

Orogenic Copper Systems: A Global Perspective and Exploration Framework

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Copper mineralisation is found across a diverse range of tectonic settings, including porphyries found in collisional settings, to deposits such as Stratiform Sedimentary-hosted, Volcanogenic Massive Sulphide and Iron-Oxide-Copper-Gold (IOCG) systems typically formed in extensional settings. While these archetypal deposit types have proven to be (and remain) fruitful Cu sources, the increased demand in Cu due to the Just Energy Transition over the past five years means that the identification and understanding of alternative Cu sources and systems is becoming increasingly vital, especially in the context of tectonic settings that have not previously been considered.

The latter stages of the orogenic cycle is an example of an alternative tectonic setting that shows potential for Cu exploration, evidenced by several Cu deposits and districts within the Mt. Isa Inlier (Eloise, Tennent Creek, Ernest Henry), Mauritanides Orogenic Belt (Guelb Moghrein), Damara Orogenic Belt (Omitiromire, Onganja), Lufilian Arc (Kansanshi, Lumwana), the Itacaiúnas Belt (Sossego), Nautanen Deformation Zone (Nautanen), and the Aravalli–Delhi Fold Belt (Khetri). Copper \pm (Au \pm U \pm REE \pm Mo \pm Co \pm Ni) mineralisation in the aforementioned systems was produced by fluids migrating along regional-scale structures related to late-orogenic exhumation processes. Sodium \pm Ca \pm K alteration associated with mineralisation typically produced alteration assemblages that reflect cooling from Amphibolite or upper-Greenschist conditions during exhumation. Both mineralisation and alteration phases reflect chemical traps, which include redox buffers, pH buffers and/or P-T changes. Notably, many of the aforementioned deposits lack the voluminous Fe-rich phases common to IOCG deposits, thus distinguishing them from conventional IOCG systems (although some have been classified as orogenic IOCGs; Skirrow, 2022).

Using the characterisation of Orogenic Copper Systems described above, this research aims to outline exploration methodologies that use an integrated approach, combining deformation histories, structural controls on mineralisation, types and extents of alteration and changes in metamorphic facies, to effectively target Orogenic Copper Systems.