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Contrasting Cu-Au and Sn-W Granite Metallogeny through the Zircon Geochemical and Isotopic Record

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Magmatic genesis and evolution – mediated by geodynamic setting - exert a primary control on the propensity of granites to be metal fertile. A revolution in our understanding of these petrogenetic processes has been made through a range of mineral-based tools, most notably the common accessory mineral zircon. There is consequently considerable interest in whether the geochemical and isotopic compositions of zircon can be applied to metallogenic problems.

The paired magmatic belts of Myanmar have broadly contrasting metallogenic affinities (Sn-W versus Cu-Au), and are interpreted to have formed on the accretionary margin of the subducting Neo-Tethys Ocean. They therefore present the opportunity to geochemically compare and contrast the zircon compositions in two end-member types of granite-hosted mineral deposits generated in collisional settings. We present an integrated zircon isotope (U-Pb, Lu-Hf, O) and trace element dataset that fingerprint: (a) source; (b) redox conditions; and (c) degree of fractionation. These variables all impact on magma fertility, and our key question to address is whether they can be reliably traced and calibrated within the Myanmar zircon record.

Granitoid-hosted zircons from the I-type copper arc have juvenile εHf (+7 to +12) and mantle-like δ18O (5.3 ‰, whereas zircons from the S-type tin belt have low εHf (-7 to -13) and heavier δ18O (6.2-7.7 ‰. Plotting Hf versus U/Yb reaffirms that the tin belt magmas contain greater crustal contributions than the copper arc rocks. Links between whole rock Rb/Sr and zircon Eu/Eu* highlights that the latter can be used to monitor magma fractionation in systems that crystallize plagioclase (low Sr/Y). Ce/Ce* and Eu/Eu* in zircon are thus sensitive to redox and fractionation respectively, and can be used to evaluate the sensitivity of zircons to the metallogenic affinity of their host rocks. Tin contents that exceed the solubility limit are required in order to make a magmatic-hydrothermal deposit, and empirical observations suggest that this threshold may be marked by zircon Eu/Eu* values of ca. < 0.08. The isotope and trace element signatures of both magmatic and detrital zircons can be developed into a useful exploration tool.