

Hydrothermal Alteration and Volatile Element Halos for the Rosebery K Lens Volcanic-Hosted Massive Sulfide Deposit, Western Tasmania

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Abstract

A detailed study of alteration mineralogy, mineral chemistry, and lithogeochemistry in the host rocks surrounding the A-B and K lenses at the north end of the Rosebery mine has revealed a series of overlapping alteration halos with characteristic mineralogy and geochemistry. The study involved logging and sampling from nine drill holes spaced at varying distances from the A-B and K lenses. The stratiform Zn-Pb-Cu ore lenses have a sheetlike morphology and are hosted by a mixed sequence of rhyolitic to dacitic massive medium-grained quartz-porphyrific pumice breccia, black mudstone, and crystal-rich volcaniclastic sandstone, overlying a thick homogeneous sequence of rhyolitic pumice breccia.

The major alteration minerals at Rosebery are arranged in a complex series of zones passing away from the deposit—quartz-sericite zone, Mn carbonate zone, chlorite zone, and outer sericite zone. The chlorite zone is best developed in the immediate footwall below the copper-pyrite-rich ore lenses, whereas the strongest Mn carbonate alteration occurs in the immediate hanging-wall volcanics or lateral to the ore lenses. The outermost visible sericitic alteration extends about 60 to 100 m into the footwall, 10 to 20 m into the hanging wall, and over 500 m along the upper contact of the footwall pumice breccias.

Thallium and antimony form the most extensive trace element halos related to the mineralization. Thallium forms a halo that extends 200 to 300 m into the overlying volcanics and 60 to 100 m into the footwall. Anomalously high thallium also occurs over 500 m along strike marking the contact between the footwall pumice breccias and the overlying volcaniclastic sandstones. Proximal to the ore lenses Tl and Sb values range from 10 to 100 ppm, compared to the halo zone where they vary from around 1 to 10 ppm.

Studies of alteration mineral chemistry at Rosebery have revealed some important relationships that may assist exploration. The Mn content of alteration carbonate increases toward ore, both along strike and across strike. Close to ore, alteration carbonates contain >20 mole percent MnCO₃ (kutnahorite, rhodochrosite, Mn siderite, and Mn ankerite), whereas at distances of 40 to 60 m across strike the mole percent MnCO₃ in carbonate drops to below 10 percent. At greater than 80 m, the carbonates are Mn-poor calcites and are commonly located in synmetamorphic structures. White mica composition changes with stratigraphy and alteration assemblages and may be related to the mineralizing event, although this has not been convincingly demonstrated. Proximal white mica contains minor Ba substituting for octahedral Al. However, except for their Ba content, these phenetic white micas are similar to those found in nonmineralized areas of the Mount Read Volcanics. Sodic white mica with up to 0.35 Na/(Na + K) and a low phengite content (<0.5 Fe + Mg cations) occurs in a zone of volcanic sandstones and black slates overlying the ore deposit.

This research has led to the development of a series of proximal, medial, and distal vectors useful for both regional and mine-scale exploration. The most useful vectors, listed from proximal to distal, include Zn, Ba content of white mica, Na₂O, K₂O, Ishikawa alteration index (AI), S/Na₂O, Ba/Sr, Mn content of carbonate, Tl, and Sb.