The critical role of architecture in sustaining chemical gradients in Late Archean Gold Systems, eastern Yilgarn

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Late Archean orogenic gold deposits are known from five continents and represent one of the great epochs of gold metallogeny in Earth's history. The Yilgarn craton, one of the world's most well-endowed cratons, has a resource of >250 Moz of Au with approximately half of this resource occurring in the Kalgoorlie Terrane. Despite extensive work there is still debate about the source of gold and fluids, time and length scales of transport, nature and chemistry of the transport medium and mechanisms of precipitation for these systems. We generated deposit- and camp-scale quantified mineral maps of numerous Archean gold systems from the Eastern Goldfields Superterrane, Western Australia to delineate gold mineral systems. Zoning of minerals produced by hydrothermal alteration is traced using energy-dispersive x-ray spectral measurements from the SEM (1000s of samples), textural SEM phase maps, whole rock multi-element geochemistry and trace elements of select mineral phases. We show that fluid pathways in Archean gold systems can be strongly controlled by the architecture (both structural and lithological). Impermeable or weakly permeable talc-rich ultramafic and thick coherent phenocryst-rich mafic volcanics occur in the hangingwall of ore-zones. Footwall domains contain broad (>100m) alteration zones with minerals, such as anhydrite, mapped and paragenetically linked to mineralisation. Footwall pyrite-anhydrite domains transition into pyrrhotite-domains into mineralised zones, indicating chemical redox gradients. Other minerals (micas, chlorite, sulphides, amphibole, Ti-phases and feldspars) also display complex spatial distributions that are controlled by fluid pathways as well as the precursor lithology. Textural relationships demonstrate syn-mineral stage alteration that extends significant distances from the main structures which host ore zones. These data reflect the chemical evolution of gold mineral systems, ultimately driven by changes in fluid chemistry, T and P.