

Using the chemistry of apatite to track fluids in Fe-oxide Cu-Au systems

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Apatite has long been recognised as a suitable mineral for determining the HF/H₂O and HCl/H₂O compositions of fluids in fluid-rock systems [1,2] [Yardley, Munoz, Zhu & Sverjensky]. It has also been recognised as an important indicator mineral for the evolution of S in magmatic systems [3]. This work presents results from the microprobe analysis of apatite associated with regional un-mineralised and mineralised Fe-oxide-Cu-Au hydrothermal breccia systems from the Mount Isa Eastern Succession.

The apatites are dominantly F-rich with subordinate amounts of Cl and little or no calculated OH. The F is stoichiometrically enriched relative to the normal 2 afu which, aside from some analytical complexities, may indicate the presence of CO₂ in the structure [4]. In the mineralised system (Ernest Henry) there is strong zoning in the apatite with S-rich cores (0.5 wt% SO₃) and As-rich rims (5 wt% As₂O₅). These components are measured in apatite from the regional breccia systems but never in such abundances. Changes in the bulk mineralogy of the regional hydrothermal breccias from magnetite-calcite to Ti-magnetite-titanite are linked to changes in the S/As and F/Cl/(CO₂) chemistry of the apatite.

Assuming that the apatite does not cause in-situ oxidation during the process of substituting S and As for P these elements record the relative activities of the oxidised components (S⁶⁺ and As⁵⁺) in solution.

References

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