

Trace element geochemistry of magnetite and pyrite in Fe oxide (\pm Cu–Au) mineralised systems: Insights into the geochemistry of ore-forming fluids

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LA-ICP–MS analyses of magnetite and pyrite from Fe oxide (Cu–Au) (e.g. Ernest Henry, Osborne, Starra and Mount Elliott) and related deposits in northwest Queensland, Australia shows that these minerals are enriched in a diverse suite of elements. Magnetite typically contains detectable Ti, Si, Al, Mg, Sc, Co, Ni, Cu, Zn, Ga, Sn, Pb, Mn, V, Cr and Mo, whereas co-genetic pyrite contains detectable Ti, Co, As, Si, Se and Ni. Comparison of ore-related and barren systems shows that magnetite and pyrite exhibit differences in relative trace element concentrations, where magnetite associated with ore typically contains lower Ti, V and Cr and higher Sc and Mo, while Co and As were higher in ore-related pyrite. These chemical differences are common for many Cu–Au ore systems in the district, and potentially indicate that magnetite and pyrite can be employed as geochemical mineral indicators toward ore-forming systems.

The main factors considered important in controlling magnetite and pyrite geochemistry include: (i) fluid composition; (ii) process of ore formation (e.g. fluid mixing and fluid–rock interaction); and/or (iii) physicochemical conditions (e.g. T, f_{O_2}) during mineral deposition. Given that the minerals in this study largely occur as open-space fill (e.g., veins), they were probably formed in fluid-buffered environments where contributions from the host rocks via element exchange were minimal. Consequently, we propose that the chemistry of magnetite and pyrite in the ore systems probably reflects the geochemistry of the precipitating fluid(s) which considered together with the stable isotope characteristics and complex chemistry of ore-forming fluids from the Ernest Henry and Starra Cu–Au deposits suggests a significant magmatic contribution to the metal budget of the ore deposits (1).

Reference

Williams, P.J., Dong, G., Ryan, C.G., Pollard, P.J., Rotherham, J.F., Mernagh, T.P., Chapman, L.H., . *Econ. Geol.* **96**, 875–883.