SUNRISE DAM GOLD DEPOSIT, EASTERN GOLDFIELDS, WA

D.J. Gray and A.F. Britt

CRC LEME, CSIRO Exploration and Mining, P.O. Box 1130, Bentley, WA 6102

LOCATION

The Sunrise Dam Au Deposit is located approximately 55 km S of Laverton in the Eastern Goldfields Province of Western Australia. It is on the eastern margin of Lake Carey, at 29°05'S and 122°25'E; Edjudina 1:250 000 map sheet (SH 51-06). The deposit is now wholly owned by AngloGold Australasia Ltd (formerly Acacia Resources Ltd). It was previously co-owned by the Granny Smith Joint Venture (Placer Pacific Ltd and Delta Gold NL), who call their (eastern) portion 'Sunrise', and by AngloGold Australasia Ltd, who called their (western) portion 'Cleo'.

DISCOVERY HISTORY

The Sunrise portion was found in August 1988, after a 500x500 m BLEG survey (Newton *et al.*, 1998). Subsequent RAB drilling in April 1989 produced a best intersection of only 4 m at 0.28 g/t Au in sediments several hundred metres NW of the current deposit,. The first intersection of supergene Au, in the main part of the deposit, was 4 m at 16.1 g/t Au as part of a six hole RAB profile over an untested soil anomaly in late 1992. By November 1993, the resource was 2.3 Mt at 4.2 g/t Au and the Sunrise mine commenced operations in May 1995 (Newton *et al.*, 1998).

The Cleo portion was first indicated by tenement-wide RAB and aircore drilling in 1991 (Newton *et al.*, 1998). The significance of this area was recognized in 1993 following a RC drilling intersection of 54 m at 10 g/t Au. Acacia Resources Ltd commenced production in February 1997. Gold resources in 2002 were: (i) Sunrise - 0.4 t measured, 22.1 t indicated and 3.4 t inferred and (ii) Cleo - 10.1 t measured, 75.9 t indicated and 52.4 t inferred (Minedex, 2002).

PHYSICAL ENVIRONMENT

The area has the low relief typical of the Yilgarn Craton. Apart from a small outcrop of banded iron formation (BIF) at Sunrise Hill, there is virtually no outcrop nearby. Sand and gypsiferous dunes, salt pans and sheet wash deposits dominate the surface around Lake Carey. The climate is semi-arid with a highly variable annual rainfall averaging 200-250 mm. Mean minimum and maximum temperatures range from 21-36°C in January and 5-18°C in July. Regional vegetation consists of sparse to dense *Acacia* woodland with an understorey of smaller shrubs consisting of *Acacia, Cassia* and *Eremophila* (poverty bush) species (Butt *et al.,* 1997).

GEOLOGICAL SETTING

The deposit is hosted by the Archaean Norseman-Wiluna belt, in the Eastern Goldfields Province of the Yilgarn Craton. The deposit falls within the structurally complex Laverton Domain, which is characterized by tight folding and thrusting. A number of other Au deposits lie within or near the margins of the Laverton Domain, including Laverton, Granny Smith (*this volume*), Red October (*this volume*), Childe Harold, Lancefield and Keringal (Figure 1). Most of these deposits are hosted by metasedimentary rocks, a distinctive feature of the Laverton region relative to other parts of the Yilgarn Craton.

The host rocks are shallow-dipping interbedded Archaean metasedimentary, metavolcaniclastic and felsic to intermediate metavolcanic rocks (Newton *et al.*, 1998). The metavolcaniclastic rocks are interbedded with BIF. In general, they are thick, bedded to massive and fine upwards. The BIF units are typically 2-10 m thick and commonly grade into magnetite-rich tuffs. A 20-40 m thick mafic intrusive postdates the metavolcaniclastic sequence on the western side of Cleo. Quartzfeldspar porphyries also intrude the sequence at both Cleo and Sunrise and, at Cleo, post-date the mafic intrusive.

The Sunrise Shear cuts through the Sunrise-Cleo deposit and dips shallowly N to NW. This structure is 10-20 m wide and the associated carbonate-sericite alteration halo is commonly 30-40 m wide. Smallscale shears above the Sunrise Shear are both parallel and discordant



Figure 1. Regional geology and setting of the Sunrise-Cleo Au deposit (after Newton et al., 1998).

to the shallow dipping Archaean succession. Early recumbent folds have axial planes that parallel the Sunrise Shear and, in cross section, the geometry of this deformation is similar to a thrust duplex or imbricate stack. Second phase deformation structures consist of upright to inclined folds with N-striking axial planar surfaces and gently N-plunging axes. Quartz veins are abundant throughout the deposit, and regardless of host rock, most are 5-20 mm thick and less than 1 m long (Newton *et al.*, 1998).

REGOLITH

The Archaean rocks are weathered to approximately 60-80 m. Although surface relief is muted, the palaeotopographic relief of the basement beneath the cover exceeds 30 m. There is widespread transported overburden, up to 27 m thick, obscuring the western part of the area (Newton *et al.*, 1998; Gray and Britt, 2000), with up to 60 m additional sediment infilling a deep palaeochannel trending S to SW through the deposit area. The sediments generally consist of a lower unit, 20-60 m thick, of green-grey to white clay interbedded with pisolitic gravel lenses, saprolitic detritus and other materials. An upper unit of dune sand, which forms the eastern margin of Lake Carey, is generally less than 3 m thick. Several ferruginous bands have developed in the sedimentary profile. Beneath the sediments, weathering is generally deep (60–120 m below surface). The base of weathering is deepest beneath the palaeochannel, but the underlying weathered residuum is thin, suggesting some erosion.

MINERALIZATION

The Sunrise Shear, within the Archaean rocks, controls geometry of the mineralization and is thought to have been the main conduit for Au-bearing hydrothermal fluids (Newton *et al.*, 1998). Pyrite replacement of BIF accounts for most of the primary mineralization and is well developed where the shear zones, parallel to bedding, follow the contact of BIF with less competent units. Gold is also associated with quartzankerite-pyrite veins and pervasive ankerite-silica-sericite-pyrite alteration of intermediate volcaniclastic host rocks. Thin quartz-carbonate veins also host Au, but are mostly located in the Sunrise part of the deposit. Supergene mineralization has developed in the weathered bedrock and in transported cover in the eastern part of the study area.

REGOLITH EXPRESSION

Residual regolith

Within the residual regolith, Au content is generally greatest over mineralization and peaks in the lower saprolite at approximately 65 m depth (330-340 m elevation; Figure 2). Across the study area, mean Au at 55-80 m depth is at least double the primary Au concentrations. There is some evidence for Au depletion in residuum above 45 m depth (Gray and Britt, 2000) (Figure 3C). This is difficult to verify over much of the deposit because the base of the sediment, which is commonly barren, is



Figure 2. Plans of Au distribution in horizontal slices through the Cleo region. The slices intersect different units of the regolith profile, as indicated. The Cleo mineralization can be clearly seen in the NE corner. a) Au distribution at 340 m elevation. Gold concentrations between 50 and 200 ppb are widespread in the palaeochannel sediments at this depth. Dotted lines mark the cross sections depicted in Figure 3. b) Gold distribution at 320 m elevation. The basal palaeochannel sediments have patchy Au contents.

generally at this depth. However, in areas where the sediment is thinner (e.g., Figure 3B; northing greater than 69500mN), Au concentrations decrease up profile, with the upper saprolite above 35 m depth containing less than 20 ppb Au.

Transported overburden

Within the palaeochannel, there is patchily dispersed Au in the basal sediments and units at higher levels have variable Au enrichment. At Sunrise, in the eastern part of the deposit, economic mineralization occurs as horizontal blankets, possibly related to Fe redox fronts and associated water-tables (L.M. Lawrance, unpublished data, 1994). Two horizons are noted, at 5-15 m depth and at 20-40 m depth.

In contrast, palaeochannel sediments at Cleo, in the western part of the deposit, do not host economic mineralization (Gray and Britt, 2000). There are patchy Au concentrations to 1 ppm or greater near the base of the palaeochannel (Figures 2B and 3B). Additionally, there is moderate Au enrichment in the sediments (0.05-0.3 ppm Au; Figures 2A and 3A) as a 15 m thick horizontal blanket below about 50 m depth (Figure 5), dispersed to 300 m from the apparent source (Figure 2A). A conceptual diagram (Figure 4) illustrates these two forms of Au enrichment. The horizontal geometry and general homogeneity of Au concentrations in the sediment blanketing the western area around Cleo suggests a chemical origin, although complete or partial physical transport cannot be discounted. The top of the Au enrichment blanket in the palaeochannel sediments and the depletion front over the orebody both occur at about the same elevation (345 m RL, 55 m depth; Figure 4). The absence of significant Au in residual or transported regolith above 55 m depth indicates leaching down to this level. Below this, Au has precipitated, in both the residual regolith and sediments in the palaeochannel blanket, following dispersion in groundwater.

REFERENCES

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direction

Figure 3. Gold distribution along three N-S cross sections of the Sunrise region. See Figure 2 for locations.



Figure 4. Model for Au dispersion in the Cleo palaeochannel. Gold is dispersed both down slope along the unconformity and as a blanket within the sediments.

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Figure 5. Gold distribution in the Cleo palaeochannel, excluding sediment in the first 10 m above the unconformity.