Types of fluid compositions and evolution at the St Ives Gold Camp

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The analysis of the alteration assemblages (sulphide - oxide - silicate) in the St Ives gold camp (SIGC) in combination with fluid inclusion (FI), geochemistry and stable isotope data indicate a significant variation in physicochemical parameters such as redox and pH (Neumayr et al., this volume). Relating these chemical gradients, alteration mineralogy, and the architecture is a key step in building targeting concepts and ore forming models.

The redox gradient in the SIGC is expressed by the distribution of secondary magnetite, hematite, pyrite, pyrrhotite and arsenopyrite Mineral assemblages are classified as OR (oxidized-reduced) or RO (reduced-oxidized) together with the dominat FI type:

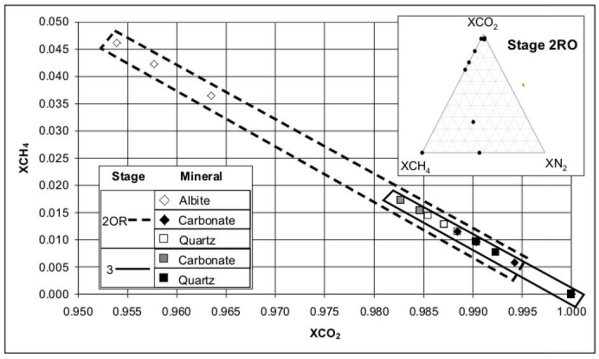
Type 1OR: epidote - magnetite ± pyrrhotite (aqueous FI),

Type 2RO: pyrrhotite - carbonate - amphibole - biotite ± albite ± quartz ± arsenopyrite ± pyrite ± sphalerite ± gold ($CO_2 \pm CH_4 \pm N_2$, no visible H_2O);

Type 2OR: albite - carbonate - pyrite - gold/silver ± magnetite ± hematite ± quartz (CO_2, no visible H_2O);

Type 3: quartz ± carbonate ± pyrite ± gold (remobilized?) (H_2O - NaCl ± CO_2, frequent daughter crystals).

The spatial distribution and temporal sequence (crosscutting textural evidence) of sulphide - oxide - gold assemblages indicate the presence of, at least, two spatially restricted but broadly synchronous alteration types (2RO and 2OR) at the time of gold mineralization. Fluid inclusion analyses also show that these two alteration types are characterized by a high content of volatiles (e.g., CO_2, CH_4, N_2 - see diagram below) and very low H_2O, relatively to the earlier Type 1OR and the later Type 3.



The presence of anhydrous fluids (CO_2 and CH_4-N_2-rich with inferred SO_2, H_2 and Na) with a wide range of redox states implies mixing of fluids of different origins rather than local boiling at about the time of mineralization. Gold probably precipitated by fluid mixing reactions.