U-Pb Geochronology and trace element analysis of Apatite and Calcite from the Ernest Henry Iron-Oxide-Copper-Gold Deposit, NW Queensland

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The Ernest Henry Iron-Oxide-Copper-Gold (IOCG) deposit is located on the Easternmost margin of the Proterozoic Eastern Fold Belt of the Mount Isa Inlier.

Ernest Henry is the largest IOCG deposit in the Eastern Succession of the Mount Isa Inlier.

This deposit is structurally bound by two Northwest trending shear zones that dip ~45° Southeast.

Four main stages of alteration include regional sodic alteration, pre-mineralization alteration, Cu-Au mineralization and post-Cu alteration (Mark et al., 2006).

The recent discovery of a pre-mineralization structure termed the “Interiors” shows apatite brecciated by a mineralogy comparable to the ore-stage assemblage (Brenn, 2016).

Core Logging (EH859)

Core logging shows a large increase in P and coarse-grained (cm scale) apatite in the Interiors.

The Interiors is associated with a large decrease in Cu, Au, and U.

Apatite and calcite samples were collected from ore-stage mineralization and the Interiors.

Apatite Geochronology

Apatite from the Interiors produced an age of 1536 ± 37 Ma.

Apatite from the ore-stage assemblage produced an age of 1532 ± 47 Ma.

The age produced correlates with regional Na-Ca alteration, the intrusion of the nearby Mount Margaret Granite and ore-stage bismuth.

Although the same age, there is a large difference in the initial Pb (207Pb/206Pb) estimate of the two samples, hinting towards closed system behavior (e.g. the apatite from the ore-stage assemblage was likely sourced from the Earth’s reservoir) (Kirkland, et al. 2017).

Rhenobochinites is likely derived from the Interiors to form the ore-stage apatite.

Apatite Trace Elements

- Different styles of zoning in apatite reflects different processes.
- REE’s can be fractionated by the transport complexes they form.
- CI preferentially forms complexes with UREE’s.
- 5 complexes have no REE preference.

Therefore, the LREE depletion from BC22A to BC22C was likely caused by alteration from a CI rich fluid whilst the non-preferential depletion in REE’s from BC10A to BC10B suggests alteration occurred by a S rich fluid.

Calcite Trace Elements

- Trace element analysis shows calcite from the ore-stage assemblage and later veins possess a similar trace element geochemistry.
- Calcite from the nearby E1 deposit has a similar trace element geochemistry comparable to apatite from the Interiors.

A similar trace element geochemistry suggests the calcite samples share a similar genesis.

Alternatively, calcite from the ore-stage assemblage and late veins could possess this similarity due to diffusion of REE’s during reheating. Calcite from the E1 sample is post mineralization, potentially suggesting a late regional hydrothermal event.

Calcite Geochronology

- Geochronology was unsuccessful on samples from Ernest Henry.
- The method used proved successful on a calcite standard with a known age of 251 ± 2 Ma (WC-1).
- This dating method is viable for future studies.

References

Kirkland, et al. (2017). Geochemical SOC report, Ernest Henry Iron Ore Project, Mount Isa Inlier, Queensland, Australia