PENNY WEST GOLD DEPOSIT, YOUANMI, WA

Nigel Radford[1] and Tim Boddington[2]

[1]*CRC LEME, Curtin University of Technology, P.O. Box 1130, Bentley, WA 6102, Australia*

[2]*Tim Boddington and Associates, 1445 Falls Rd, Hovea, WA 6071, Australia*

LOCATION

The Penny West gold deposit in Western Australia is located at 28°51'13"S, 118°48'28"E; Youanmi 1:250 000 map sheet(SH50-04). It is approximately 115 km SSW of Sandstone and 28 km S of the old mining centre of Youanmi (Figure 1).

PHYSICAL ENVIRONMENT

The deposit occurs on a low, N trending ridge that rises to about 20 m above the recent alluvial plains to the E. The area is covered by a climax vegetation of *Acacia aneura* with scattered eucalyptus trees and a few sandalwood trees *(Santalum sp.*). It receives 200-250 mm of rain per year, mostly in winter associated with passing cold fronts. Maximum temperatures range from 15ºC in winter to 30ºC in summer. The deposit is on Youanmi Downs pastoral station, subject to low density sheep grazing.

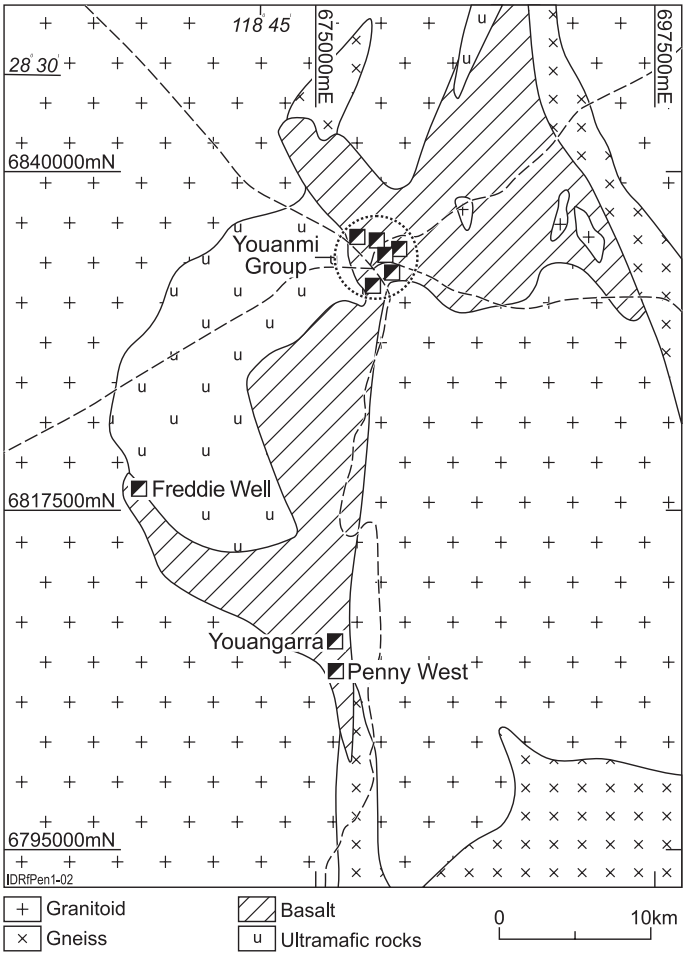

Figure 1. Location map of the Penny West Au deposit in relation to the local geology and mining activity.

DISCOVERY HISTORY

The deposit was a blind discovery with no associated old workings. It was within a group of tenements comprising the Youangarra Joint Venture between Eastmet Ltd and Aquarius Minerals NL. Exploration was managed on the JV's behalf by Eastmet's beneficial owner, Metana Minerals NL, for whom both authors worked at the time.

An orientation soil sampling study was completed in 1989 around the old Youangarra mine workings several kilometres N of where Penny West was eventually discovered. The known mineralization was well defined by Au analysis on the <180 µm (<80#) fraction of soil samples collected at a depth of 100-150 mm , with Au concentrations of up to 500 ppb (R. Beaton, pers.com.).

Consequently, this method (<80# fraction at 150 mm depth, aqua regia digestion, AAS carbon rod finish to 1ppb Au detection limit) was adopted for routine surveying of the adjoining tenements. Because the Freddie Well and Pincher Well base metal deposits are nearby, soil samples were analysed for a selection of trace elements (Pb, Zn, Cu, Au, Ag and As). Lines 200 m apart were routinely sampled at 50 m centres. Gold-in-soil results were contoured by eye and a N striking anomaly, some 400 m in length and up to 150 m wide, was found to contour at 30 ppb Au with maximum values at about 300 ppb. Weakly anomalous Pb (40 ppm against a <5 ppm background) coincided with the Au anomaly.

Field examination of the area showed no old workings and no surface lag of vein quartz. This was surprising, given that a reasonably prominent but geochemically barren quartz blow outcrops at the northern end of the soil anomaly. Quartz is common elsewhere, adjacent to mineralization, for example at Youangarra. The anomaly follows a low, but noticeable N striking ridge, which rises gradually towards the quartz blow to the N, with lower ground to the W, S and E. No calcrete was observed in the soil profile.

Infill soil sampling confirmed the anomaly that is parallel to interpreted geological structures in the area. Follow up vacuum drilling proved very difficult. An apparent abundance of rocks and stones continually impeded the narrow diameter vacuum drill after a few metres. This was abandoned and a program of vertical RAB drilling successfully reached saprolite, and recorded sporadic Au concentrations up to 1.5 ppm.

RAB drilling in June 1990 was on five E-W oriented lines 100 m apart, N-S across the target with holes angled 60° to the W. This assumed that, with the granite contact to the W, the regional dip would be easterly. To ensure overlap, holes were drilled on 25 m centres to a depth of 50 m. The drilling intersected significant sulphidic and gossanous quartz with high grade Au in three holes on two adjacent lines, and intersected the vein in consecutive holes on the northern line, confirming the dip. The highest grade was 339 g/t Au over 1 m. The RAB drilling was infilled on 50 m line spacing at Penny West, and extended at 100 m line spacing for a kilometre S in September 1990. The infill RAB drilling confirmed the mineralisation over approximately 400 m of strike, but at a lower grade than the original intersections. Subsequent RC and limited diamond drilling delineated a mineralized quartz vein striking roughly N. Highest Au grades occurred where the strike of the quartz vein swung by approximately 10º to the NNE. The deposit was mined in 1991-1992, and treated through the Youanmi plant, some 28 km N. It produced approximately 150 000 oz of gold from 200 000 t of rock at an average grade of 22 g/t.

GEOLOGICAL SETTING

The deposit is situated at the southern extremity of the Youanmi-Sandstone greenstone belt, which is classified as the northern extension of the Southern Cross Province of the Archaean Yilgran Craton (Hughes, 1990). Locally referred to as the Youanmi Greenstone Belt, the belt comprises predominantly metamorphosed tholeiitic basalts and intrusives, with minor banded iron formation, porphyries and felsic, pyroclastic rocks. The Youanmi Intrusive complex of layered mafic and ultramafic rocks occurs to the immediate W of the N-S striking greenstone belt. The greenstones are generally metamorphosed to greenschist facies, and strongly deformed close to the dominant regional structure, the Youanmi Fault, which occurs some 3 km E of the Penny West deposit (Munro, 1990).

A quartz vein up to 5 m thick, but commonly less than 3 m thick hosts the Penny West gold deposit. This is contained in weakly sheared meta-basalts. Alteration includes weak development of carbonates (calcite and possibly ankerite) and sericitization.

REGOLITH

Drilling revealed that the top 10 m was composed principally of gravel and sand, with saprolite below 10 m vertical depth. Exposures in the open pit showed layers of imbricate gravel in the lower portion of the alluvial profile. A stone line, dominated by white vein quartz, marks the unconformity. Saprolite extends to about 50 m vertical depth. Fresh rock predominates below 60 m vertical depth, although oxidation extends to at least 80 m in fracture zones.

MINERALIZATION

The auriferous vein is hosted by Archaean meta-basalts. In the centre of the mineralized zone, as indicated by the soil anomaly, the vein changes direction by some 5 to 10 degrees, and along that flexure high Au grades, commonly in excess of 50 g/t and reaching 200 g/t were localized. Below the weathering front (approximately 50 m), pods of pyrite, galena, sphalerite and minor chalcopyrite occur in the vein, generally associated with high Au grades. However, some high Au grades, and some zones of abundant visible gold occur in quartz with no sulphides (Radford 1991a). Pre-mining reserves were of the order of 200 000 t, grading 11 g/t Au, using a 20 g/t top cut. This top cut was severe as it downgraded the high-grade flexure zone of the orebody. Mining subsequently recovered roughly the same tonnage but at approximately 22 g/t Au. The high grade of the body mined is, in part, a consequence of remaining undiscovered and not being 'high graded' by early miners.

REGOLITH EXPRESSION

Ten metres of alluvium on top of the saprolite profile was unexpected. During mining, layers of imbricate gravel were found immediately above the base of the transported overburden (L. Hill, pers. com.). At that time it was normal practice to avoid soil sampling areas of transported overburden. Had the alluvium, subsequently defined by absence of quartz lag, been recognised, almost certainly soil sampling would not have been used. So a surface anomaly in transported overburden, directly over the ore body, was unexpected and exciting, causing much speculation about its source. Attempts were made to optimise both surface sampling methods and to examine possible mechanisms for Au mobility in transported overburden before the deposit was mined.

Typically, Au concentrations above detection limit (5 ppb) were found in the first metre of each hole, confirming the soil anomaly. Below this, Au concentrations decreased to below detection until the stone line at the interface was reached. Gold concentrations in the grams per ton range were common in the stone line vertically beneath the peak soil anomaly. A massive, 0.5-5.0 m thick quartz vein was intersected in the centre of each traverse, more or less beneath the peak of the surface soil anomaly. Gold in this vein reached 200 ppm along with sporadic concentrations of Cu, Pb and Zn reaching 5000 ppm.

Two lines 100 m apart were soil sampled at 25 m centres over mineralization and at 50-100 m centres further away (Radford, 1991b). At each site, two samples were taken for Au-in-soil analysis, a fine fraction (<150 µm) and a lag sample (>500 µm) and analysed by aqua regia, with an AAS finish for Au and Pb. In each fraction, the Au anomaly was about 200 m wide across strike (Figure 2), compared with the maximum vein width of 5 m in saprolite. Values in the fine soil and lag, were similar, with peak values of 350 ppb against a background of <5 ppb. It was concluded that a robust Au-in-soil anomaly would have been detected using either fine fraction or lag sampling at 100 m centres over this orebody.

Samples of vegetation were collected along these two orientation lines. Two distinctly different mulga (Acacia) species were identified, but only the more abundant was sampled, believed to be *Acacia aneura*. Bushes up to 2 m grew at a density of 1 per 5 m linear distance. Sandalwood and eucalypt trees were too scarce to provide anything other than sporadic coverage. Mulga leaves were ashed and digested in aqua regia prior to carbon rod AAS determination for Au and Pb. The background for Au was about 1-2 ppb, whereas, over mineralization, somewhat erratic values up to 4 ppb occurred on both lines. There was no systematic variation in Pb content.

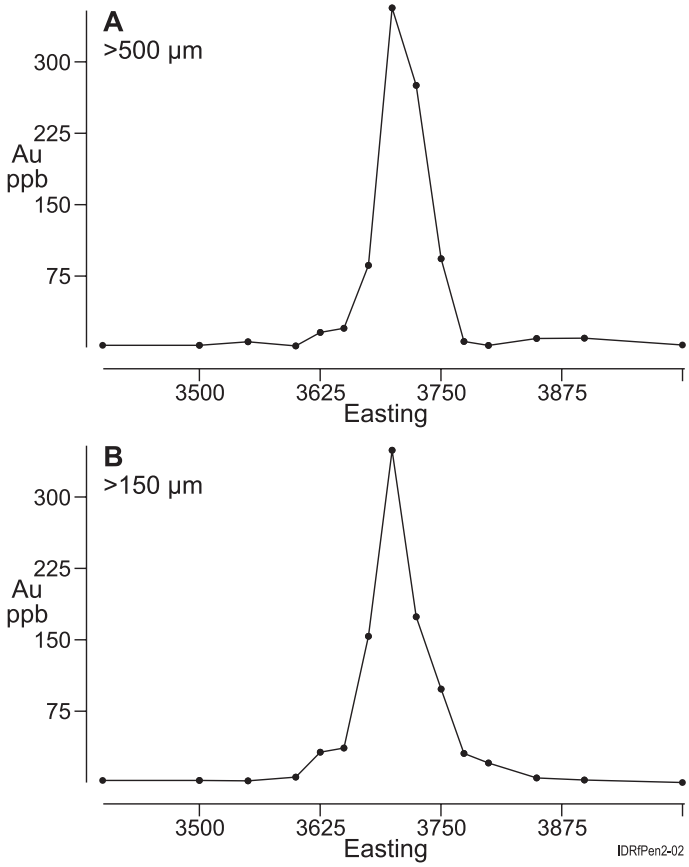

Figure 2. A. Gold in >500 µm soil fraction over the Penny West Au deposit, line 3600mN. B. Gold in <150 µm soil fraction over the Penny West Au deposit, line 3600mN.

The alluvial gravels overlying mineralization occur high in the present landscape and are not associated with the current drainage. It may be inferred that the alluvium is old relative to the landscape, and it would appear that the landscape had been stable for a long time. It is tentatively postulated that Au might be mobilized to surface through transported overburden from the underlying saprolite by mulga, and other plants, and, over a long time, concentrated at the surface. During mining, hairline rootlets were observed at least 30 m below surface; ie., 20 m into the residual regolith (L. Hill, pers comm.).

Whilst the above interpretation is feasible, it can also be argued that the enhanced Au in mulga is caused by uptake of gold by the plants from an already-established soil anomaly. No attempt has been made to undertake a mass balance of Au in vegetation against Au in soil.

REFERENCES

Hughes, F.E. (Ed.), 1990, *Geology of the mineral deposits of Australia and Papua New Guinea* (The Australasian Institute of Mining and Metallurgy: Melbourne).

Munro, K.D., 1990, Youanmi Gold Deposit, in *Geology of the mineral deposits of Australia and Papua New Guinea*(Ed. F.E. Hughes), pp. 279-282 (The Australasian Institute of Mining and Metallurgy: Melbourne).

Radford, N.W., 1991(a). Report on multi-element geochemistry, Penny West gold deposit, Youanmi, WA. Eastmet Ltd. Company report 1991/29, (unpublished).

Radford, N.W., 1991(b). Report on orientation soil geochemistry at the Penny West deposit, Youanmi, WA. Eastmet Ltd. Company report 1991/28, (unpublished).

SAMPLE MEDIA SUMMARY TABLE

Sample medium	*Indicator elements*	*Analytical methods*	*Detection limits*	*Background*	*Threshold*	*Maximum anomaly*	*Dispersion distance*
Primary mineralization	Au, Pb, Zn, Cu	Total acid AAS	1ppb, 5ppm, 5ppm, 5ppm	<5ppb <5ppm <5ppm <20ppm		300ppm 5% 1% 0.5%	All within quartz vein lode
Soil	Au Pb	Aqua regia AAS	1ppb 5ppm	<1ppb <5ppm	5ppb 10ppm	300ppb 40ppm	Up to 200m across strike
Interface/unconformity	Au	AR AAS	1ppb	<5ppb	10ppb	1.5ppm	unknown
Vegetation	Au	Ashed sample AR AAS	0.1ppb	Approx 1ppb	2.0ppb	4.2ppb	Approx 100m