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**Protracted and polyphased gold mineralisation in the Agnew District
(Yilgarn Craton, Western Australia)**

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Abstract

The Archean orogenic gold deposits exhibits common characteristics including coeval emplacement age often proposed to be associated with a single late tectonic gold mineralisation event. Although valid for a large majority of deposits in the Yilgarn Craton, this model does not account for certain atypical gold deposits. In the world-class Agnew District (Yilgarn Craton, Western Australia) structural and paragenetic relationships, combined with a compilation of geochronology and multiple sulfur isotopes, indicate that mineralisation developed during a two-stage process involving different fluid sources. The initial event dated at c. 2660 Ma is related to the onset of folding during Kalgoorlie Orogeny and presents characteristics compatible with magmatic intrusion related mineralisation. A second mineralisation event dated at c. 2630 Ma presents a mineral and metal inventory typical to Archean orogenic-like gold mineralisation, and developed at a later stage of the orogenesis. Measurements of $\delta^{34}\text{S}$ and $\Delta^{33}\text{S}$ from spatially constrained samples from the two temporally distinct mineralising events further ascertain contrasting fluid compositions and/or reservoirs. Combined with geochronological data obtained on the poly-magmatic Lawlers granitic complex, we argue for a protracted ore forming process. The first stage of mineralisation has a magmatic affinity and is followed by a second stage of mineralisation whereby Au-bearing hydrothermal solution incorporated an Archean sedimentary sulfur reservoir. We propose that the

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