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An Innovative Tectono-Metallogenic Model for Revitalised Targeting of IOCG-related Deposits in the Gawler Craton

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A new tectono-metallogenic model for the Olympic Metallogenic Event (OME) provides the framework for a significant step-change in ore vectoring for a spectrum of IOCG and coeval deposit styles.

Minerals exploration resulted in the recognition of the Nankivel advanced argillic cap in the nineties and the discovery of the 42 Moz Paris silver deposit in 2011. Paris is interpreted as an intermediate sulphidation epithermal associated with a porphyry system at Nankivel and the Helen copper-gold-silver magnetite skarn, all within a 100-km^2 sericite pyrite lithocap. The mineralisation is hosted in part by 1620 Ma subduction monzodiorites, with the Paris-Nankivel mineralisation dated within 2 Ma of the 1590 Ma Olympic Dam mineralisation.

The revised model proposes the Paris-Nankivel epithermal-porphyry belt was rapidly formed at the same time as Olympic Dam, other IOCG deposits, and many of the gold deposits in the Hiltaba/Gawler Ranges SLIP. Both the SLIP and speed, size, and diversity of the OME are explained by precursor double subduction under compression followed by a rapid extension and formation of a super caldera filled with Gawler Range Volcanics (GRV). Northerly subduction associated with the St. Peters suite intrusives and southerly subduction by the colliding North Australia Craton resulted in super metasomatism of the mantle during 1640 to 1605 Ma. A change to extension from 1597 Ma resulted in two subparallel belts of low-eNd and high-F Hiltaba granites above the fossil subduction zones, the formation of the 90,000-km^2 super caldera, and highly fractionated (Zr/Hf = 20) cupolas telescoped into the rising shoulders of the craton. Differing precursor subduction conditions resulted in epithermal-porphyry deposits on the southern margin of the caldera, whereas IOCGs formed on the northern and eastern margins with haematite- or magnetite-dominated systems respectively forming on the shoulder or in hotter, more reduced conditions under the GRV blanket within the caldera.

Variants of a mid-GRV strato-tectonic marker of the caldera collapse and OME are interpreted as the Bitalli Rhyolite at Paris and Nankivel palaeosurface on the southern shoulder, and as lateral ferruginous sediments and volcanogenic conglomerate facies that collapsed into the IOCG systems on the northeastern shoulder (Fig. 1). Drill logs indicate the overlying Pandurra (Sandstone) Formation is transitional with the OME marker, so the cover role of that unit needs reassessment with implications for deposit preservation and exploration.

The new model provides an improved 4-D guide to selecting target areas with preferential structural preparation and favourable intrusives around the super caldera margin and at prospective levels beneath the OME marker. This revitalises previously mature IOCG districts with better prioritisation of gravity targets and offers a new paradigm of targeting other hydrothermal deposit styles both in old and new priority areas. The application of new magneto-telluric and pathfinder geochemical techniques to extensively map hydrothermal systems is agnostic to deposit styles and will expand the discovery space beyond the successful but tiring dogma of IOCG gravity targeting.

Figure 1: Regional Long Section looking west across the proposed Gawler Super Caldera with different copper-gold deposit styles determined by precursor subduction preparation.