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Potential links between porphyry copper deposits and exhumed metamorphic basement complexes in northern Chile

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Porphyry copper deposits (PCDs) are typically associated with magmatic arcs in compressional subduction zone settings where thickened crust and fractionated calc-alkaline magmas produce favourable conditions for copper mineralisation. A classic example is the Eocene-Oligocene PCD belt of Chile, the world's leading copper producing country. In other parts of the world, older late Cretaceous to early Tertiary PCDs are found in regions of former subduction-related magmatism that have undergone subsequent post-orogenic crustal extension, such as the Basin and Range province of western North America, and the Eurasian Balkan-Carpathian-Dinaride belt.

In the Basin and Range there is a striking correlation between the location of many PCDs and exhumed metamorphic core complexes (isolated remnants of the middle to lower crust exhumed during extensional normal faulting). This close spatial relationship raises questions about the links between the two. For example, are their exhumation histories related? Could the presence of impermeable metamorphic rocks at depth affect and localise mineralising fluids?

In Chile there appears to be a similar spatial relationship between PCDs and isolated outcrops of exhumed metamorphic basement. In northern Chile, isolated exposures of high-grade metamorphic gneisses and amphibolites are thought to be exhumed remnants of the pre-subduction Proterozoic–Paleozoic continental margin of Gondwana [2], although little is known about when they were exhumed and by what mechanism.

For example, the Limón Verde metamorphic complex, exhumed from a depth of ca. 50 km, is situated adjacent to Chuquicamata, the largest open pit copper mine in the world. In northernmost Chile, another metamorphic exposure, the Belén complex, sits close to the Dos Hermanos PCD, a small deposit that is not actively mined. Comprising garnet-bearing gneisses and amphibolites, the Belén is thought to have been exhumed from a depth of ca. 25 km, but when and how is unclear [3].

We present new mapping, structural analysis, and geochronologic data from both the Limón Verde and the Belén metamorphic complexes and explore the relationship between these isolated outcrops and PCD formation in northern Chile.

References:
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