ML Modeling of Multiparameter Data for Ni-Cu-PGE Targeting

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Recent advances in hyperspectral core scanning technology and increased use of machine learning in mineral exploration have resulted in several studies successfully predicting lithologies and alteration assemblages in hydrothermal deposits. Fewer studies have focused on application of these technologies in Ni-Cu-PGE deposits because of the longer spectral wavelengths of key minerals in mafic and ultramafic rocks and lack of alteration vectors. We present an approach combining laser-induced breakdown spectroscopy (LIBS), shortwave to very near infrared (SWIR-VNIR), and portable X-ray fluorescence (pXRF) core scanning with petrophysical measurements on a drill hole through a mineralized, layered gabbroic intrusion to show the same approaches can apply in exploration of critical metals.

The Crystal Lake Gabbro is a layered intrusive complex, approximately 40 km southwest of Thunder Bay, Ontario, that was emplaced late in the 1.1 Ga Midcontinent Rift event. It contains a non-compliant historic resource of 45.6 Mt at 0.334% Cu, 0.183% Ni, 0.12g/t Pt, and 0.59 g/t Pd in the shallowest part of the southeast-dipping intrusion. Mineralization occurs as disseminated chalcopyrite, pentlandite, and PGMs in taxitic gabbro within and at the base of the intrusion. Mineralization is high tenor, with typical (Pt+Pd)/(Cu+Ni) values between 1.8 and 2, peaking at over 4 within short intervals, indicating likely high R-factor for the system. Hence, discovery of a substantial body of mineralization within part of the intrusion represents a very attractive exploration target.

To effectively target such a body during ongoing exploration, we have developed novel analytical routines to integrate chemical, mineralogical, and physical properties data. By bringing multi-parameter drill hole data, both routine and novel, into a machine learning environment, we illustrate strategies to better navigate within multi-phase intrusions and produce testable predictions about locations of larger orebodies.