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Gokona: An Archean Porphyry-Epithermal Au Deposit

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Exploration expenditures are increasing as discoveries are in decline; evolving conceptual-genetic models are essential to identify and delineate viable ore reserves. Archean greenstone-hosted Au deposits are generally classified as “orogenic” Au, having formed in structurally complex convergent settings from reduced, low-salinity H_2O-CO_2 fluids across a broad crustal depth profile. The class accounts for ~30% of past production and known gold resources, but the origins of ore-forming fluid(s) remain controversial.

The Tanzanian Lake Victoria Goldfield (LVG) hosts several major Neoarchean Au deposits that are of “relatively late syn-orogenic timing,” c. 2660 to 2640 Ma (e.g., Geita, Bulyanhulu, Golden Pride, North Mara). The ~10-Moz Gokona deposit is enigmatic, exhibiting characteristics that are incongruous with the orogenic Au model and LVG mineralization paradigm. At Gokona, mineralization predates regional deformation and occurred in a highly dynamic, near-surface setting. The deposit is associated with intense wholesale K-feldspar alteration, anomalous base metal and telluride enrichments, and cryptic structural control that is only apparent at the camp scale. In this presentation, we synthesise our petrographically constrained paragenesis with ID-TIMS geochronology, fluid inclusion micro-thermometry, and stable isotope data (δD, $\delta^{18}O$, $\delta^{34}S$) to argue that mineralization occurred under similar conditions to Phanerozoic porphyry-epithermal deposits and was driven by a contemporaneous genetically associated calc-alkaline dacitic porphyry complex. Our proposed magmatic-metallogenetic event pre-dates regional orogenic Au mineralization by around 20 m.y., which is broadly coeval with early Au-mineralizing episodes reported in the Yilgarn and Superior cratons. The fortuitous preservation of the entire Gokona stratigraphic sequence permits recognition of this setting.

Our evidence suggests that the Gokona deposit is an oxidised magmatic-hydrothermal system, which may pose significant implications for our understanding of controversial Archean Au deposits and the magmatic contributions to greenstone belt Au inventories. This is exemplified by the increasing acknowledgement of analogous ore-related porphyries spatiotemporally associated with Au deposits.