

Geochemical Modeling of the Zoned Footwall Alteration Pipe, Hellyer Volcanic-Hosted Massive Sulfide Deposit, Western Tasmania, Australia

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Abstract

The mineralogy of hydrothermal alteration assemblages (siliceous core, chlorite zone, sericite zone) in the footwall pipe of the Hellyer volcanic-hosted massive sulfide (VHMS) deposit is controlled mainly by the temperature, pH, and redox state of the hydrothermal fluids.

Based on the results of our numerical modeling, the zoned alteration system could have formed by a combination of water-rock interaction and cooling, with a siliceous core predicted to form at the center of the conduit, passing outward to a chlorite-dominated zone, a sericite-rich zone, and finally grading out to unaltered andesite. These mineralogical changes relate to a gradual evolution of fluid chemistry, water/rock ratio, pH, and temperature from the core to the margin of the system. Initial temperatures were probably close to 350°C, and the hydrothermal fluids were reduced (H₂S dominated). At low temperatures (<200°C) a peripheral alteration zone, consisting mostly of K feldspar, chlorite, sericite, and hematite, is predicted to form. This low-temperature zone has not been recognized at Hellyer, but elevated K₂O contents and local K feldspar development have been noted at other VHMS deposits, suggesting that this zone might form at low temperatures and low water/rock ratios in the footwall of VHMS deposits. If the existence of barren outer K feldspar alteration zones is confirmed, the findings could have important implications for exploration, specifically with regards to distinguishing ore-related alteration zones from barren alteration systems.