Cu isotopic anomalies around porphyry Cu deposits

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Significant isotopic fractionation of Cu is generally considered to be associated mainly with supergene redox processes rather than hypogene processes. Here we report large, systematic Cu isotopic variations in the Northparkes Cu-Au deposit, NSW, Australia, which is a typical orthomagmatic porphyry Cu deposit.

Copper isotopes have been measured in sulfide minerals by solution MC-ICP-MS and laser ablation MC-ICP-MS. The results from both methods show a variation in δ^{65}Cu of hypogene sulfide minerals (chalcopyrite and bornite) greater than 1.2‰ (relative to NIST976). Significantly, the results from four drill holes through two separate ore bodies show strikingly similar patterns of Cu isotope variation with depth (Fig. 1). The patterns are characterized by a sharp down-hole decrease from ~ 0.8‰ to ~ -0.3‰ at the margins of the most mineralized zones (Cu grade > 1wt.%). Below the margin, the compositions are more consistent (around 0.2‰). Sulphur isotopes show no such concomitant variation and the mechanism(s) responsible for the Cu isotopic distribution is not yet clear. Nevertheless, this work demonstrates that Cu isotopes show a large response to high-temperature porphyry mineralizing processes, and that they may act as a vector to buried mineralization.

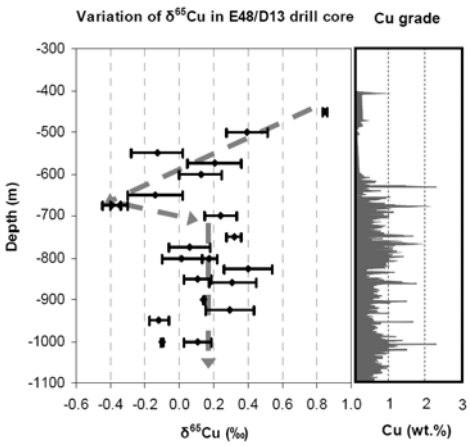

Figure 1: Variation of Cu isotope ratio and Cu grade with depth in drill hole E48/D13 from Northparkes Cu-Au porphyry deposit, NSW, Australia.