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Title: EPITHERMAL AND PORPHYRY DEPOSITS OF THE COWAL DISTRICT, MACQUARIE ARC, NEW SOUTH WALES: ALKALIC MINERALIZATION?

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Abstract: The early Ordovician to early Silurian Macquarie Arc of the Lachlan Orogen, NSW, was an oceanic island arc formed by subduction-related processes. It comprises four distinct structural belts and is host to a variety of mineral deposits. Low sulfidation style Au deposits within the Junee-Narromine volcanic belt occur in the Cowal district. They are currently being mined and explored by Barrick Australia Ltd. The Endeavour 42

(E42), Endeavour 41 (E41), and Endeavour 46 (E46) deposits are hosted by the Ordovician calc-alkaline Cowal Igneous Complex (CIC, 457-467 Ma; U-Pb zircon). These deposits, and additional prospects, define a north-south trending "gold corridor" approximately 6km long by 2km wide. Open pit production from the E42 mine began in June 2006, making it the newest mine in the Macquarie Arc.

The CIC is a sequence of interbedded sedimentary and resedimented volcanoclastic facies, trachyandesite and porphyritic andesite lavas and intrusions (coherent and autoclastic facies), which have been intruded by a large diorite sill and later dykes. Resedimented volcanoclastic facies include mudstone, sandstone, and polymictic volcanic breccias. Deposition likely occurred in a subaqueous basin or depocenter medial to distal from a volcanic center. Intruding the CIC is a heterogeneous diorite complex and a mafic monzonite unit, both of which are important local hosts to mineralization. At E42, tilting and faulting of the host rocks appears to have occurred prior to the development of the mineralizing hydrothermal system.

The E41 and E42 deposits have characteristics compatible with pyrite-quartz and carbonate-base metal epithermal deposits, but are interpreted to have formed at greater depths (1-2 km) than typical low sulfidation epithermal systems. These quartz-carbonate base metal-gold veins are similar to early veins at Porgera, which also formed at depth (2 km). The E41 gold prospect has features characteristic of both epithermal and porphyry environments, including both styles of mineralization and alteration. This implies the transition from deep to shallow-level magmatic-hydrothermal activity, and the potential unroofing of the system during mineralization.

The host rocks to E41 and E42 are predominantly calc-alkalic. However, a S isotopic zonation characterized by negative $\delta^{34}\text{S}$ values in the core of E42, together with the characteristic alkalic porphyry-related "red rock" K-feldspar-hematite alteration of monzonite in E41, the presence of tellurides and gypsum in veins, and published alteration ages (~440 Ma) similar to major alkalic porphyry Cu-Au deposits in the Macquarie Arc indicate that mineralization in the Cowal district may be alkalic in nature. If mineralization at Cowal is associated with alkalic fluids, this will be the first documented occurrence of both alkalic porphyry and epithermal deposits in the same province, thereby having global implications for alkalic-related mineral exploration.