Variations in Whole-Rock and Mineral Compositions as Exploration Vectors for VHMS Deposits in the Que-Hellyer District, Tasmania, Australia

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The Hellyer, Fossey, Que River, and Mount Charter volcanic-hosted massive sulfide (VHMS) deposits occur along a 6 km strike length within the Que-Hellyer Volcanics of the Mount Read Volcanics, Tasmania. We use a combination of whole-rock geochemistry, short wavelength infrared (SWIR) spectrometry, laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) analyses, and historic whole-rock geochemical data compilation to develop mid-range and short-range exploration vectors towards VHMS mineralization. The compilation of a semi-continuous spread of regional and deposit-scale data over the 6 km strike length provides a unique opportunity to link up other under-explored areas and review the exploration potential of the Que-Hellyer district as a single, large mineralized field.

On the basis of whole-rock geochemistry, the rocks in the Que-Hellyer district can be divided into eight alteration groups. Strong sericite and K-feldspar altered rocks form a linear trend from Hellyer to Mount Charter; whereas weak sericite, albite and least-altered rocks occupy peripheral locations. Hydrothermal alteration associated with the formation of VHMS deposits is also highlighted by alteration indices and whole-rock major element enrichments and depletions. Some trace elements, such as Tl and Sb, highlight a very specific corridor of strongly altered rocks that are closely associated with all four VHMS deposits in the Que-Hellyer district.

White mica (sericite) and chlorite samples from the Fossey and Mount Charter deposits were analyzed by electron microprobe and LA-ICPMS to determine their major and trace element concentrations. The results show that white micas closest to mineralization are mostly phengitic, with high Mg/(Mg+Fe) ratios, elevated Ba, Tl, Sb, F and Zn and depleted Na, Ni, and Co concentrations. Chlorites closest to the orebodies are characterized by high Mg/(Mg+Fe) ratios, elevated Mg, F, Li, Zn, and As, and depleted Al^{iv}, Fe, Na, Co, Ni, and Cr concentrations. The compositional variations in white mica and chlorite are further supported by regional SWIR data which show that the VHMS mineralization and alteration halos are characterized by long Al-OH absorption wavelength (phengitic) mica and short Fe-OH absorption wavelength (Mg-rich) chlorite. These variations are interpreted to represent the change in white mica and chlorite composition due to the alteration by hydrothermal fluids associated with the formation of the VHMS deposits.

The combined use of whole-rock alteration mineral classification and mineral composition variations allow for an improved understanding for the apparent whole-rock major and trace element distribution within the Que-Hellyer district. Hydrothermal upflow zones are highlighted by the systematic variations in SWIR data and are coincident with the strongly sericite and K-feldspar altered rocks as identified by whole-rock analyses. More localized, trace element anomalies that are associated with VHMS mineralization within these areas are therefore highly prospective. These techniques are particularly useful in mature exploration terrains where existing drill core is available for quick, inexpensive SWIR data collection and the compilation of historic data can be used to maximize data coverage on a regional scale.