HARMONY GOLD DEPOSIT, BAXTER MINING DISTRICT, WESTERN AUSTRALIA

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LOCATION

The Harmony Deposit is approximately 10 km W of Peak Hill at 25º39'10"S, 118º37'50"E; Peak Hill 1:250 000 sheet.

DISCOVERY HISTORY

Afmeco Mining and Exploration Pty Ltd discovered the deposit in 1991 by RAB drilling the contact between the Ravelstone and Narracoota Formations and sampling the buried residual profile. This discovery was made in an area with neither bedrock exposure nor known mineralization. Subsequent orientation studies of surficial materials (soil and lag as BLEG) gave equivocal results. In retrospect, buried laterite and interface sampling and possibly ground water sampling, followed up by detailed saprolite, bedrock would provide the most cost effective techniques but they require consistent and accurate drill-spoil logging.

PHYSICAL FEATURES AND ENVIRONMENT

The climate is semi-arid with an irregular average rainfall of 200 mm pa. Vegetation is thin, mainly consisting of Acacia spp. and other drought resistant shrubs and grasses. The deposit is located under a depositional plain (Figure 1) surrounded by low hills and rises.

GEOLOGICAL SETTING

Harmony is located within the Palaeoproterozoic Bryah Basin, on the contact between the folded mafic and ultramafic Narracoota Volcanics and the thick turbidite sequence of fine-grained, lithic, feldspathic and mafic wackes of the Ravelstone Formation. Both sequences are metamorphosed to lower to middle greenschist facies.

REGOLITH

Harmony is on a NW trending palaeohigh of ferruginous saprolite (Figure 2) completely blanketed by colluvium. Nodular to pisolithic lateritic duricrust is buried on the flanks of the palaeohigh. The nodules and pisoliths are dark red and have distinctive yellow-brown cutans. The lateritic duricrust is about 8 m thick, but can reach 19 m in places, where a localized accumulation is likely.

A deep palaeochannel parallels the palaeohigh to the S of the deposit (Figure 2). It drains to the W, from the Narracoota Volcanics to the Ravelstone Formation. A smaller, shallower, palaeochannel sub-parallels the palaeohigh on the N side. Both palaeovalley floors are particularly deeply weathered, and are underlain by mottled zones and clay-rich saprolite. The valleys have been partly filled with 10-24 m thick mottled, soft, puggy, clay-rich sediments. The clays are patchy in the northern palaeovalley but extensive in the southern palaeovalley.

MINERALIZATION

Primary stratabound Au mineralization is hosted within metadolerite and metabasalt at the top of the Narracoota Formation with minor mineralisation in the Ravelstone Formation metasediments, and is associated with sulphide-poor, hematitic quartz veins and carbonate-filled breccia. The most intense veining is in a zone of high strain, close to the contact with the metasediments. Mineralization is accompanied by albitionization, sericitization, silicification, carbonate and chloride alteration. Gold and Ag occur as inclusions in pyrite with associated pyrrhotite, pentlandite, chalcopyrite, supergene Cu sulphides and scheelite; trace elements include As, Te, Zn and Pb (Harper et al., 1998). The most useful pathfinders are Au and W. A sub-horizontal, near-surface, supergene enrichment occurs mainly within the saprolite, and there is a significant lateritic resource that extends slightly into the overlying colluvium. The depth of oxidation averages about 80 m; the water table is at 30 m. The deposit had a reserve of 2.148 Mt @ 3.6 g/t Au.
Figure 3. Comparison of the top of the basement sampling (A,C,E) with interface sampling (B, D and F) for Au, W and Ta respectively. Pit outline shown.

REGOLITH EXPRESSION

Ferruginous residual regolith (lateritic residuum, mottles and ferruginous saprolite) has anomalous concentrations of Au (over 100 ppb) and W (over 6 ppm) close to the mineralization; background concentrations are 10 ppb and 2 ppm respectively (Figures 3A and C). The ferruginous saprolite was not particularly enriched in Au (maximum 72 ppb), although one sample immediately to the SW of the mineralization had a concentration of 975 ppb Au, suggesting very limited dispersion in this material. Saprolite in the pit has a mean Au content of 33 ppb.

Concentrations of Ni (over 300 ppm) and Cr (over 2000 ppm) in
the upper residual regolith indicate underlying ultramafic bedrock. Concentrations of Pb and Rb >20 ppm indicate metasediments of the Ravelstone Formation.

Prior to deposition of the colluvium, the residual profile was eroded so the lateritic residuum is only partly preserved. Dispersion along the residual regolith-colluvium interface produces larger and more consistent anomalies than the stripped basement (Figures 3B, D and F). Interface sampling revealed that Au is anomalous over the deposit on the palaeo-high (over 200 ppb), and there are dispersion trains down the palaeoslopes. Tungsten shows distinct dispersion trains (over 6 ppm).

Geochemical dispersion in the palaeochannel sediments is complicated by indurated layers, vertical leaching and, in the upper layers, by mixing with colluvium. The palaeochannel clays have low Au abundances, even in the vicinity of the deposit, averaging 25 ppb in the southern palaeovalley and 10 ppb in the northern palaeovalley. Tungsten has a mean concentration of 2 ppm in the sediments, and higher concentration in the basal sands (13 ppm). Mean W concentration in the palaeochannel sediments is 18 ppm close to the deposit. Arsenic (19 ppm) and Sb (2.3 ppm) are at background abundances in the palaeovalley clays.

The soil has weak enrichments of Au (15 ppb) and W (4 ppm) in the less than 75 µm fraction, compared to backgrounds of 3 ppb and 1 ppm respectively (total analyses). These enrichments occur only where the colluvium is very thin (<1 m), and fragments of lateritic residuum have been brought to the surface. The variance of all pathfinder elements in the soil at Harmony is random, rather than related to mineralization, except where the colluvial cover is very thin (Gray et al., 1996), aqua regia and CN extraction would also be expected to work but milder extractants were ineffective.

In summary, there is a geochemical halo in laterite and at the base of the colluvium (interface) around the Harmony deposit, and the most effective pathfinder elements are Au and W. However, in basal palaeochannel sediments, Au contents are low and W seems to be a more effective indicator of mineralization. Tungsten tends to be independent of Au, has limited dispersion in the regolith, and may occur where Au has been leached. Soil sampling is only successful where the transported overburden is very thin (here about a metre). Transported overburden at Harmony varies in thickness (0.5-12 m) and is generally unknown prior to drilling, making its efficacy questionable.

HYDROGEOCHEMISTRY

The groundwaters at Harmony are neutral (pH 6-8) and have low salinity (mean 0.04% TDS) compared to the saline acid groundwaters of the southern Yilgarn and have moderate Eh values. In contrast with the southern Yilgarn, ionic proportions are dissimilar to seawater. The low salinities mean that mobilization of Au as halide complexes would be insignificant, as would other mechanisms, such as organic ligands or thiosulphate, because these waters are organic-poor and conditions do not favour weathering of sulphides to thiosulphate. Consequently, groundwaters at Harmony are Au poor although dissolved Au is still a useful pathfinder albeit at low concentrations (~0.015 µg/L). Gold is not dispersed significantly into soil or transported overburden. However, Sc, Mo, W and, possibly, Rb may be useful pathfinders as they are more abundant in groundwater near Au mineralization. Concentrations of dissolved Cr reflect ultramafic lithologies at Harmony and elsewhere (Gray, 1995).

DISPERSION MODEL

TBA

REFERENCES


Robertson, I.D.M., Phang, C., and Munday, T.J. 1996. The regolith geology and geochemistry of the area around the Harmony Gold Deposit, (Baxter Mining Centre), Peak Hill, Western Australia. CRC LEME Restricted Report 5R.


SAMPLE MEDIA - SUMMARY TABLE

<table>
<thead>
<tr>
<th>Sample medium</th>
<th>Indicator elements</th>
<th>Analytical methods</th>
<th>Detection limits (ppm)</th>
<th>Background (ppm)</th>
<th>Threshold (ppm)</th>
<th>Max anomaly (ppm)</th>
<th>Dispersion distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh rock</td>
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<td>0.007</td>
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