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POSSIBLE SUBMARINE ADVANCED ARGILLIC ALTERATION AT THE BASIN LAKE PROSPECT, WESTERN TASMANIA, AUSTRALIA

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Abstract

The Basin Lake copper-gold prospect lies in western Tasmania's Mount Read Volcanics and is hosted in a series of calc-alkaline andesites, quartz-feldspar porphyries, mudstones, carbonates, and sandstones between the Tyndall Group and the Central Volcanic Complex. Alteration at the Basin Lake prospect occurs over a strike length of 1.4 km and includes thin, strata-bound pyrophyllite-quartz-paragonite-kaolinite-pyrite-alunite alteration zones, up to 12 m wide and containing up to 50 wt percent pyrophyllite, with local fluorite veining. These zones grade out to paragonite-muscovite-kaolinite-quartz-pyrite and muscovite-carbonate-chlorite alteration zones. Extensive propylitic alteration (chlorite-carbonate-epidote) affects most other rocks outside these zones.

Mineralization consists of thin strata-bound zones of massive and vein pyrite, tennantite, and chalcopyrite, with trace covellite and galena, hosted mainly within an intensely silicified core of the pyrophyllite-quartz-sericite alteration zone. Pyrite has $\delta^{34}S$ values of –1.4 to +6.9 per mil, although marginal vein pyrite in the propylitic zone has $\delta^{34}S$ values around 12.4 per mil. Large silicified glacial erratic boulders at surface contain massive and vein pyrite, enargite, and tennantite, with minor barite, and trace covellite, stannoidite, and mawsonite. Pyrite and enargite have $\delta^{34}S$ values of 1.7 to 6.8 per mil; barite has $\delta^{34}S$ values around 35.2 per mil with $^{87}Sr/^{86}Sr$ around 0.7108.

The alteration and mineralization at the Basin Lake prospect is similar to that associated with high-sulfidation copper-gold systems formed by acidic, relatively oxidized fluids. A new geochemical vector, here termed the "advanced argillic alteration index" [AAAI = 100 $(SiO_2)/(SiO_2 + 10MgO + 10CaO + 10Na_2O)$], has been devised to help quantify the intensity of alteration. The values of the AAAI at Basin Lake are similar to those of several high-sulfidation epithermal deposits. The low sulfide $\delta^{34}S$ values are similar to those at other sulfide occurrences in the Mount Read Volcanics that have previously been considered to be barren, are lower than those of nearby volcanic-hosted massive sulfide deposits, and may indicate a magmatic fluid component. However, the $\delta^{34}S$ and $^{87}Sr/^{86}Sr$ values of Basin Lake barite at the assumed highest exposed level of the system and higher $\delta^{34}S$ values in pyrite from marginal veins are similar to those of Cambrian volcanic-hosted massive sulfide systems, indicating the involvement of reduced seawater sulfate at these locations. Calcite carbon and oxygen isotope values, silicate oxygen isotope values, and the unusual abundance of carbonate close to advanced argillic alteration indicate fluid mixing and suggest that acidic, magmatic fluids were likely neutralized by seawater. This occurrence strengthens the case for prospecting the Mount Read Volcanics and other similar submarine volcanic belts for copper-gold and gold-only deposits that formed by the actions of hyperacid oxidized fluids.

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