McKINNONS GOLD DEPOSIT, COBAR DISTRICT, NEW SOUTH WALES

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LOCATION

The McKinnons Au deposit is approximately 37 km SW of Cobar at 31º46’51”S, 145º41’33”E; Cobar 1:250 000 map sheet (SH 55-14).

DISCOVERY HISTORY

Norgold Ltd discovered the deposit in December 1988 by sampling a quartz-veined siliceous outcrop near McKinnons Tank. Rock chip samples along a 380 m traverse assayed at 0.28-4.2 g/t Au (Allan and Taylor, 1989; Discombe and Engelhardt, 1996). Stream sediment data revealed only one low-order BLEG anomaly (0.45 ppb Au) downstream from McKinnons Tank. Drilling between 1989 and 1991 outlined a deposit (380 x 200 m) with probable reserves of 1.4 Mt at 1.65 g/t Au (Bywater et al., 1996). Subsequent mapping, soil geochemistry and geophysics outlined a 400 x 900 m anomaly, but later detailed ground magnetic, reconnaissance total count radiometric and gravity surveys did not produce significant anomalies over the deposit (Discombe and Engelhardt, 1996). Burdekin Resources purchased the deposit in 1993 and, by additional drilling, increased reserves to 2.2 Mt at 1.91 g/t Au at a 0.7 g/t cut-off. Open pit mining commenced in 1995 and was completed in 1996. Stockpiles were processed until mid 2000. Total production was 131 000 ozs of Au.

PHYSICAL FEATURES AND ENVIRONMENT

Regionally, the area is within an elevated palaeoplain (200 m asl) near the boundary between predominantly erosional landforms to the E and extensive depositional plains to the W. A range of hills of the late Devonian Mulga Downs Group occurs 10 km to the S. The deposit occurs on a low ridge and spur of silicified metasedimentary rocks in an area of subdued relief with undulating low rises (<20 m) with slopes of <2º. There is an adjacent alluvial flat to the N. The surrounding area has a broad ephemeral drainage to the W and NW. East of the deposit, in drainage headwaters, there are minor remnants of an erosional plain and to the NW and SW, extensive areas of alluvial valley plain.

The climate is semi-arid with an average annual rainfall of 415 mm and temperature ranges of 19-34ºC (January) and 4-16ºC (July). Mean annual evaporation is 2550 mm. Vegetation around the deposit consists of open woodland dominated by Bimble Box (Eucalyptus populnea), Red Box, Cypress Pine (Callitris glaucophylla) and Mulga (Acacia aneura) in elevated areas. Clearing has disturbed much of the original vegetation. There are areas of woody weed and sparse areas dominated by spear grass.

GEOLOGICAL SETTING

The McKinnons Au deposit is located near the SW margin of the Cobar Basin within the Nullawarra Anticline, a major NW-trending fold hinge (Glen, 1987) (Figure 1). It is hosted by low-grade metasedimentary rocks of the early Devonian Lower Amphitheatre Group. These turbidites are mainly shallow marine siltstones and sandstones with minor volcanic-derived sediments and limestone lenses. At the deposit, the rocks dip 20-40º NW and there is some local faulting. The deposit was the first to be worked on the western margin of the Cobar Basin.

REGOLITH

There is little outcrop. Weathering penetrates approximately 60 m at the deposit but locally reaches 90 m along faults. The weathered profile consists mainly of strongly bleached saprolite and saprock (quartz, illite and minor kaolinite) extending to 30 m below the surface, overlying a pink-brown slightly mottled ferruginous zone (hematite and goethite), generally between 30-60 m from the surface. A 1 m thick brownish zone of ferruginized and hardened saprolite, enriched in hematite and goethite, marks the top of the profile which has been truncated by erosion. Depth to the water table is about 50 m.

The area surrounding the outcrops is infilled with residual to local colluvium and red soil (hematite, goethite and illite with lesser kaolinite, halloysite and muscovite) and gravel (0.3-1 m thick), and is mantled with a lag of ferruginous pisoliths (hematite with some maghemite and goethite) and lithic fragments. This cover is thin on rises and slightly thicker (commonly >1 m) in valleys. There are minor watercourses with alluvium but few active channels. Transport of surface materials is largely by sheet-wash.
MINERALIZATION

Mineralization at McKinnons consists of a stockwork of narrow quartz-pyrite veins in silicified silstones that is structurally controlled by sets of complex, subvertical brittle fractures (Bywater et al., 1996). The deposit is zoned from pyrite-Au mineralization near the surface to massive galena-sphalerite veins (0.3-1.5 m thick) at depth (>100 m). Primary ore includes pyrite, sphalerite, galena and minor chalcopyrite, tennantite, tetrahedrite and arsenopyrite. Gold is mainly minute inclusions in pyrite in the host rock and as discrete grains in high-grade epithermal quartz-chalcedony veins. Gold grades in primary sulfide ore are generally <1 g/t and less than 50% of this primary Au can be recovered (Elliot et al., 1998). Gold production is largely from oxidized supergene ore, where Au has been released from pyrite and variably enriched (Marshall and Scott, 1999). The Au grade of this is 0.5-2.5 g/t with isolated high-grade pods of 10-20 g/t (Figure 2).

The Au-Ag mineralization has been described as a low sulphidation epithermal type (strong silicification of the upper part; no high-level felsic or intermediate intrusives; adularia and carbonate in the quartz-mineralized veins; sphalerite and galena below the boiling zone). Alteration assemblages are quartz-chalcedony with interstitial sericite-illite in the upper levels (metamorphosed argillic alteration) and an increase in quartz-sericite-chlorite-K-feldspar alteration with depth (Forster and Seccombe, 1999).

The primary ore zone (below 60 m) contains quartz, muscovite, kaolinite, weakly altered pyrite and minor illite. Primary geochemical trends in drilling below the base of oxidation (60 m) are consistent with this epithermal model (Rugless and Elliott, 1995). Gold is enriched above 100 m depth. In contrast, As, Cu and Zn are anomalous below 100 m. Antimony closely follows the Au dispersion and Pb is broadly dispersed at depth. Manganese has an antipathetic relationship with Au and, along with Cu and Zn, is enriched peripherally to the more intensely altered zone.

REGOLITH EXPRESSION

Saprolite

Sulphate minerals (alunite-jarosite and anglesite) are important minor minerals in the regolith. Barren profiles consist of quartz, muscovite and kaolinite, with kaolinite increasing above 16 m depth; mineralized profiles contain illite instead of muscovite and very minor kaolinite (Marshall and Scott, 1999). Acid conditions, due to pyrite weathering, have transformed muscovite to illite and destroyed kaolinite.

Soil

The regional soil geochemical program in 1995-97 analysed <75 µm B horizon soils after a partial digest in 40% HCl (see Summary Table). This highlighted the deposit with a 450 x 200 m Au, As, Ag, Sb and Pb anomaly but failed to locate additional mineralization. These Au analyses suffered from batch variations, mainly due to varying temperatures, making Au dispersion difficult to interpret. Anomalous Au extends up to 5 km N of the mine and would appear to mark a N trending splinter fault. Both Au and Ag dispersions also follow the palaeodrainage that is infilled by magnetite gravel. There is a 40 km² As and Bi depletion halo extending to the N and W of the deposit (Figure 3) associated with mineralized hydrothermal alteration coinciding with a broad aeromagnetic anomaly.

Soil samples, analysed at ppb levels after a weak, partial, dilute HCl digest, revealed both positive, apical Au, Ag, Sb and negative As anomalies over potential mineralization. Regional depletion haloes in As, Bi and, possibly, Sb occur over an area of 40 km². They are similar to the anomaly revealed by the Enzyme Leach® technique (see below). These are thought to relate to a reduced body, possibly a large hydrothermal alteration cell, associated with a buried felsic intrusive inferred from the regional aeromagnetic data.

Enzyme Leach® analysis of soil, which produces distinctive ‘rabbit ears’ negative anomalies above potential mineralization (Hill et al., 2001) and outlines a continuous geological feature extending over a strike of 700 m to the N of McKinnons on traverse 15500mN for the oxidation suite elements. There are apical highs for Zr, indicating shear-related mineralization on traverses 15800mN and 16200mN (not shown). The Enzyme Leach® response (Figure 4) confirms that buried Au mineralization, shown by RC drilling, corresponds with apical Br, Cl, I, Ce, La and Cu highs. The chargeability IP anomaly is associated with a ‘rabbit ears’ depletion anomaly extending over a width of 400 m.


