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HELLYER HOST ROCK ALTERATION

BY

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Submitted in fulfilment of the requirements
for the degree of Master of Science

UNIVERSITY OF TASMANIA

HOBART

FEBRUARY 1989

This thesis contains no material that has been accepted for the award of any degree or diploma in any university. To the best of the candidate's knowledge this thesis contains no copy or paraphrase of material previously written or published by another person, except where due reference is made.

D. J. Jack

Signed: D. J. Jack

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1.

ABSTRACT

Hellyer is a large (16 million tonne plus), Kuroko-style, polymetallic, volcanogenic massive sulphide deposit in Cambrian high-K, calc-alkaline, arc-like, volcanics in western Tasmania. Hydrothermal alteration in the Hellyer host lavas is preserved in a near pristine condition, overprinted only by low-grade prehnite-pumpellyite facies metamorphism.

The massive sulphide deposit occurs at the time break between an albite porphyritic andesite footwall and a hangingwall basalt. Within the Hellyer hangingwall basalt is a lava flow directly above the Hellyer deposit with regionally high Ti/Zr ~53, higher primary MgO, Ni, Cr and lower primary SiO₂, TiO₂, P₂O₅, Y, Zr, La and Nb than the surrounding basalt. The structure which localized the Hellyer hydrothermal system is thought to have also provided the locus for the extrusion of this deeper sourced, more-primitive lava.

Not only is an excellent example of a hydrothermal feeder system developed in the footwall andesite, but a plume shaped zone of chrome green alteration occurs in the hangingwall basalt. The basalt was extruded while the hydrothermal system was still active. The Cu, Pb, Zn mineralized stringer-zone core consists of quartz barite surrounded by quartz sericite pyrite grading outwards into a chlorite rich zone including massive Mg-chlorite schists. This is surrounded by an envelope zone of quartz sericite pyrite alteration. K-feldspar develops across the outer margins of the envelope zone. The green hangingwall plume consists of pervasive calcite-fuchsite, accessory Fe-chlorite patches, calcite veining and increased quantities of interpillow pyrite. Albite alteration extends out from the plume.

Element distributions highlight the stringer zone with a Na_2O low, and more complexly, with SiO_2 , Fe_2O_3 , MgO , S , Cu , Pb , Zn , Ba highs. CaO and Sr depletion in the footwall is more widespread than the Na_2O depletion and extends outside the stringer zone. In the hangingwall, the plume is highlighted by increased S (2-4 times background S), increased CaO (2 times background CaO), and elevated Ba . Na_2O highs trace albite alteration.

In the hangingwall calcite-fuchsite alteration there has been a major mass addition of CaO , K_2O , Al_2O_3 , Ba and depletion in Fe_2O_3 , MgO , and SiO_2 , with relative enrichment in As , Rb and Mn . Zr , TiO_2 , Y , Nb and the rare-earth elements remain immobile as evidenced by unchanged ratios of these elements regardless of the degree of alteration. In the footwall stringer zone core there is some mobility of all elements.

Sulphur isotopes show a progressive decrease in $\delta^{34}\text{S}$ (pyrite) values inwards and up the stringer zone from +13 per mil at depth through +8 per mil to consistent values of +7 per mil in the orebody. This is due either to an increase in oxygen fugacity towards the quartz barite stringer-zone top and into a narrow oxygen fugacity field for the deposition of the orebody, or to mixing a hydrothermal fluid with a value of +7 per mil with a variable supply of reduced seawater sulphate. Sulphur in light pyrite (-14 per mil) in hangingwall interpillow areas is produced from reduced seawater sulphate rapidly replenished by a high seawater flux.