COX-CRUSADER GOLD DEPOSIT, LAWLERS DISTRICT, WESTERN AUSTRALIA

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LOCATION

The Cox-Crusader deposit is located at 28°04'59"S 120°29'53"E, approximately 27 km SW of Leinster and 120 km NW of Leonora, near Agnew (Figure 1) on the Leonora 1:250 000 map sheet (SH51-1).

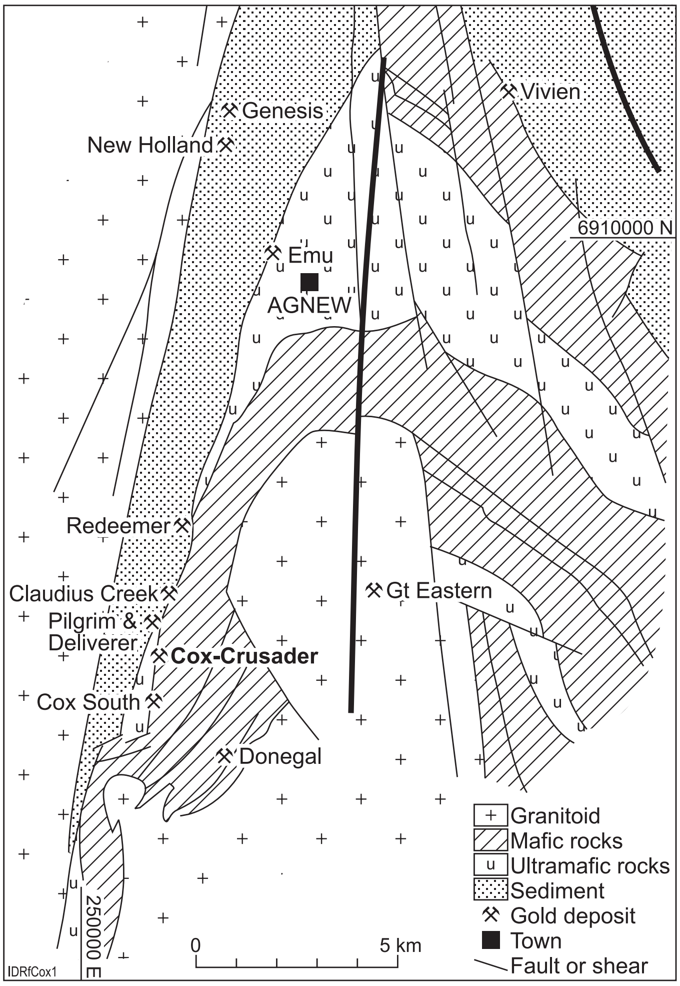

Figure 1. Location map and geological setting of the Agnew gold deposits (after Broome et al, 1998).

DISCOVERY HISTORY

Asarco Australia Ltd discovered the deposit in 1988 by drilling a strong anomaly for Au in lag. The initial discovery, the Cox deposit, was mined by open pit, which yielded some 177 000 t of ore at a grade of 5.6 g/t. The northern down-plunge extension of the orebody crosses a tenement boundary into leases controlled by WMC Resources, where it has been exploited by underground mining under the name Crusader. Production to June 2000 was 1.3 Mt at a grade of 9.24 g/t for a recovery of 374 000 oz Au.

PHYSICAL ENVIRONMENT

The climate is semi-arid with irregular rainfall averaging about 200 mm annually. The deposit occurs in undulating terrain marked by low hills, with sporadic exposures of partially weathered bedrock and siliceous and ferruginous remnants of a former deep lateritic weathering profile. A well-developed network of vegetation-lined drainage channels traverse the area, flowing in a generally south-westerly direction. Interfluves are sparsely vegetated. The terrain in the immediate vicinity of the Cox Lode subcrop slopes gently NE.

GEOLOGICAL SETTING

The Cox-Crusader deposit is a 20-30° plunging, N-trending ore shoot in Archaean mafic and ultramafic rocks on the western limb of the Lawlers Anticline (Broome et al., 1998). The rocks strike N, young to the W and dip at 50-60º. They consist of tholeiitic pillow basalts and interflow marine sediments including sulphidic carbonaceous shale. The basalts are overlain in turn by 40-60 m of serpentinized and carbonated dunites and orthocumulate peridotites, by sheared ultramafic komatiite flows, high magnesium basalt and shale with felsic and gabbro intrusions and capped by sheared mafic conglomerate.

REGOLITH

The deposit occurs in an erosional landform, with shallow immature soils and a few outcrops of weathered rock. A dense lag of ferruginous and siliceous weathering products blankets the surface. The depth of weathering is highly variable. RAB refusal in some holes occurs at less than 5 m due to hard unweathered rock, whereas strong oxidation extends locally to depths of 90 m.

MINERALIZATION

The Au mineralization occurs predominantly within a basal tholeiitic basalt, at or close to its contact with an overlying cumulate ultramafic unit. The orebody consists of multiple discrete lodes localized by compressional tectonics near a flexure in the sequence. Native Au is finely to very finely disseminated and associated with enrichment in Bi, Se, Te, Mo and W. Wall-rock alteration is characterized by an epidote-magnetite-chlorite±actinolite-biotite assemblage (Broome et al., 1998).

REGOLITH EXPRESSION

The distribution of Au in the >2 mm surface lag, sampled initially on a 200 x 50 m grid, with infill locally to 50 x 25 m, is shown in Figure 2. An extensive anomalous zone reflects the widespread mineralization within the stratigraphy. Within this zone, the Cox deposit is expressed as a strong, coherent anomaly, covering some 15 000 m^2, within the 120 ppb Au contour and with a peak of 1150 ppb Au.

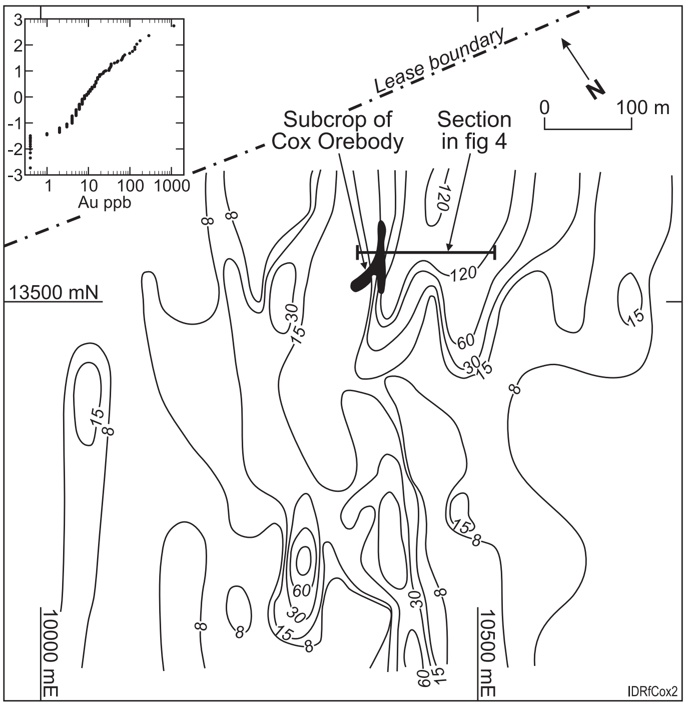

Figure 2. Distribution of Au in <2 mm lag samples in relation to the subcrop of the Cox deposit.

Discovery of the lag anomaly was initially followed by intensive (20 x 10 m-spaced) RAB drilling to a maximum depth of 10 m within the area shown in Figure 3. The outline of the Cox deposit is indicated by Au concentrations of >1 ppm in the RAB drilling. This is closely circumscribed by the 0.1 ppm Au contour at 9 m depth, showing limited lateral dispersion of gold in bedrock at this depth. Contouring of the

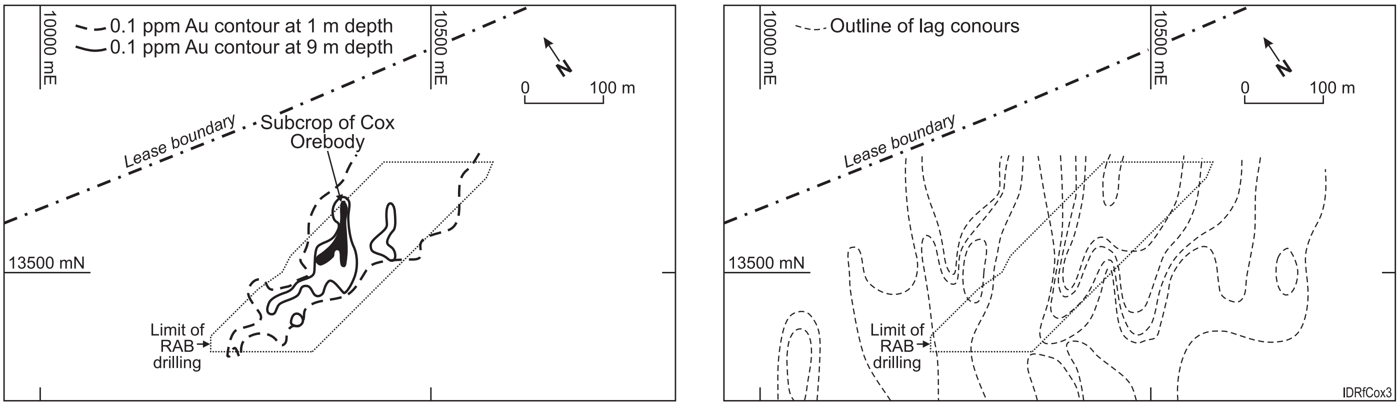

Figure 3. Distribution of gold concentrations >100 ppb at depths of 1 m and 9 m, based on detailed RAB drilling. Gold contours for lag from Figure 1 shown for comparison.

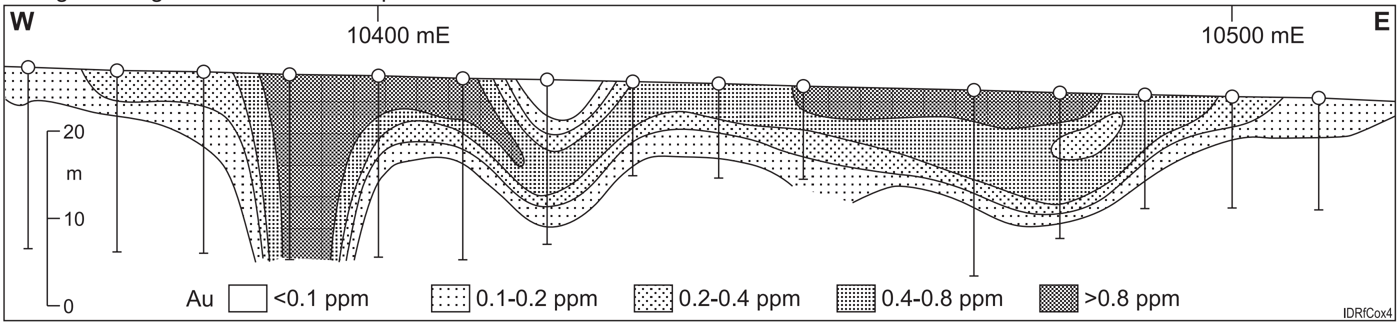

Figure 4. Distribution of Au in weathered bedrock on cross section at 13560N based on RAB drilling.

RAB data in cross section reveals typical 'T'-shaped dispersion patterns, with an extensive zone of near-surface enrichment, as illustrated by the cross section at 13560N (Figure 4). The footprint of the bedrock anomaly, as indicated by the 0.1 ppm Au contour, is much more extensive at a depth of 1 m than that at 9 m (Figure 3), and approximates the lag dispersion pattern. The northern three RAB traverses show a strong surface enrichment without a source at depth, apparently due to dispersion to the N from the source. The asymmetry of the anomaly in lag and the topmost bedrock samples reflects the surface topography.

Samples of groundwater collected from a seep in the Cox open pit and exploration drilling indicated up to 44 ppt Au in close proximity to the Cox deposit, compared to a regional background of <4 ppt (Giblin, 1990). Although the sampling density was not adequate to define the extent of any groundwater anomaly, the results suggest that Au, As, Co and V concentrations in groundwater could provide useful indications of Cox-style gold mineralization in this exploration environment. Arsenic, in particular, appears to be strongly anomalous in many of the samples collected in the belt and may constitute a regional exploration guide.

SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Indicator element	Analytical method	Detection limit (ppm)	Background (ppm)	Threshold (ppm	Maximum anomaly (ppm)	Dispersion distance (m)
Fresh Rock	Au	FA-AAS	0.01	<0.01-0.03	0.03	?	?20
Weathered rock	Au	?	0.01	<0.01-0.03	0.03	24.85	170+
Lag	Au	AAS-GF	0.001	<0.001-0.007	0.008	1150 ppb	350+
Groundwater	Au	INAA	1 ppt	<1-3 ppt	4 ppt	44 ppt	?
	As	GF-AAS	0.01` ppb	<0.1-1 ppb	1 ppb	23.8 ppb	?
	Co	ICP-MS	0.5 ppb	<0.5-2 ppb	2 ppb	24 ppb	?
	V	ICP-AES	10 ppb	<10-10 ppb	10 ppb	60 ppb	?

OTHER INFORMATION

This case history illustrates several important aspects of dispersion patterns related to gold mineralization in erosional terrain. Firstly, significant mineralization can present very small targets when bedrock is used as a sample medium. In the case of Cox, intensive exploration by RAB drilling prior to the lag survey had failed to locate any significant mineralization, although scattered bedrock anomalies of the type seen in Figure 3 as satellites to the Cox anomaly were encountered. Secondly, the displacement of the lag anomaly to the NE of the bedrock source indicates the need for care in follow-up testing, to ensure the source of the anomaly is located. The small areal extent of the source compared to the extensive dispersion at the top of bedrock and in lag also emphasises the need for systematic and detailed testing of anomalies for exploration to be effective.

REFERENCES

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Giblin, A., 1990. Groundwater geochemistry in exploration for gold in the Miranda Project area (Prepared for ASARCO, Perth). Restricted Report 179R (CSIRO: North Ryde, NSW).