Multi-Parameter Footprints of the Canadian Malartic Gold Deposit

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A multidisciplinary team is investigating the metasomatic halo of the Canadian Malartic gold deposit to delineate the spatial distribution of alteration zones within the deposit footprint and provide vectoring information for gold exploration. A suite of over 50 structural, lithogeochemical, mineralogical, petrophysical and geophysical footprint parameters have been identified and the integration of these parameters is in progress. Gold occurrences in the Canadian Malartic district are associated with structurally complex zones, which are interpreted to be joined F_1 and F_2 fold hinges. The spatial variation of the intensity of the D_2 deformation event is tentatively interpreted to be correlated with alteration by mineralizing fluids during D_2. The lithogeochemical footprint is expressed through mass changes in the metasedimentary and metabasic rocks. Significant mass gains of Au, Ag and Te occur proximal to the deposit. Elements such as S and C are intimately associated with gold mineralization and are enriched in the vicinity of the deposit. Significant mass gains are also observed for the large-ion lithophile elements (e.g., K) and for the light rare-earth elements but their distribution highlights a more distal alteration process, which is particularly well recorded in the meta-basic dykes. The mineralogical footprint is host dependent. The metabasic dykes were more reactive to the hydrothermal fluids than the Pontiac metasedimentary rocks. Their mineralogy evolves from a distal amphibole-rich composition to a proximal biotite–carbonate–quartz–pyrite–rutile mineral association. The mineralogical footprint in the metasedimentary rocks is more subtle. Biotite and white mica compositions are highly dependent on the protolith and metamorphic grade but a distinct "hydrothermal" signature can nevertheless be identified around the Canadian Malartic deposit. Hyperspectral (SWIR) data can efficiently detect and map these mineral composition changes. Defining petrophysical and geophysical footprints is more challenging, but there is a decrease in density and magnetic susceptibility that accompanied alteration. Time-domain versus spectral induced polarization ground survey were tested in meter-scale mineralized Bravo zone and seems to be able to respectively detect graphitic mudstone layers and mineralized greywacke. In summary, individual footprint parameters delineate proximal, medial and distal alteration zones and the combination of footprint parameters will enhance our capacity to vector deposits and diminish false positive results. Identification of a minimum set of parameters that best described the footprint is currently being investigated. CMIC-NSERC Exploration Footprints Network Contribution 159.