NSERC-CMIC FOOTPRINTS

Smith RS, Mir R, Perrouty S, 2018, Geophysical exploration for mineral systems: highlights from the NSERC-CMIC Footprints Project and CFREF Metal Earth Project, Abstract, BC Geophysical Society, Vancouver, BC

Footprints of mineral systems can be evident at multiple scales. At lithospheric scales, MT and seismic surveys can image major structures (e.g., terrane boundaries, faults) that could act as conduits for mineralizing fluid flow from the deep in the crust. The Metal Earth project aims to map these crustal-scale structures across ten 100-km long traverses in the Superior Province. Some of these traverses are in metal-rich greenstone belts with a long history of mining (e.g., Abitibi), while others are in similar geological environments, that are not as rich in metals (e.g., Wabigoon). It is hoped that deep geophysics will help us identify and understand the key differences between these settings, so that future exploration campaigns for metal-rich zones in greenfields can be designed more effectively. At camp scale, geochemistry, mineralogy and petrophysics can map the metasomatic halo around mineral systems, thus acting as mineralization vectors. The Footprints project has characterized several such parameters that can be considered vectors to mineralization. At Canadian Malartic, gold mineralization in meta-sedimentary rocks is commonly hosted within zones of structural complexity (e.g., fold hinges). The physical property changes that are associated with mineralization were measured from drill core and hand samples. The challenge is to detect these subtle changes or a suitable proxy for structural complexity from geophysical measurements taken at or above the ground surface. Helicopter-borne electromagnetic data at Canadian Malartic shows some high resistivity zones correlating with low structural complexity, but the presence of a discontinuous resistive Quaternary sediment cover (i.e., glacial till) limits the possible interpretations. To overcome this difficulty, fifteen ground resistivity and IP surveys have been compiled and inverted to estimate the properties below this cover. The high chargeability zones correlate with pyrite-pyrrhotite-rich areas close to felsic-intermediate intrusive bodies and/or mineralized structures like fold hinges and faults. The low resistivity zones correlate with areas of variable bedding orientation (or high structural complexity). The anisotropy of resistivity is important at Canadian Malartic, being greater where the bedding is sub-vertical. This has implications for survey design, specifically when choosing the line direction. This work demonstrates that geophysics can be used to infer structural orientation and complexity at depth, and ultimately be used to outline prospective areas for gold mineralization.

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