

# Geologic Constraints on Base Metal Mineralization of the Whim Creek Greenstone Belt, Pilbara Craton, Western Australia

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## Abstract

The Whim Creek greenstone belt, Pilbara Craton, Western Australia, contains a volcano-sedimentary succession that was deposited in two, separate meso-Archean basins. The oldest lithostratigraphic unit (Whim Creek Group) was deposited within an arc-related basin at ca. 3010 Ma. The younger unit (Bookingarra Group) was deposited in the >2950 Ma continental rift-related Mallina basin. The two packages are separated by an erosional unconformity. Rocks of the Cistern Formation and the Rushall Slate (Bookingarra Group) host base metal sulfide ores at Whim Creek and Mons Cupri. Previous interpretations have suggested that the source of ore-forming fluids was felsic rocks of the Mons Cupri Dacite (Whim Creek Group). The relationship between the two groups is crucial to the understanding of mineralization of the Whim Creek greenstone belt.

The stratigraphy and geochemistry of the Whim Creek Group are consistent with deposition within an arc-related basin over rifted continental crust. Volcanism within the depositional basin initially produced small volumes ( $\leq 5 \text{ km}^3$ ) of tholeiitic basalt lava of the Warambie Basalt. This was followed by felsic volcanism that produced large volumes of pyroclastic debris preserved as the Red Hill Volcanics. Small- and large-volume dacite units were emplaced as syndepositional intrusions into the Red Hill Volcanics. These are collectively termed the Mons Cupri Dacite member.

Sedimentation of the Bookingarra Group began with the deposition of reworked basement material derived from the Whim Creek Group. Coarse-grained, volcanic sedimentary rocks grade upward into sandstone and shale derived from the weathering of a granite-dominated (continental) source. The preserved stratigraphy suggests that rifting took place over continental crust and may be related to the formation of the Mallina basin. Continued extension led to the formation of up to a 2-km thickness of basaltic lava and high-level intrusions of the Mount Negri and Loudon Volcanics.

A new interpretation of the stratigraphy of the Whim Creek greenstone belt suggests that a major unconformity separates the Whim Creek Group from overlying formations. As a consequence, these rocks cannot be the source of the base metal sulfide mineralization hosted by the Bookingarra Group. All major orebodies are structurally hosted and are chronologically related to extension and granitoid emplacement recognized within the Mallina basin at 2950 to 2940 Ma.