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The Petrography and Paragenetic Sequence of U-REE-Cu-Au Skarn Mineralisation in NW Queensland

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The Mary Kathleen deposit is the best-known U-REE-Cu-Au skarn deposit in the Mount Isa Inlier, NW Queensland, Australia. Similarities in mineralisation style and host rocks connect the Mary Kathleen deposit to several Cu-Au \pm U-REE prospects in the region indicating the existence of an unrecognised large U-REE-Cu-Au mineralising system. However, the deposits are complex and the processes controlling trace element enrichments are contentious. Understanding the paragenetic sequence and links to regional tectonic, metamorphic, magmatic, alteration, and mineralisation events will define their provenance and assist with exploration for similar systems in Australia and worldwide.

Regionally extensive clinopyroxene skarn--overprinted by an extensive network of garnet skarn along faults and aplite dikes followed by scapolite-feldspar dominated alteration and U-REE mineralisation--extends westward from the Burstall granite to the Mary Kathleen shear zone (MKSZ). Known U-REE-Cu-Au skarn deposits and prospects in the region occur in the Corella Formation within or proximal to the MKSZ west of the ca. 1730 Ma Burstall granite. Mineralisation is hosted in garnet- or clinopyroxene-dominated, texturally and mineralogically diverse skarn lithologies. U-REE mineralisation occurs as uraninite-apatite-allanite assemblages primarily associated with garnet-dominated skarn. Cu-Au mineralisation is hosted in a texturally diverse sulfide assemblage associated with titanite. Complex overprinting relationships of skarn lithologies and mineralisation indicate multiple mineralisation episodes and significant changes in mineralisation style. We propose a multi-episode mineralisation sequence spanning ~280 Ma from ca. 1750 to 1470 Ma. Multi-stage skarn formation and initial U-REE mineralisation is associated with syndeformation 1750 to 1700 Ma granitic magmatism. Cu-Au mineralisation and U-REE remobilisation occur synchronous with extensive post-orogenic A-type magmatism, Na-Ca alteration, and diverse Cu-Au \pm U-REE mineralisation in the eastern Mount Isa Inlier. Similarities in fluid composition and vein mineralogy with IOCGs and Cu-Au \pm U-REE mineralisation indicate a genetic link with the ca. 1550 to 1500 Ma skarn-hosted Cu-Au mineralisation.