

Geochemistry and Hydrothermal Alteration at the Mt Carlton High Sulfidation Epithermal Gold-Silver Deposit

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The Mount Carlton high sulfidation Au-Ag-(Cu) deposit is situated ~140 km SSE of Townsville, Queensland, Australia. Gold-(Cu-Ag) ore is currently being mined at V2 (11.4 Mt @ 2.4 g/t Au, 22 g/t Ag and 0.27% Cu) and Ag-(Cu-Au) was mined at A39 (0.9 Mt @ 197 g/t Ag and 0.33% Cu). Both orebodies are hosted within the Permian andesitic to rhyolitic Lizzie Creek Volcanics, formed during early stages of back-arc rifting in the Bowen Basin. Gold, silver, and associated hydrothermal alteration are localized within coherent and volcanoclastic rhyodacite above underlying andesitic volcanic and volcanoclastic rocks, and below overlying intermediate volcanic, volcanoclastic, and sedimentary rocks.

Many programs of multi-element geochemistry and SWIR hyperspectral analysis have provided valuable insights into both the stratigraphy and deposit- to camp-scale zonation in alteration assemblages and pathfinder elements. Classification of rock units using immobile trace elements—in particular, Ti, Nb, Sc, and Th—is possible despite widespread, intense, acidic alteration. Where one rhyodacitic unit had previously been interpreted, two geochemically distinct units have been recognized: a lower ~rhyolitic unit hosting V2, and an upper ~dacitic unit hosting A39. Andesitic lavas and volcanoclastic rocks occurring above and below the host rhyodacites, previously difficult to differentiate visually when altered or weathered, have been shown to represent two geochemically distinct units that can now be more consistently mapped across the district.

Hydrothermal alteration assemblages at Mt Carlton are zoned from a core of quartz-alunite ± barite ± dickite ± gypsum ± pyrite to quartz-dickite ± kaolinite ± alunite ± barite ± pyrite to illite-smectite-quartz-pyrite ± kaolinite ± chlorite to distal chlorite-calcite-smectite ± illite ± zeolite. Advanced argillic alteration assemblages (quartz-alunite and quartz-dickite) show a strong lithological control, forming extensive sheets within the rhyodacitic units. Gold and silver occur in crosscutting veins, breccias, and disseminations of pyrite, marcasite, enargite, sphalerite, galena, and Ag-bearing sulfosalts hosted within advanced argillic alteration facies. This mineralization is concentrated at the margins of thick intervals of quartz-alunite alteration within coherent rhyodacite (V2) and alunite-dickite-quartz-pyrite alteration in volcanogenic sedimentary rocks and rhyodacitic breccias (A39).

At the camp scale, alteration mineral zonation reflects proximity to porphyry intrusive centers and the level of preservation at the current surface. The composition of alunite, determined from SWIR spectroscopy using the wavelength of the ~1480 nm absorption feature, changes from potassic in V2 and A39 to intermediate Na-K alunite immediately above occurrences of porphyry-style stockwork elsewhere in the district. Pathfinder elements map out camp-scale zonation in mineralization style and preservation level using Mo, As, and Tl, or Sb. Molybdenum is elevated in more deeply eroded areas prospective for porphyry-style deposits and in the interpreted hotter, deeper roots of the epithermal environment. Arsenic is associated with shallow level advanced argillic alteration, prospective for high sulfidation epithermal deposits, while Tl and Sb are elevated on NE trends where low to intermediate sulfidation-style veining has been mapped.

In summary, more detailed understanding of the local stratigraphy, alteration zonation, and pathfinder element distribution have allowed for better prioritization and testing of exploration targets.