Tectonic Controls on Porphyry Copper Formation in the Northern Great Basin (Nevada-Utah-Idaho), Western USA

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The prevailing Andean model for the formation of porphyry copper deposits (PCDs) along convergent continental margins requires a prolonged period of compression and crustal thickening, which stalls juvenile mantle wedge-derived magmas in the lower crust. While stalled, fractionation gradually causes their volatile content and thus ore-forming potential to increase. Upon relaxation of compressional stress, these deep fertile magmas ascend to form PCDs in the shallow crust. Tectonic models are becoming increasingly important in defining new exploration areas for buried, undiscovered deposits in the western USA. However, it is unclear to what extent the Andean model applies in this region. Understanding the controlling factors for mineralisation requires comparison of copper-rich districts such as the Laramide belt in Arizona (~80–50 Ma) to tectonically similar areas of less extensive mineralisation, such as the Northern Great Basin (NGB), where there are fewer PCDs and they tend not to be of Laramide age (generally >100 Ma, or <40 Ma).

This study tests two predictions of the Andean model for PCDs in the NGB: (1) they are emplaced directly after compression ends; and (2) they are most prevalent in areas with the greatest magnitude and longest duration of compression. To do this, we focus on three metamorphic core complexes, which represent exhumed remnants of the mid-lower crust (the Raft River-Albion-Grouse Creek Range, the Ruby Mountains, and the northern Snake Range). Preliminary in situ Rb-Sr dating of syntectonic micas from contractional structures within the Raft River-Albion-Grouse Creek Range yields ages of ~45 to ~100 Ma, providing new constraints on the timing of compression in this area. Further dating of structures within all three core complexes, combined with thermobarometric constraints to estimate crustal thicknesses, will provide a spatial-temporal database for comparison with PCD mineralisation both within the NGB and in copper-rich Arizona.