Lesher CM, Mineral Exploration Research Network, 2016, NSERC-CMIC multidisciplinary Mineral Exploration Research Network: the next generation of mineral exploration models, DMEC, PDAC Workshop, Toronto, ON

The objectives of the Mineral Exploration Footprints Network are to: 1) enhance the ability of the Canadian mining industry to recognize the entire "footprint" of ore deposits from their high-grade cores to their most distant cryptic margins, 2) develop methods that truly integrate (not just layer) the comprehensive range of multi-scale 3D geological-structural-lithological-mineralogical-geochemical-petrophysical-geophysical data that define ore deposit footprints, and 3) develop workflows for how specialists in these areas need to interact in order to accomplish these goals. Phase I of the program is focusing on the footprints of the Canadian Malartic disseminated Au deposit, the McArthur River and Millennium U deposits, and the Highland Valley porphyry Cu deposit. New and reprocessed /QAQC-controlled geological, structural, whole-rock lithogeochemical-isotopic, mineral chemical-isotopic, surface-drill core hyperspectral, multi-media surficial geochemical-isotopic, and surface-drill core-borehole petrophysical properties to constrain inversions of airborne-ground-borehole geophysical data are being integrated to define or extend multiple footprints at each site. For example, at Canadian Malartic multiple alteration halos have been defined using lithogeochemical-mineral chemical- isotopic-hyperspectral-physical property data not only in the host metasedimentary rocks, but also in associated meta-basic dikes, which provide a greater geochemical contrast and are therefore a more sensitive indicator of ore-related alteration. At McArthur River and Millennium S-wave seismic and physical property data for the glacial overburden are being used to remove their influence on the gravity signatures of the ore-related alteration zones. At Millennium innovative processing techniques are being developed to extract physical property information from legacy 3D-3C seismic data to identify alteration and vertical structures, and fusion of geochemical and 3D pole-pole resistivity data will allow the numerical characterization of how host rock resistivity varies as a function of alteration intensity and mineralization. At Highland Valley traditional feldspar staining, visible-near IR spectral analysis, multi-element ICP analysis, and petrologic methods have been integrated with detailed geologic-structural-vein mapping to better define the alteration footprint in a system with multiple ore centers, multiple types of alteration fluids, and variable stages of erosion and post-mineral cover. We are in the process of integrating the various data types and inversions in GOCAD to produce self-consistent Common Earth Models, and using deterministic and nondeterministic multivariate statistical methods, including heat map clustering and HyperCube®, to extract more information out of the data and to develop more sensitive and more robust vectors to mineralization.

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