted of plotting a number of key major and trace elements to differentiate the different igneous units. Key variables were P_2O_5, Fe_2O_3, SiO_2 TiO_2, Ba, and V. Different similar igneous units were successfully differentiated using these variables.