CALISTA GOLD DEPOSIT, MOUNT McCLURE MINING DISTRICT, WESTERN AUSTRALIA

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LOCATION

The Calista Au deposit is located approximately 65 km NE of Leinster and 14 km SW of Bronzewing among the Mt McClure gold deposits (Figure 1) at 27°25′S, 120°56′E; Sir Samuel 1:250 000 map sheet (SG51-13).

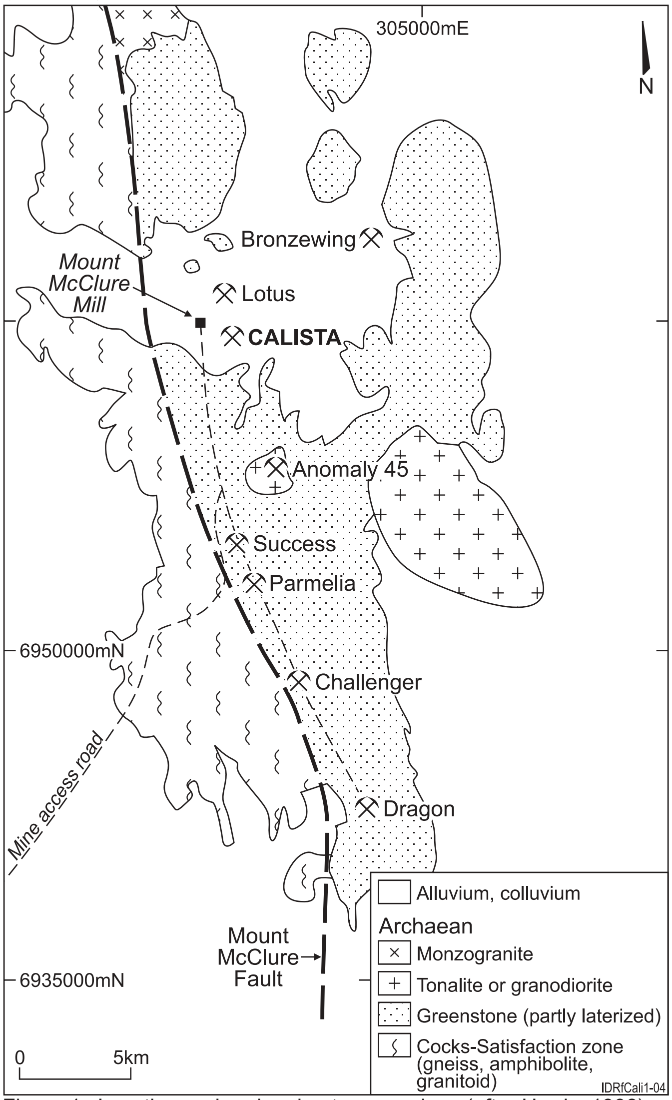

Figure 1. Location and regional outcrop geology (after Harris, 1998).

DISCOVERY HISTORY

Calista is the largest deposit of six that comprise the Mt McClure Gold Mine. Other deposits in the Mt McClure mining district (e.g., Dragon, Success and Challenger, S of Calista) occur in a partly truncated terrain and were discovered by gossan and soil sampling. The Calista deposit, covered by 20 m of transported overburden, was found by Arimco Minerals NL by drilling lateritic residuum and saprolite.

PHYSICAL FEATURES AND ENVIRONMENT

The deposit is located on a depositional plain with low hills to the S (Figure 2). The climate is semi-arid and has an irregular average annual rainfall of 200 mm. Temperature ranges are 22-38ºC (January) and 5-19ºC (July). Vegetation is mainly *Acacia* spp with *Eucalyptus* spp and *Santalum* spp in defined creeks.

GEOLOGICAL SETTING

Calista lies within the W margin of the Yandal greenstone belt on the Archaean Yilgarn Craton. The greenstones that host the Calista Deposit are separated from a belt of gneisses to the W by the NNW trending Mt McClure fault (Figure 1). Small granitoid stocks occur NNE and E of the Success Deposit. The Archaean volcano-sedimentary succession trends generally NNW and dips from near vertical to moderately easterly and westerly. Host rocks to the Calista Deposit are metakomatiite, metabasalt and metabasaltic tuffs, separated by a sulphidic chert (Harris, 1998).

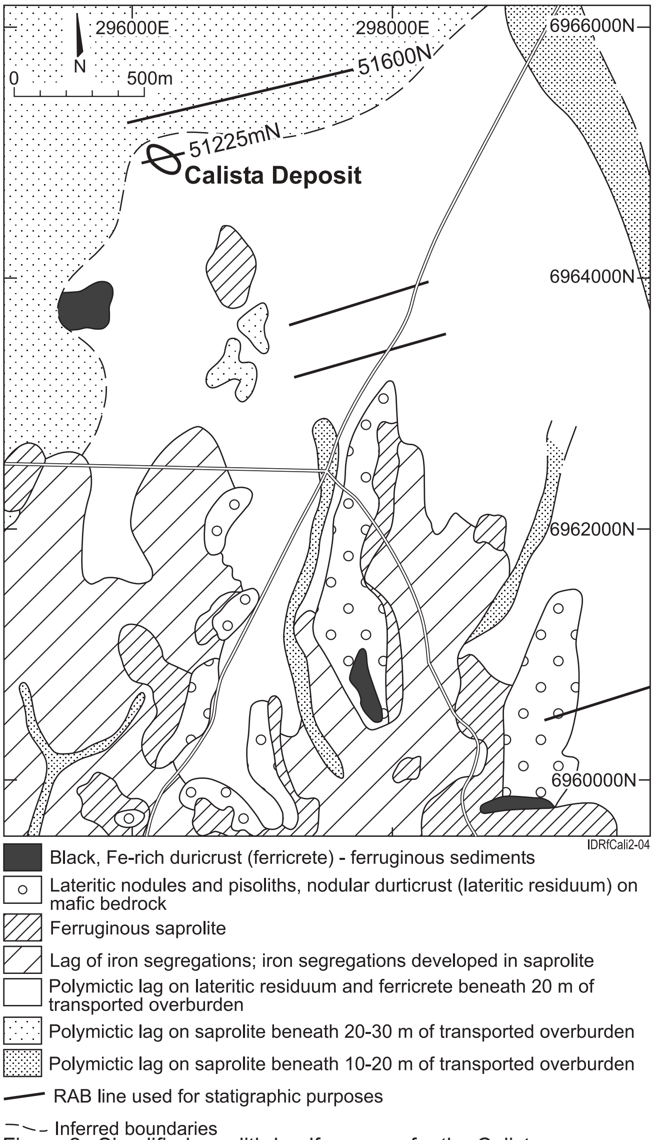

Figure 2. Simplified regolith-landform map for the Calista area.

REGOLITH

This summary has been drawn from several detailed studies covering regolith evolution and geochemical dispersion in the regolith (Williamson, 1992; Anand *et al*., 1993; Anand and Williamson, 2000). The district contains partly truncated, lateritic profiles on uplands and extensive colluvial-alluvial plains that cover the Calista deposit (Figure 2). To the S of the Calista deposit, low rises with a surface of lateritic nodules and pisoliths overlie ferruginous duricrusts. These duricrusts developed by weathering of mafic and ultramafic bedrock and ferruginization of sediments. Erosional plains, pediments and low hills of ferruginous saprolite, saprolite and iron segregations developed on mafic rocks. In depositional environments around Calista, the upper regolith of aeolian, fluvial and lacustrine deposits, commonly several metres thick, is partly underlain by lateritic residuum.

At Calista itself, areas of lateritic residuum commonly lie under 15-20 m of transported overburden (Figure 3). The transported overburden consists of sandy soil, silicified sandy colluvium and gravelly colluvium.

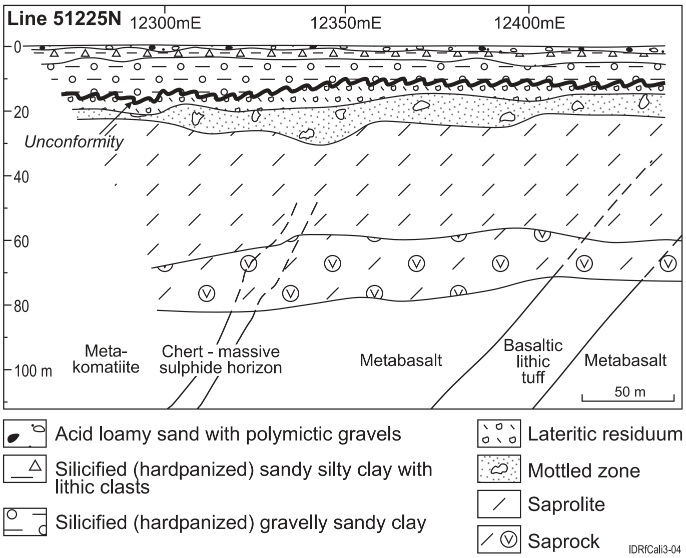

Figure 3. Cross section showing the regolith stratigraphy for line 51225mN, Calista deposit (see Figure 1 for location).

The saprolite is 40-50 m thick and the transition from unweathered to weathered rock occurs below 60 m depth. Gossan from the sulphide horizon persists through the saprolite into the mottled zone. The mottled zone is transitional between saprolite and a nodular-pisolitic lateritic residuum. Lateritic residuum forms the uppermost unit of the residual regolith, occurs as an almost continuous unit over the deposit and varies in thickness (2-6 m). The abundance of Cr in lateritic residuum reflects the underlying lithology (Figure 4A). Lateritic nodules and pisoliths range from 5-30 mm in diameter and have characteristic 1-2 mm thick, yellow-brown goethite-rich cutans. Nodules and pisoliths of the lower lateritic residuum have retained cores of primary rock fabrics and gossan fragments. The upper part has been transported mechanically and mixed with sandy material.

MINERALIZATION

In the Mt McClure region, Au mineralization is related to shears, splay shear zones and associated faults (Otterman and de San Miguel, 1995). Mineralization generally follows the controlling structure and is hosted by some of the volcano-sedimentary lithologies through which the controlling structure passes. At Calista, primary mineralization is sulphide-rich and is hosted by overturned, steep, westerly dipping rocks. The oldest unit is green tremolite-chlorite-talc-carbonate schist after peridotitic komatiite. The primary mineralization is characterized by Au, Bi, Se, Cu, Zn, Sn, W, As and Ag. It occurs beneath 70-100 m of regolith. In the Yandal Greenstone Belt, there are significant differences in the distribution of Au in saprolite between the various deposits and prospects. In general, there are two situations: (a) Au restricted to quartz veins and structures tends to remain stable in the regolith and can be residually concentrated near the surface with little or no depletion in the upper regolith and (b) depletion of Au in the upper regolith without appreciable quartz veining. At Calista, supergene mobilization of Au has occurred, resulting in depletion in the upper 20-40 m of the *in situ* regolith. Here, Au associated with sulphides is more mobile. Submicron particle size, easy access of supergene solutions and increased concentrations of various oxyanions favoured Au dissolution and generated corrosive conditions. At the Calista deposit, these conditions have led to strong Au remobilization in the regolith, independent of the surrounding groundwater regime. Supergene Au enrichment at Calista occurs in the lower saprolite (Figure 5).

REGOLITH EXPRESSION

Gold, W, Sn, Se, Bi, As, Zn and Cu are anomalous in mineralized gossan near the bottom of the profile. Primary mineralization is indicated by a halo of Au (Figure 4B), As (Figure 4C), Bi, Sn, Ag, Se and Cu in lateritic residuum (Table 1). In detail, the lower part of the lateritic residuum shows a more consistent and stronger geochemical anomaly than the upper part, although the distribution of Au is erratic (11-6860 ppb). This presumably reflects its nuggety distribution.

Copper appears to be leached from the lateritic residuum, except at the

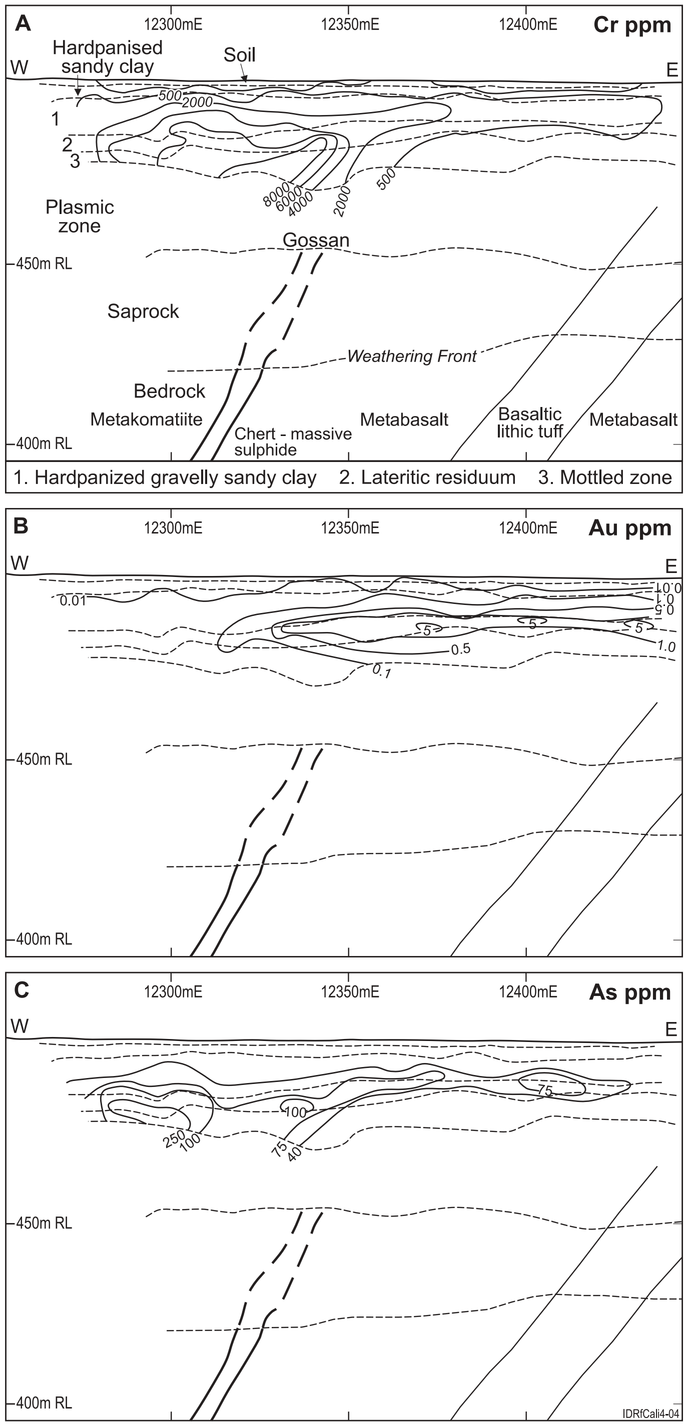

Figure 4. Cross sections at 51225 mN showing contoured Cr (A), Au (B) and As (C) abundances for the Calista deposit.

extrapolated position of the main mineralization, where a strong anomaly occurs (1100 ppm; two samples over 10 m). Similarly, Ag is only weakly anomalous in the lateritic residuum over mineralization. However, one sample of lower lateritic residuum is highly anomalous in Ag (1.5 ppm), Cu (1100 ppm), Se (31 ppm), Bi (43 ppm), W (21 ppm) and Sn (26 ppm) due to gossan fragments within cores of pisoliths and nodules. Electron microprobe analysis shows that Cu, Bi and Zn are in goethite.

Tin (2-26 ppm) and Se (1-31 ppm) are more widely dispersed around mineralization (>80 m) than Bi (1-43 ppm) and W (1-21 ppm). These elements peak in abundance where the mineralization intersects the lateritic residuum and are dispersed down slope of the mineralization to the W.

Gold concentrations in the surface soil are below 10 ppb except for two samples containing 55 and 27 ppb that are considered anomalous. All partial extractions give Au anomalies but cyanide leach provides the greatest anomaly to background ratio (Anand and Williamson, 2000). The least effective Au extraction method is pH 5 acetate. Copper, Pb,

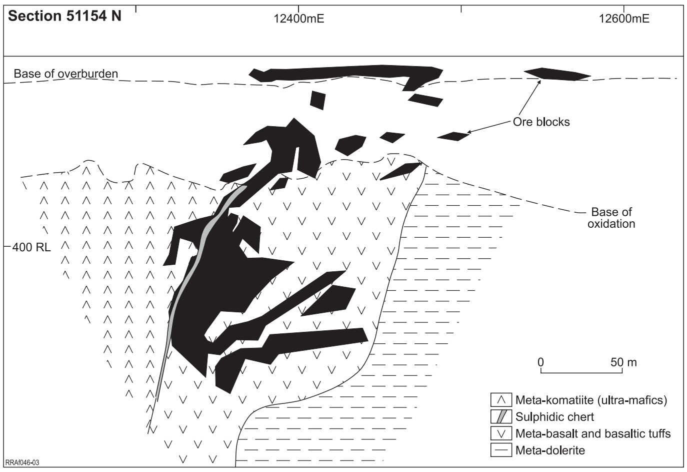

Figure 5. Distribution of ore blocks in saprolite and transported overburden, Calista deposit.

Sb and Ni occur in Mn-rich samples adjacent to the Au anomaly and can be detected by all methods (INAA, HCl extraction, iodide and cyanide leach). This is the only site in the Yandal Greenstone Belt where Au mineralization beneath thick transported overburden may have a surface geochemical expression (Anand, 2000). Alternatively, this may be due to gravelly sediments derived laterally from another Au mineralization.

Gold, Cu and Ag are all anomalous in the gravelly hardpanized colluvium (maximum Au 600 ppb, Cu 120 ppm) but are low in the sandy hardpanized colluvium. Bismuth, W, Se, As, Zn and Sn occur in very low concentrations in both sandy and gravelly units. Gravels appear to represent relatively proximal lateritic debris that may have been derived, in part, from the now-truncated profile overlying the Lotus deposit, 1.5 km to the NNW. Mine data show that Au concentrations (>0.5 ppm) persist in the bottom 5-6 m of the gravelly hardpanized colluvium for at least 150 m across the strike of mineralization (Figure 5). Manganese nodules, formed at the residual-transported interface, show high concentrations of Cu (400-900 ppm) and Zn (200-600 ppm) but are very poor in Au (<5 ppb).

Host rock-related elements, including Cr, V, Ga, Zr, Nb and Ti, are also enriched in the lateritic residuum. They are either hosted by their resistant primary minerals or associated with Fe oxides.

In conclusion, the Calista deposit is clearly shown by the composition of the buried lateritic residuum, with Au, Bi and Se the best indicators. The lower lateritic residuum shows a more consistent and stronger geochemical anomaly than the upper part. Geochemical dispersion of Au from the primary mineralization into the sedimentary cover is only minor, except for a layer directly overlying the lateritic residuum (interface). The dispersion is mainly mechanical and there appears to have been little, if any, post-depositional chemical dispersion.

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TABLE 1 - COMPARISON OF SAMPLE MEDIA

	Sulphide Mineralization	Gossan	Upper lateritic residuum N=15				Lower lateritic residuum N=12			
	Sample A	Sample B	Mean	Minimum	Maximum	Median	Mean	Minimum	Maximum	Median
Cu ppm	2990	1960	58	36	99	51	183	18	1100	94
Zn ppm	340	385	34	15	58	37	49	23	117	41
As ppm	336	238	76	40	146	146	111	13	351	72
Sb ppm	2	4	2.5	0.7	5	5	2.5	0.7	6	2.5
Bi ppm	48	14	10.4	0.7	18	10	17.5	4	43	13.5
Sn ppm	4	5	6	2	10	6	8.3	2	26	6.5
W ppm	nd	80	10.9	1	20	11	12.5	1	21	12.5
Se ppm	46	27	3.7	1	12	3	7.3	1	31	4
Au ppb	18800	4100	1735	11	6860	1060	1092	16	6600	400

	Soil N=8				Sandy hardpanized colluvium N=15				Gravelly hardpanized colluvium N=15			
	Mean	Minimum	Maximum	Median	Mean	Minimum	Maximum	Median	Mean	Minimum	Maximum	Median
Cu ppm	36	20	76	29	35	27	43	35	85	67	122	83
Zn ppm	23	17	34	22	39	32	45	40	51	27	70	49
As ppm	6	2	10	7	4	0	7	4	27	14	51	25
Sb ppm	1.3	0.7	2	1.3	0.8	0.7	2	0.7	1.7	0.7	4	2
Bi ppm	0.7	0.7	0.7	0.7	0.7	0.7	2	0.7	0.7	0.7	2	0.7
Sn ppm	2.8	0.7	4	3	3.3	2	7	3	3	0.7	5	3
W ppm	3	1	6	3.5	4.3	1	7	5	2.3	1	6	1
Se ppm	1.3	1	3	1	1	1	1	1	1.4	1	3	1
Au ppm	16	5	55	8	10	4	28	8	126	9	580	31

SD = Standard deviation