Vectors to Porphyry Copper Deposits Hosted in Carbonate Rocks: an Update on the Bingham to Stockton Carbonate Transect Geochemistry

Michael J. Kirschbaum[1], Zhaoshan Chang[1], Adam Pacey[3], Paul Agnew[3], Phillip Nickerson[2], Kim Schroeder[2], Kathleen Gundy[2], Andrew Sasso[2]
1. Colorado School of Mines, Golden, CO, USA, 2. Rio Tinto, Salt Lake City, UT, USA, 3. Rio Tinto, Bundoora, VIC, Australia

Copper is one of the most important metals utilized by modern civilizations and it is estimated that ~75% of the known global copper resources (~3,100 Mt) are contained within porphyry deposits. Most future porphyry discoveries will require deep drilling of systems with only minor (or completely absent) surficial expression of ore. Researchers in the last few decades have made progress on identifying the distal geochemical footprints and vectors to porphyry copper deposits but most of these studies have focused on igneous host rocks. Our research aims to expand upon this knowledge by investigating the proximal to far-field geochemical signals of porphyry copper deposits emplaced within carbonate rocks.

In this Bingham – Stockton research update we present geochemical trends in two laterally continuous carbonate units, the Jordan and Commercial limestone beds. These two carbonate units were sampled along a 17km transect between the giant Bingham and the smaller Stockton porphyry systems. Whole rock analyses reveal several notable elemental trends:

1) Be, Cu, Fe, Ga, In, Mo, Ni, Re, S, Se, Sn, V, Pd and most REE's show higher concentrations near Bingham with a sharp drop ~1km outboard

2) Ag, As, Nb, Nd, P, and Pb decreases to a distance of ~5km from Bingham to background.

3) Ba, Cd, Mn, and Zn increase to a distance of ~2km from Bingham, then decreases outboard

4) Sr increases outward to ~2km, then stabilizes.

Drilled vein samples show similar relations, although Ba, Cd, Ga, Nb, Ni, Pd, Re, REE, Se, and V do not show trends, whereas Ge shows an increasing outwards trend. Whole rock C-O isotopes show hydrothermal signatures ($\delta^{18}O$<15‰, $\delta^{13}C$<-3.3‰) within 2km of Bingham, then jump to marine carbonate signatures ($\delta^{18}O$ 20-29‰, $\delta^{13}C$ -1.8 to 3.6‰) outwards without temperature corrections.