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Granite-cored domes and gold mineralisation: Architectural and geodynamic controls around the Archaean Scotia-Kanowna Dome, Kalgoorlie Terrane, Western Australia

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ABSTRACT

Granite-cored domes are associated with many of the larger gold deposits of the Archaean Eastern Yilgarn Craton of Western Australia. The Scotia-Kanowna Dome is eroded to sufficiently deep levels to provide insights into the role granite-cored domes play in controlling fluid flow and gold deposition. At the centre of the Scotia-Kanowna Dome is a granite batholith, which is surrounded by outward-dipping greenstone belts and associated shear zones. This upper-crustal dome sits above mid-crustal domes, providing a series of stacked geometries favourable to focussed fluid flow. A number of small- to medium-sized gold deposits occur on the limbs and the centre of the dome, and the world-class Kanowna Belle gold mine occurs on the nose of the dome. At least three separate gold mineralising events are defined, each of regional significance, which can be correlated with other well known gold deposits of the Eastern Yilgarn Craton.

The palaeostress across this region was dominated by both maximum contractional and extensional vectors oriented perpendicular to the north-northwest trending grain. The resultant strain is seen in the architecture of the Scotia-Kanowna Dome, with its margins and associated shear zones controlling the distribution of stratigraphy, which is relatively linear and parallel to the margin. Throughout most of the tectonic history, the flanking shear zones were high-strain domains that recorded multiple stages of contraction, with thrust and mostly sinistral strike-slip shear kinematics. In contrast, the dome nose region was a relatively low-strain domain as it was located in the strain shadow of the regional contractional events. For example, the early extensional record has been preserved at the nose, with late-stage basins formed in the hangingwall to the extensional faults, adding to the stratigraphic complexity of the local region. These late basins also may have contributed to the fluid budget. In contrast, along the flanks of the domes there is no record of these late basins or the extensional faults that controlled their deposition.

The architecture of the dome played an important role in controlling mineralisation during a significant deviation in the maximum contractional stress vector to an east-southeast-west-southwest orientation. At this time, basins in the nose region underwent inversion, with thrusting to the north and northwest. Shortening was accommodated along the dome flanks by sinistral strike-slip shearing, which was relatively free to move due to the mostly linear stratigraphy, combined with limited anisotropy and perturbations along the flank. However, the stratigraphic and geometrical complexity around the dome nose resulted in localised maximum dilation and gold deposition at this time. The dome nose area was also a favoured locus for gold-enriched, dominantly Mafic-type magmas, which are seen as the extensive porphyry swarms in the region. These felsic-intermediate rocks also may have contributed to the complex fluid budget and are considered as indicators of particular fertility for gold. They may have been the primary source for much of the metal endowment.

The architecture of granite-cored domes has played a critical role in focussing magma as well as mineralising fluids into regions of maximum dilation. They did this by virtue of their inherent competence, and by influencing the position and geometry of shear zones (fluid pathways) and hence distribution of stratigraphy (depositional sites) across the region. The Scotia-Kanowna Dome is a good example of this effect, and inferences can be made in favour of similar controls by concealed domes, such as beneath Kalgoorlie.

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