

# Camp-scale alteration dispersion: indicators for multiple fluids and pathways

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Previously, hydrothermal alteration halos around Archaean orogenic gold deposits have been documented at the metre to 100 m scale centred around the gold lode. The preferred model for this spatial relationship and the available fluid inclusion and stable isotope data was a one fluid model with gold deposition largely caused by fluid-wallrock reactions and phase separation. Camp-scale studies in the St. Ives gold camp and at the Kanowna Belle and Wallaby deposits in Western Australia have documented camp-scale hydrothermal alteration cells which are asymmetric to gold.

Several hundred metres to kilometre scale magnetite-pyrite or phengite alteration cells, which are indicative of oxidized, alkaline fluids, are centred around porphyry intrusions. Sulfur isotopes are negative down to about -8 ‰. 3D modelling identified distinct pathways for the oxidized fluids (e.g., N-S trending, subvertical pathways in the St. Ives camp). Based on the spatial association of the oxidized alteration with porphyry intrusions, these fluids are interpreted to be magmatically derived or associated.

In contrast, pyrrhotite or muscovite/paragonite-bearing assemblages are associated with regional faults, which also typically carry elevated As, or shallowly SW- to S-dipping shear zones and possibly E-W trending deformation zones in the St. Ives camp. This alteration assemblage can extend tens of kilometres and is indicative of reduced and acidic fluid conditions. It is associated with CH<sub>4</sub>-CO<sub>2</sub> fluid inclusions which typically contain little or no H<sub>2</sub>O (Petersen et al., this volume). The acid alteration is interpreted to result from the interaction of deeply-sourced, anhydrous, reduced fluids with an ambient H<sub>2</sub>O-CO<sub>2</sub>-NaCl fluid (metamorphic fluid). Sulfur isotopes in the reduced domain are typically positive.

Gold mineralization is located in domains which show the greatest chemical gradient, i.e. at boundaries of reduced, alkaline or acid fluid domains and oxidized, alkaline fluid domains. This spatial relationships imply the interaction of two endmember fluids ("mixing") within the gold lode. Chemically, fluid mixing provides a highly effective gold depositional mechanism. This interpretation is supported by mutual overprinting relationships for oxidized and reduced alteration assemblages at the Conqueror mine in the St. Ives gold camp. The model implies oxidized and reduced fluids were transported in different structures. Gold deposition occurred where reduced and oxidized structures intersected.