BEASLEY CREEK GOLD DEPOSIT, LA VERTON DISTRICT, WESTERN AUSTRALIA

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LOCATION

The Beasley Creek Au Deposit is approximately 12 km WNW of Laverton at 28°34'S, 122°18' E; Laverton 1:250 000 sheet SH51-02.

DISCOVERY HISTORY

WMC Exploration Ltd discovered the deposit in 1987 using \textsuperscript{6}mm soil sampling on a 500 x 40 m grid (Perriam, 1987). The anomaly consisted of 6 samples above 25 ppb Au, including a maximum of 500 ppb and five samples in the 39-58 ppb range. Drilling of the 500 ppb site found gossanous quartz veins in talc-carbonate ultramafic rocks but nothing of ore grade. Drilling 120 m S of the original soil anomaly in an area of gossanous ironstone intersected 7 m at 3.9 g/t Au.

PHYSICAL FEATURES AND ENVIRONMENT

The mineralization lies beneath a low, N-oriented rise, only 3-4 m high (Robertson and Churchward, 1989). The rise has a broad crest with a gentle slope to the W and a steeper slope to the E. The rise is flanked by wash plains, covered by Wanderrie banks with a ribbed texture on air photographs. The wash plains pass to the N and S to broad drainages in which ephemeral streams are incised. The climate is arid with an irregular but mainly summer rainfall, averaging 250 mm per annum. Vegetation is degraded acacia shrubland, mainly sparse Acacia aneura and Acacia linophylla with a few low shrubs of Cassia desolata and Eremophila spp.

GEOLOGICAL SETTING

The Beasley Creek Au deposit lies within the Margaret sector of the Laverton Greenstone Belt. There are three major cycles of ultramafic to mafic metavolcanic rocks separated by thin metasediments, including banded ironstone formation, carbonaceous shale and chert (Hronskey et al., 1990). The greenstones are intruded by a variety of preterctic to syntectonic granitoids, from granodiorite to monzodiorite (Hallberg, 1985). The Au deposit occurs in interflow sediments near the top of the first volcanic cycle (Reddell and Schmulian, 1990). The host is a black shale (Figure 1) enclosed in amphibolitic metbasalts and ultramafic rocks metamorphosed to the upper greenschist facies that have been intruded by dolerite and porphyry.

REGOLITH

The weathered Archaean rocks at Beasley Creek have been partly stripped (Robertson and Churchward, 1989). This is indicated by the absence of a lateritic duricrust over all but the eastern flank of the rise (Figure 2). The ferruginous duricrust contains numerous vermiciform voids lined with yellow-brown clay and gibbsite. Sporadic outcrops of gossanous (in part) ironstone overlie both the ore-bearing black shale and metadolerites. Calcrites are abundant near the top of the rise. A shallow, dish-like channel of Permian fluvioglacial sediments is exposed in the eastern margin of the mine pit (Robertson et al., 1996) and its saprolites overlap those of mafic and ultramafic Archaean rocks (Figure 1).

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MINERALIZATION

The weathered mineralization is hosted in a N-striking phyllitic black shale, some 15-40 m thick, which dips E at 45° and Au is associated...
with ferruginous zones within it. Prior to mining, proven and probable ore reserves (all in the weathered zone) were 2.1 Mt at 2 g/t Au. Gold at 70-80 m depth consists partly of xenomorphic primary grains (Ag to 48%) and partly of high-fineness secondary grains. Above 60 m depth, there are only euhedral secondary grains and above 20 m a second generation of irregular, rounded, weakly corroded secondary grains occurs (Freyssinet and Butt, 1988).

REGOLITH EXPRESSION

Gossan and ore zone
Robertson and Gall (1988) investigated diamond core from drilling that intersected the mineralized ferruginous horizon near surface and penetrated the footwall (DDH BCD1). Gold mineralization was marked by anomalous Pb, W and As with erratic increases in Be, Zn, Sb and Co. The envelope for As slightly exceeds that of Au. Tungsten is restricted to the ore zone.

Saprolite
The host lithology is marked by elevated Al, Fe, Ba, Cr, Ga, Mn, Ni, Rb, V and Y. Apart from Au, the mineralization is marked by elevated Ag, As, Cd, Cu, Pb, Sb, W and Zn. The lateritic duricrust and mottled zone are weakly enriched in Ag, Nb and W, and are strongly enriched in the pathfinders As, Bi, In, Pb, Sb, W and Sn. Cobalt, Zn and Cu are depleted near surface (Robertson, 1991).

Regional soil and lag
Although the discovery was made by sampling <6 mm soil (Figure 3A), this sandy soil is known to fail to detect some promising locations due to dilution by aeolian material. This site has been investigated by multi-element orientation studies by WMC and CSIRO. The soil grid was resampled for 2-6 mm lag (Figure 3B). The ratio of the lag/soil percentiles increases from 2 at the 50th percentile to 7 at the 97.5th percentile, demonstrating aeolian dilution (Table 1). The difference between soil and lag Au signatures is most evident at Beasley NW (Figure 3).

Detailed soil and lag
Figure 4A shows the distribution in the discovery data of Au in soil in a 1 km² area around the deposit. Although Au is elevated over the mineralization (25-75 ppb), detailed sampling by WMC showed that the soil anomaly maximum lies 100-200 m to the E of the ore subcrop (Figure 4B). The NW trends in the data were attributed to structures with this trend. Arsenic (Figure 4C) shows poor contrast in the soil with a broad area of 20-40 ppm; the peaks (40-80 ppm) are also offset to the E. The distribution of Au and As in lag (Figures 4D and 4E) is similarly offset E as the soil but with twice the abundances. Similar anomaly offsets of As and Au to the E in both lag and soil were noted by Robertson (1996a) and were attributed to the asymmetric development of lateritic duricrust on the eastern side of the deposit, in which these elements have been chemically dispersed. The distribution patterns of Cu (Figure 4F), Zn and Sb in the lag showed improved targeting of the mineralization.

Coarse lag (10-50 mm) gave strong but rather spiky anomalies that accurately target the mineralization. The fine lag gave a smooth, weaker but broader dispersion halo (Figure 5). The magnetic (about 40%) and non-magnetic (about 60%) components of the lag gave similar Au anomalies but the non-magnetic lag component was far more successful for the pathfinders As, Zn and Cu (Figure 6). The lag contains gossan fragments, enriched in Au, As, Cu and Zn that are all non-magnetic. As non-magnetic lag predominates, removal of the magnetic fraction, prior to analysis, is not worthwhile and the total lag sample should be analysed. (Robertson, 1996a)
Three soil size fractions (710-4000, 4-75 and <4 µm) were compared to the complete soil (Robertson, 1999). The largely acolian sandy material (75-710 µm) was discarded. The 710-4000 µm fraction consists largely of black goethite- and hematite-rich nodules, red to yellow ferruginous clay granules, minor quartz, calcite and, close to mineralization, minor gossan fragments. It gives the best response and the distributions of As, Au, Cu, and to a lesser extent Cd, Sb, W and Zn are related either to mineralization or to dispersion in the lateritic duricrust (the broader target). These results are closely comparable to the fine lag, which is derived from this. Gold gives a 600 m-wide E-offset dispersion of >20 ppb, locally reaching 200-300 ppb. The black shale host is indicated by maxima in Ba and Mn. The 4-75 µm fraction is significantly less effective than the <4 µm fraction due to dilution by acolian silt. The <4 µm fraction indicated the host shale by an increase in sericite and the mineralization is indicated by anomalies in Au, As, Cd and Cu.

The Beasley Creek mineralization has a strong Au anomaly in lag and the soil coarse fraction that covers 0.3 km² above a threshold of 8 ppb. For As, there is a broad regional anomaly of similar extent (30 ppm) but the contrast is poor with little internal detail. From the discovery history and the Au distribution, the Au anomaly as a whole should be the drill target and not the more restricted Au maxima (>75 ppb). For As, there is a broad regional anomaly of similar extent (30 ppm) that covers 0.3 km² above a threshold of 8 ppb. The 4-75 µm fraction indicated the host shale by an increase in sericite and the mineralization is indicated by anomalies in Au, As, Cd and Cu.

REFERENCES


Robertson, I.D.M. and Gall, S.F. 1988. A mineralogical, geochemical and petrographic study of the rocks of drillhole BCD1 from the Beasley Creek Gold mine - Laverton, Western Australia. CSIRO and petrographic study of the rocks of drillhole BCD1 from the Beasley Creek Gold mine - Laverton, Western Australia. CSIRO and petrographic study of the rocks of drillhole BCD1 from the Beasley Creek Gold mine - Laverton, Western Australia. CSIRO and petrographic study of the rocks of drillhole BCD1 from the Beasley Creek Gold mine - Laverton, Western Australia. CSIRO Division of Minerals and Geochemistry, Perth, Restricted Report Number MG67R, 47 pp. (Reissued as Open File Report 9, CRC LEME, Perth, 1998).


