Post-collisional Alkalic Porphyry Au-Cu Mineralization Controlled by Reactivated Extensional Subbasin Faults: Cadia East, NSW, Australia

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Cadia East, located in the accreted remnants of the Macquarie arc, is the largest alkalic porphyry Au-Cu deposit currently known. A 2-km-long, NW-trending volcano-sedimentary subbasin centered directly on Cadia East and oriented parallel to a major crustal lineament has been identified by mapping variations in the distribution and thickness of two sedimentary marker horizons in the upper part of the Forest Reefs Volcanics. Displacement along normal faults bounding the extensional subbasin was initiated at least by the Late Ordovician (454–450 Ma), prior to porphyry mineralization. Macquarie arc volcanism was terminated in the Early Silurian as the arc was accreted to the margin of Gondwana during the Benambran orogeny. Following this collision, mineralizing alkalic porphyry dikes and associated sheeted quartz-sulfide veins were emplaced along the subbasin bounding structures, most likely reactivated by postorogenic extension in the Early Silurian. The geometry of the highly elongate, NW-striking Cadia East orebody was directly controlled by reactivation of faults bounding the volcanosedimentary sub-basin.

The Cadia East deposit was buried by post-mineralization Middle to Late Silurian sedimentary rocks deposited within marine basins. Devonian shortening during the Tabberabberan orogeny was accommodated by district-scale thrust faults (e.g., the Cadiangullong fault) oriented orthogonal to the volcano-sedimentary subbasin. This favorable orientation of the Ordovician volcanos-edimentary subbasin, oblique to the direction of postmineralization deformation, resulted in limited basin inversion and enhanced the preservation of porphyry mineralization.

Volcano-sedimentary basins may develop within transverse zones oriented obliquely to the main arc axis either during arc normal convergence or during subsequent relaxation. These basin structures may remain active during the life of the arc or even following arc collision and associated orogenesis. The preferential orientation of such volcano-sedimentary basins, typically oblique to the direction of convergence, enhances their reactivation potential and focusing emplacement of mineralizing (postcollisional) magmas, but also reduces basin inversion which may uplift and erode porphyry deposits. From the district to the deposit scale, the preexisting crustal architecture exerts a primary control on both the structural character and the preservation potential of porphyry deposits throughout the arc life cycle.