

## Discovery of the West 45 Volcanic-Hosted Massive Sulfide Deposit Using Oxygen Isotopes and REE Geochemistry

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### Abstract

A number of innovative geochemical techniques were tested around the Thalanga volcanic-hosted massive sulfide (VHMS) deposit in North Queensland, with the objective of being able to recognize a “near miss” in the exploration drilling in and around the mine.

Whole-rock oxygen isotope analyses were used to determine temperature gradients in the footwall rocks just beneath the ore horizon. By assuming a water  $\delta^{18}\text{O}$  value of 0 per mil, consistent with a seawater-dominated hydrothermal system, an alteration temperature was calculated for each sample. A quantitative determination of the mineralogy was used to work out a weighted fractionation factor for each sample so that the variance attributable to differences in mineralogy could be taken into account. Comparison of the temperatures to a sodium depletion index indicates that the  $\delta^{18}\text{O}$  halo is comparable in size to an alteration mineralogy halo, but the distribution of Na is somewhat unpredictable in the distal parts of the hydrothermal system. This study identified a hot spot 1 km west of the limit of the mine workings.

The Mount Windsor Volcanics, which host the Thalanga deposit, contain a large number of stratiform quartz-hematite lenses (red jaspers). Rather than drill test all of these occurrences, a geochemical index was determined to assist in ranking them. Elevated Ba, S, and Pb along with positive chondrite-normalized Europium anomalies were found to be characteristics of proximal jaspers as compared to barren jaspers. A red jasper outcrop west of Thalanga, coincident with the  $\delta^{18}\text{O}$  hot spot, was the most anomalous sample in this study. Subsequent drill testing of this target led to the discovery of the West 45 VHMS deposit.