Fertility of arc volcanic suites for Cu-Au mineralisation: A case study from NE Queensland, Australia

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Coeval volcanic rocks distal and proximal to hydrothermal Au-Ag-Cu mineralisation in the early Permian Lizzie Creek Volcanics (LCV), NE Queensland, Australia, have been studied to evaluate whether geochemical parameters of these rocks can be used to assess magma fertility.

The LCV (~280-295 Ma) form the basement of the Bowen Basin that developed due to back-arc extension behind the Carboniferous Connors Arch. The LCV range in composition from basalt to rhyolite, and have geochemical compositions that are typical of arc lavas (e.g. LILE enrichment, Nb, Ta depletion). Samples collected distal to known mineralisation are bimodal (basalt – dacite to rhyolite) in composition displaying the commonly known "Daly Gap". By contrast volcanic samples from the mineralised district (Mt Carlton epithermal and porphyry deposits) cover the full range of compositions from andesite to rhyolite. Distinct differences in whole-rock geochemistry can be particularly observed in TiO_2, Sr/Y, V/Sc and REE element composition.

Our approach applies proposed Cu-Au fertility concepts for causative porphyry intrusions to volcanic rocks [1]. Sr/Y and V/Sc ratios of samples from the Mt. Carlton district fall within the favorable range of proposed Cu fertility concepts; the samples distal to mineralisation fall outside these fertility ranges. La/Yb and Dy/Yb ratios of Mt. Carlton samples suggest the cryptic involvement of a hydrous phase (amphibole?) during fractionation, which is not evident in distal samples.

Hf isotope data from zircons from the Mt. Carlton district records a trend towards unradiogenic compositions with time, from inherited early Carboniferous zircons (□Hf = 1 - 3) to early Permian host rocks (□Hf = + 1 to - 1), indicating increased input from old crustal sources due to crustal thickening and a compressive environment.

Our data shows that geochemical proxies for Cu fertility used for porphyry intrusions can also be applied to cogenetic volcanic sequences, which in turn may be a useful geochemical tool to aid regional-scale exploration for Cu-Au mineralisation in convergent margin terranes.

[1] Loucks (2014), *Aust. J. of Earth Sciences* **61**, 5-16.