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Granite metallogeny through the zircon record: A study from Myanmar

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Granite-hosted mineral deposits are major global sources for Cu, Mo, Sn, W, Au, Li and U. Magmatic genesis and evolution 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. As a consequence, there is considerable interest in whether the geochemical and isotopic properties of zircon can be applied to metallogenic problems.

We study the sensitivity of zircon geochemical data to the mineralization potential of the paired magmatic belts of Myanmar. In their broadly contrasting metallogenic affinities (Sn-W versus Cu-Au), these belts present the opportunity geochemically to compare and contrast the zircon record in different types of granite-hosted metallogeny. We focus on the measurement of geochemical elements within zircons that fingerprint (a) source, (b) monitor redox conditions, and (c) inform upon the degree of fractionation. These have all been interpreted to be primary controls on magma fertility[1], and our key question to address is whether they can be reliably traced and calibrated within the Myanmar zircon record.

Source controls both metal endowment and intensive properties of the magma. The role of mantle-and crustal-sourced material in granite petrogenesis can be determined through zircon Lu-Hf and O isotope analysis. The Myanmar samples show distinct belt-specific groupings in Hf-O space, implying a strong mantle signature for the Cu-Au belt, and a more evolved, crustal source for Sn-W. Source also imposes a hereditary control on the redox state of the magma, which has implications for metal availability during magmatic evolution. Previous work has suggested the redox of the parent magma can be monitored through rare earth element anomalies within zircons[2]. The processes of fractionation during magmatic evolution lead to a concentration of incompatible metals, and ultimately, to the formation of ore minerals. We consider whether the degree of fractionation of the parent magmatic system can be monitored within the trace elements of the Myanmar zircons.

References:

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