

### **Long-Lived High-Temperature Metamorphism in the Late-Archean Granulite-Hosted Katanning Gold Deposit, Southwest Yilgarn Craton**

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P-T-t constraints were used to investigate part of the poly-metamorphic history of the granulite-facies greenstone belt hosting the 3 Moz (resources) Katanning gold deposit, in the Corrigin Tectonic Zone, Southwest Yilgarn Craton. We studied five samples of barren mafic granulite and felsic/metasedimentary migmatitic gneisses, using automated mineralogy (TIMA) and whole-rock geochemistry to define peak assemblages and estimate P–T conditions via phase equilibria forward modelling, further refined using EPMA mineral chemistry. Additionally, five garnet-bearing samples from barren and mineralized zones were analysed using Micro-XRF mapping and LA-ICP-MS to characterize garnet composition and obtain in-situ Lu–Hf garnet ages.

The peak metamorphic minerals exhibit from core to rim predominantly homogeneous, Fe-rich compositions ( $X_{Fe} \geq 0.5$ ) consistent with diffusional homogenization by prolonged high-temperature conditions. P–T estimates indicate high-temperature, suprasolidus conditions (780–890 °C), characteristic of granulite-facies metamorphism. However, the mafic granulites hosting the bulk of the mineralization display lower pressures (4.4–4.8 kbar) and higher thermal gradients (~196 °C/km) compared to felsic (7.5 kbar; ~113 °C/km) and metasedimentary units (5.5–6.5 kbar; ~140 °C/km). Such regimes suggest high to ultra-high-temperature metamorphism under low-P conditions, in line with prior studies in the Corrigin Tectonic Zone, and likely associated with crustal radiogenic heating and/or magmatism-driven high heat flow. Lu–Hf garnet ages from felsic and metasedimentary samples record peak and prograde garnet growth, overlapping with the (zircon U–Pb) regional metamorphic peak at c. 2650 Ma (Heseldell, 2023). In contrast, anomalous silica-rich mafic granulites, up to 70% quartz, yielded older prograde garnet growth ages c. 2670 Ma, within error of the depositional age of the Katanning greenstone belt at c. 2710 Ma (Heseldell, 2023). These results hint at a rapid and protracted high-temperature metamorphic history, and possible hydrothermal processes linked to gold the mineralization. Further micro-scale work on gold associations is underway.