Geochemistry of Fluid Inclusions from the Mt. Chalmers VHMS Deposit, Australia: Implications for Ore Genesis

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The Mt. Chalmers deposit is a volcanic-hosted massive sulphide (VHMS) deposits in Queensland, Australia. The Mt.Chalmers deposit consists of two ore lenses, the Main Lode and the West Lode, with a total pre-mining resource of 4.3 million tonnes grading 1.76% Cu and 2.15 g/t Au. The deposit is hosted within the Early Permian Berserber beds, a volcaniclastic sequence in Queensland. The host stratigraphy is relatively flat lying and appears to be continuous for at least a few kilometres around the mine. The footwall units include: graded sericite-silica-chlorite altered polymict lithic breccia, feldspar-phyric, lithic and pumice rich breccias, massive to autobrecciated feldspar-phyric rhyolitic intrusions/flows and dacitic-andesitic quartz-chlorite altered lithic breccia. The hangingwall lithologies are composed of pumiceous, polymict lithic mass-flow deposits, mass-flow emplaced pumiceous breccia, peperite, graded and well-bedded bioturbated turbidites and late-stage cross-cutting andesitic dykes and quartz-feldspar porphyry dykes. The massive sulphide mineralisation at Mt. Chalmers is hosted within well-bedded, graded, moderately to strongly quartz-sericite-pyrite altered volcaniclastic turbidites. The sulphide mineralisation comprises an upper massive zone, in part layered and fragmental, and underlain by a more extensive silica alteration cut by stringer sulphides veins. The massive sulphide contains gold, copper and silver plus minor zinc and lead. The stringer zone is much less pyritic and contains copper and gold with only traces of zinc, silver and lead, Primary fluid inclusions up to 20 µm are found in quartz from the mineralised zone, and these inclusions yielded homogenisation temperatures of 160-268°C and salinities of 5-8 NaCl equiv. wt %. Laser Raman spectroscopic (LRS) analysis indicates the presence of CO2 (<1 mole %) in the Mt. Chalmers VHMS systems. Semi-quantitative SEM/WDS microprobe analyses of fluid inclusion decrepitates indicate that the Mt. Chalmers

ore fluids were enriched in potassium and calcium but depleted in magnesium relative to seawater. PIXE microanalysis of fluid inclusions in quartz also indicates a significant base metal concentration in these fluids. Cation composition and higher salinities relative to seawater suggest that recycled seawater alone cannot be the sole source of the ore fluids. High base metal content and the presence of CO2 in the fluid inclusions imply that magmatic input of ore metals during seawater leaching of the footwall volcanic pile is a viable possibility.