Source and transport paths in large hydrothermal systems: mapping and geochemical modelling of albitization and veins around IOCGs

N.H.S. Oliver[1,2], *J.S. Cleverley*[1,3]

1.
Economic Geology Research Unit, James Cook University, Townsville, QLD 4811, Australia.

2.
Director and Principal Consultant, HCOVGlobal, Alligator Creek, QLD, 4816, Australia.
Email: nickoliver@hcovglobal.com

3.
REFLEX/IMDEX Europe, Unit 4/5, Upper Stalls Iford, Lewes, East Sussex, United Kingdom BN7 3EJ

ABSTRACT

Albite-altered rocks form widespread zones in metamorphic belts, and are considered to be a distal expression of large hydrothermal systems that generated iron-oxide Cu-Au (IOCG) mineralization in the Proterozoic eastern Mount Isa Block, and globally. Understanding the role of mass transfer in this system has relevance for the recognition of metal source regions and fluid flow patterns in other large hydrothermal systems, such as those surrounding orogenic and epithermal gold deposits.

We combined aspects of the spatial inter-relationships of albite alteration, barren veins, and mineralization with equilibrium dynamic geochemical models. Mass balance calculations comparing less and more albitized rocks shows that Al, Ti and Zr were immobile, Na was consistently gained during albitization, and Fe, Ni, K, Rb, Zn and Pb were lost. When the effluent fluid, with increased K, Fe and Ca from albitization, is reacted with host rocks, proximal IOCG alteration (e.g. biotite-magnetite-actinolite) is simulated. However, although intrusions are considered by many to be an essential part of the mass budget in IOCG systems, we had to adjust the model granite fluid composition to substantially higher Na/K ratios in order to albitize all wall rock compositions (as observed in the field). The implication, confirmed by many fluid inclusion studies, is that additional Na (from brines or potentially from fluid immiscibility) is required to contribute to this process.

The modelling also matched two types of albitites: those in which K and Fe are leached at km-scales (i.e. source rocks) and are not found in association with IOCG-related K-Fe alteration, and those that appear to be a distal halo around IOCG alteration (distal haloes). The distinction between these may be a future exploration strategy. However, albitization does not apparently contribute to the copper budget of the IOCGs, and an additional copper source is likely (e.g. fluid from crystallizing mafic magmas).