

Massive Chalcopyrite Mineralization at Red Bore, WA: The Deep Roots of a Sea-Floor Hydrothermal System

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Mineralization recently discovered at Red Bore, in the Doolgunna region of central Western Australia, includes multiple pipe-like bodies composed of massive chalcopyrite surrounded by brecciated massive magnetite. Drill core indicated that the pipes are at least 100 m long and about 10–12 m in diameter, although the total extent is unknown.

The ore replaced the mafic volcanic-subvolcanic host rocks of the Paleoproterozoic Narracoota Formation. Accessory phases include pyrite, mixed sulfide-silicate phases (partially sulfidized silicates), pyrrhotite, and various Bi-Te-(Se)-Ag-(Au) phases. The mineralization is enveloped by a narrow (<2 m) alteration halo composed of serpentine, amphibole, silica, and talc. Laser ablation ICP-MS analyses of chalcopyrite and pyrite indicated high concentrations of Ag, Au (up to ~200 and 10 ppm, respectively), other than enrichments of Se and Pd. In situ sulfur isotope analyses of chalcopyrite and pyrite indicate narrow ranges of $\delta^{34}\text{VCDT}$ (0–3.3‰, but mostly 2–3.3‰) and no mass-independent fractionation, consistent with deposition from a homogeneous fluid derived from a magmatic source.

We interpret the mineralization at Red Bore to be the result of release of Cu-rich magmatic fluids in focused channels, possibly along structural discontinuities. The fluids likely raised to the surface and contributed to the neighboring VMS mineralization known in the area. The deposit provides direct insight into deep portions of a magmatic-hydrothermal system developed in oceanic crust underneath VMS deposits.