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Testing Pyrrhotite Trace Element Chemistry as a Vector Towards the Mineralization in the Sullivan Deposit, B.C.

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The Sullivan deposit, located Kimberley, British Columbia, Canada, is one of the most important SEDEX (sedimentary exhalative) deposits in Canadian. It produced 161.97 Mt of Zn (5.86%), Pb (6.08%), Ag (67.36 g/t), and the past metal production of the Sullivan deposit is worth over $20 billion based on 2014 metal prices. The Sullivan deposit has seen extensive hydrothermal alteration by a variety of alteration processes. The most prevalent alteration is sericitic alteration. It is mostly controlled by disseminated, fragmental, coarse-grained sedimentary rocks at the Sullivan deposit. This alteration can be defined as a typical pale yellowish grey-green colour and formed due to sulphidation of biotite to form pyrrhotite and sericite during metamorphism. In this study, we investigated pyrrhotite trace element chemistry by using LA-ICPMS. Forty samples of the hanging wall, footwall and host horizon were collected from six drill holes proximal and distal to the Sullivan deposit. There are 390 analyses on different pyrrhotite samples to obtain trace element data. Three hundred ninety LA-ICPMS analyses were used to build machine learning classifiers (cluster analysis and random forests) to identify whether an unknown pyrrhotite sample was from the mineralized horizon and if so whether it was from near the mineralization. The results show a change in pyrrhotite trace element concentrations depending on stratigraphic position and the distance from the deposit. This study is promising since the pyrrhotite trace element chemistry can be used as a vector towards the mineralization at the Sullivan Deposit. Ni and Se have the most significant variation with distance to mineralization and stratigraphy, although Co, Ag, W, Bi are also useful. However, it was challenging to distinguish footwall from hanging wall units since the trace element data show slight differences, whereas the host horizon shows a significant difference. Further in this study we show that coupling machine learning techniques with pyrrhotite trace element analyses can be a powerful tool for mineral exploration.