DALGARANGA BASE METAL PROSPECT, MT. MAGNET DISTRICT, WESTERN AUSTRALIA

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LOCATION

The Dalgaranga prospect is about 75 km WNW of Mt. Magnet and 110 km NNE of the Golden Grove Cu-Zn deposit, at 27°49'S, 117°5'30"E; Cue 1:250 000 map sheet (SG50-15).

DISCOVERY HISTORY

Several base metal prospects were discovered by Carpentaria Exploration Company (CEC) in 1973 in the Dalgaranga area by rock and gossan chip surveys, followed by ground magnetic and electromagnetic surveys and shallow auger drilling. The latter found high concentrations of Cu, Zn and Pb in transported overburden in a small drainage basin (referred to initially as "Grid B" and later as "Superior"; Figure 1). Further RAB and percussion drilling by CEC delineated anomalous sediments over a strike length of about 1500 m, with some weakly mineralized sources in weathered bedrock (Ward, 1975) . Subsequent exploration by CEC was delayed by poor weather and temporarily abandoned in 1976. Diamond drilling to test geochemical and electromagnetic anomalies by the Homestake Australia Pty. Ltd. - CEC joint venture in 1978 (CEC, 1978-1980) and by the CRA Exploration Pty. Ltd. - Outokumpu Exploration Australia Pty. Ltd. joint venture in 1985-6, (CRAE, 1985-6; 1987) did not discover any significant mineralization and exploration ceased.

PHYSICAL ENVIRONMENT

The prospect is in a small S-draining alluvial basin, NW of Dalgaranga Hill, draining gently S. The climate is semi-arid. Nearby, at Mt Magnet, the average annual rainfall is about 240 mm, falling mainly between February and July. Winters are generally cool to mild and summers hot to very hot, with mean minimum and maximum temperatures of 7-19ºC (July) and 22º-38ºC (January). The vegetation is dominated by mulga (*Acacia* spp.) and a variety of sparse shrubs, including *Eremophila* spp., with sporadic kurrajong (*Brachychiton* spp.) on depositional plains.

GEOLOGICAL SETTING

The Archaean Dalgaranga greenstone belt underlies the area. This consists dominantly of felsic volcanic rocks, including rhyolite, with tholeiitic basalt flows up to 300 m thick. These are overlain by carbonaceous sericite schist, shale and siltstone, grading into an oxide-silicate facies banded iron formation (BIF). The greenstone sequence is intruded by two large sills of layered gabbro, one of which forms the prominent Dalgaranga Hill (552 m), SE of the prospect. Subsequently, the greenstone belt was intruded by syntectonic to post tectonic granitic rocks, which truncate the prospective sequence to the N (Figure 1). All Archaean rocks in the area have been regionally metamorphosed to the greenschist facies. Hornfels to amphibolite-grade metamorphism is superimposed near granites and granodiorites. Adjacent to the granitic rocks, the sedimentary and felsic volcanic rocks are now quartz-andalusite-muscovite-biotite schists. Migmatites are developed locally along the contacts. Proterozoic mafic dykes, in turn, intrude the Archaean succession.

REGOLITH

There is very little outcrop within the prospect area, which is on the margin of a buried valley. There is extensive transported overburden, with the sediment thickness increasing from 3-4 m, in the E, to over 45 m, in the W. A typical profile has about 0.5 m of clay-rich soil, overlying up to 4 m of red-brown, partly silicified, transported, pebbly clays (hardpan) containing ferruginous lithorelics, nodules and pisoliths in a silty clay matrix, becoming sandy up-drainage to the NE. These overlie 5->30 m of white and pale grey alluvial silty clays, with diffuse red-brown and ochre mottling. There is commonly a zone of strong ochre mottling and staining, 1-5 m thick, within the silty clays at a depth of 10-16 m. These sediments are underlain by saprolite derived from amphibolites, carbonaceous shales, muscovite schists and, in the E, granitic gneiss, with the weathering front at 40-60 m. The unconformity is commonly marked by the appearance of muscovite in drill cuttings.

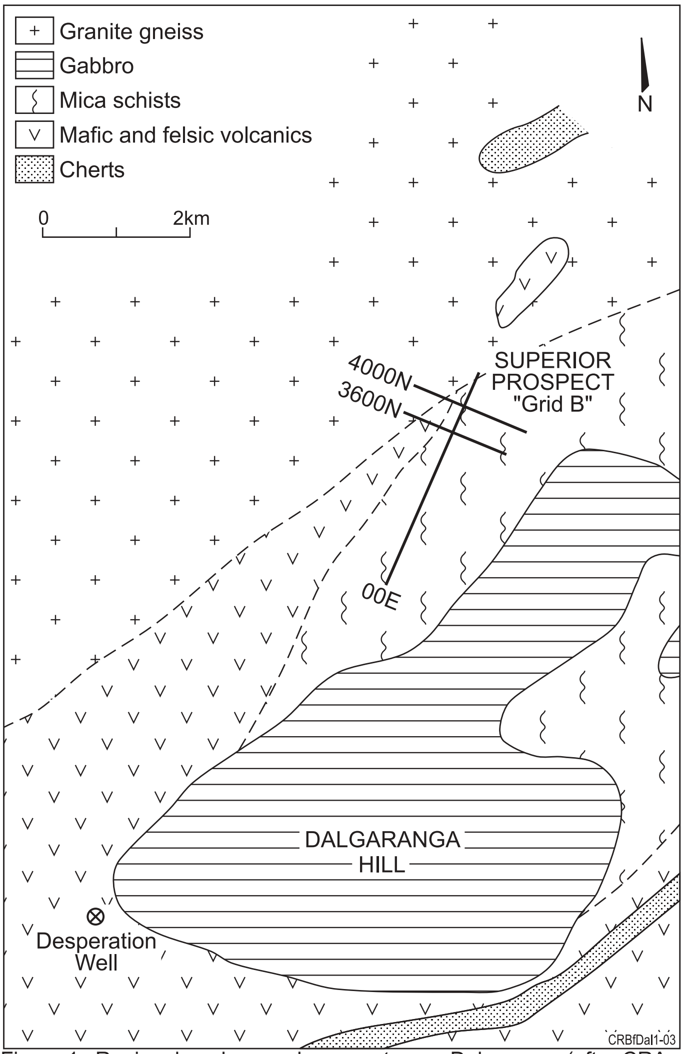

Figure 1. Regional geology and prospect area, Dalgaranga (after CRA Exploration Pty Ltd., 1987).

MINERALIZATION

Shallow drilling indicated a number of possible mineralized units in saprolite, with two metal associations, Pb-Ba-As-Sb and Cu-Zn-(Ni-Fe). Despite the tenor of the anomalies in transported and residual regolith, little significant primary sulphide mineralization has been located. On section 4000mN, for example, where Cu-Zn anomalies occur in alluvium and upper saprolite, percussion and diamond drilling intersected disseminated and semi-massive sulphides, including 26 m at 1% Zn, 0.14% Cu, 0.02% Pb and 12 m at 1.05% Zn, 0.29% Cu, both in vertical hole GWD8 (Figure 2). The sulphides are dominantly pyrrhotite (50-90%), minor sphalerite, chalcopyrite and pyrite, with traces of galena and Bi-Te-sulphides (possibly an Fe analogue of alexite, $PbBi_2Te_2S_2$). The mineralization is hosted by steeply-dipping, mostly fine-grained, schists, graphitic in places, composed of muscovite and quartz with minor biotite, chlorite and plagioclase, and large porphyroblasts of andalusite. Close to sulphides, the schists become coarser grained, with muscovite, quartz and chlorite surrounding, or intergrown with, sulphides. On section 3600mN, RAB drilling intersected 7 m of saprolite containing 0.27% Pb, 0.25% As, including a 2 m, partly gossanous unit with 0.5% Pb, 0.4% As. However, underlying schists are mostly only weakly sulphidic, with a maximum of 0.02% Pb; diamond drilling mainly found granodiorite (Figure 3).

In Pb-rich gossanous material on section 3600mN, sulphides have

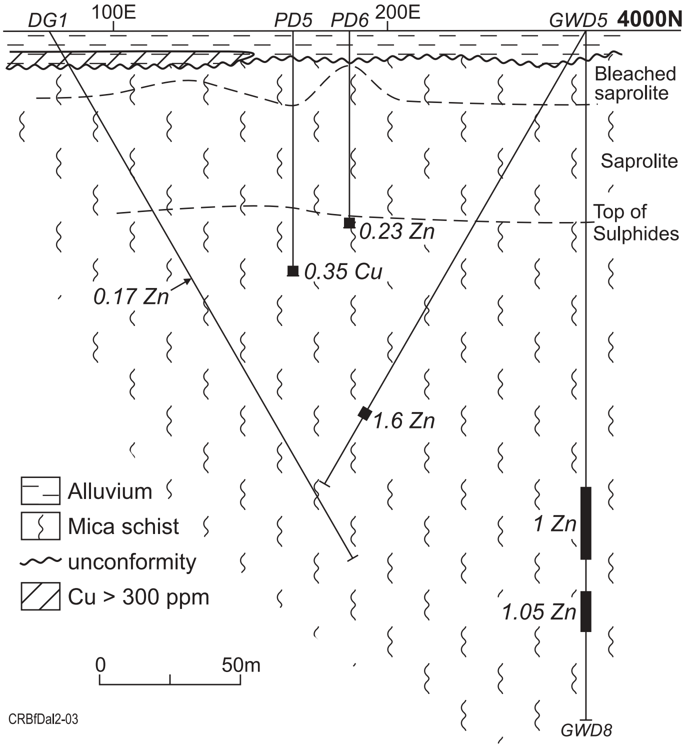

Figure 2. Percussion and diamond drill locations and principal Cu and Zn intersections (in wt%), projected on section 4000 mN. (NB: DG1 at 4060mN; GDW5 and 8 at 3950mN).

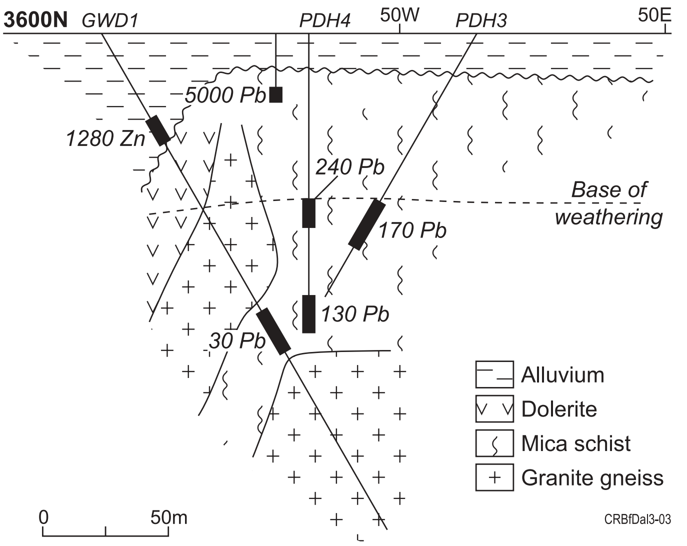

Figure 3. Percussion and diamond drill locations and principal Pb and Zn intersections (in ppm), projected on section 3600mN.

been altered to Fe oxyhydroxides, minor Pb arsenates-sulphates (alunite family), including beudantite-hidalgoite series minerals $Pb(Fe,Al)_3[(As,S)O_4]_2(OH)_6$ and plumbojarosite $PbFe_6(SO_4)_4(OH)_{12}$, with some coronadite $Pb(Mn^{4+}Mn^{2+})_8O_{16}$. Similar minerals are found in the transported overburden proximal to possible source units.

REGOLITH EXPRESSION

Saprolite

Auger and RAB drilling suggest a number of weathered metal-enriched units in micaceous saprolite, although the higher grade Cu, Pb and Zn anomalies tend not to coincide (Figure 4). Some of these have been tested by percussion and diamond drilling. As noted above, the prominent Pb-As anomaly in saprolite at 100mW, 3600mN has no continuation at depth, presumably because of a facies change, local stoping by granodiorite intrusion, or faulting. The N and S continuations of this anomaly have not been tested. The Cu-Zn saprolite anomalies between 100-250mE on 4000mN are probably derived from disseminated and semi-massive sulphides in graphitic schists that contain over 1% Zn (intersected by diamond drilling). However, it remains unclear whether these merely represent uneconomic background concentrations in the original carbonaceous shales or that

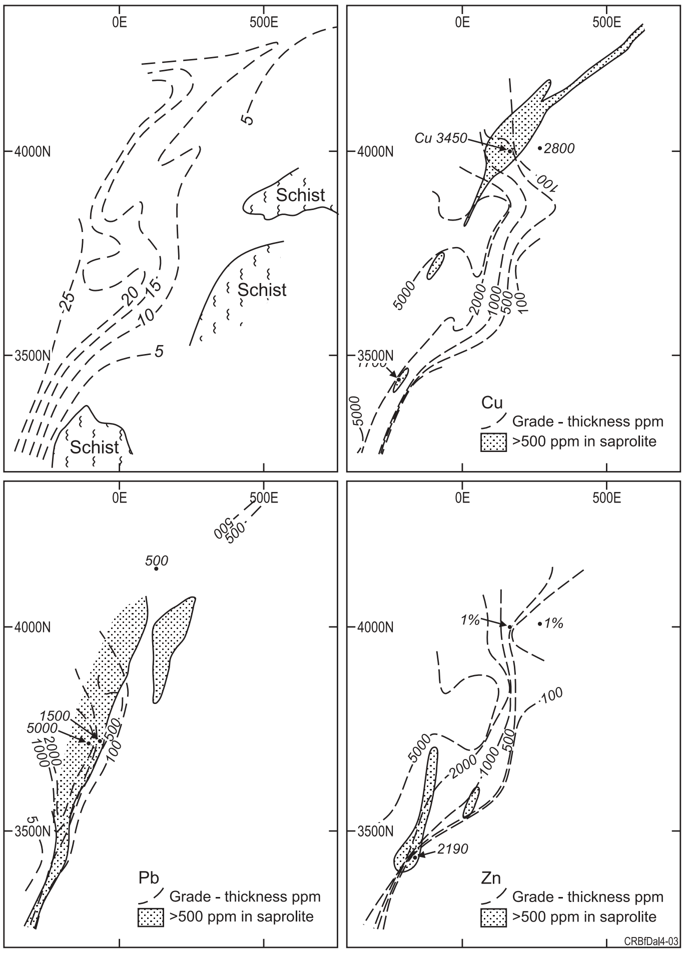

Figure 4. Sediment thickness on 'Grid B' with outcrop geology, Cu, Pb and Zn in saprolite and alluvium. Contours in alluvium expressed as concentration-thickness (ppm-metres). Figures indicate maximum concentration (ppm) in saprolite or bedrock. Location shown in Figure 1.

they are associated with nearby, undiscovered volcanic-hosted massive sulphides.

Alluvium

The clay-rich alluvium at Dalgaranga has high concentrations of Cu, Pb, Zn, As and other metals. These form a NE-trending anomaly exceeding 1000 x 400 m, open to the S and W beyond the limit of drilling. The highest concentrations of Cu, Zn and As each exceed 1950 ppm, with a maximum of 1100 ppm for Pb. The anomaly in alluvium is generally associated with the ochre-coloured horizon, commonly between 10 and 15 m, becoming deeper to the W (Figure 5). Metal contents mostly decline sharply 1-2 m below the unconformity. The Pb distribution tends to be restricted, possibly related to specific bedrock sources, whereas for Cu and, especially, Zn, the enrichment extends through the whole alluvial unit. The deepest alluvium found was in hole GWD1 (3600mN, 160mW); mean Cu and Zn contents between 10 and 45 m depth are 270 and 820 ppm, respectively, with Zn increasing to 1100-1670 ppm at 35 to 45 m (Figure 3). Fragments of ferruginous nodules and silicified clays from alluvium containing 1000-1900 ppm each of Cu and Zn were examined by SEM. This showed general Cu abundances of 0.3-0.7%, with the higher values in Fe-rich fragments. Zinc contents rarely exceed the 0.2% detection limit, implying pervasive enrichment, e.g., associated with fine-grained oxides and/or clays, or a discrete host not located by SEM. Some quartz grains in the fragments contain fine-grained, occluded pyrite, but with Cu and Zn below detection.

The high concentrations of base metals in the alluvium, expressed as a grade-thickness product on Figure 4, are very unusual. The calculated values exclude a nominal 50 ppm background abundance of each element in the sediments, which has been deducted. The distribution of Pb in the alluvium appears to be related to the probable bedrock source, with maximum values downslope from the subcrop. Copper and Zn generally occur together, broadly overlying the prospective sequence.

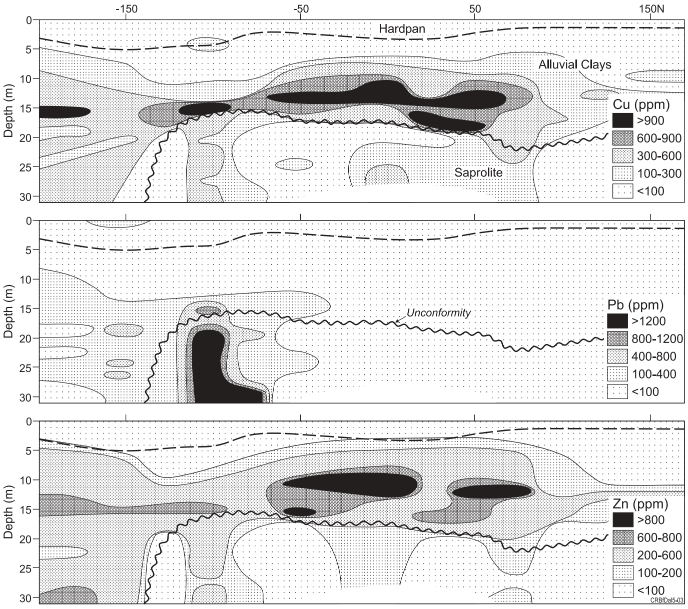

Figure 5. Copper, Pb and Zn distributions in transported overburden and saprolite, section 3600mN.

However, the maximum grade-thickness values occur in an embayment of deeper alluvium, displaced from their respective, separate, saprolite anomalies.

The pervasive enrichment of Cu, As and Zn throughout the alluvium, and possibly also into the upper 1-2 m of saprolite, and the association with ferruginous fragments and/or ochreous Fe oxide mottling, suggests that the dispersion was hydromorphic. It is unclear why the concentrations are so high, particularly given the relatively low abundances, especially of Cu, in bedrock. One possibility is that the metals accumulated in a reducing, organic-rich environment, similar to that at Mulga Rock (Douglas *et al.,* this volume), that has since been oxidized. The Pb distribution is more consistent with clastic dispersion; a similar origin for the Cu and Zn is possible, but the potential source is unclear.

Silicified colluvium and soil

Colluvium (hardpan) generally has background (<50 ppm) to weakly anomalous (50-100 ppm) Cu, Pb and Zn contents. Soil was not sampled separately; the 0-1 m drill interval is subject to cross hole contamination.

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SAMPLE MEDIA - SUMMARY TABLE

	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Sb (ppm)
Hardpan					
Minimum	5	10	5	5	5
Maximum	100	115	85	175	55
Alluvium					
Minimum	5	10	5	5	5
Threshold	300	300	300		
Maximum	1980	1105	2095	3225	190
Anomaly (m)	>1200x>200	>1000x>100	>1200x>200		
Saprolite					
Minimum	5	5	5	5	5
Threshold	500	500	500	50	-
Maximum	2000	5000	3945	4320	160
Anomaly (m)	900x100	1200x100	450x50	1200x150	-
Bedrock:					
3 m @	1430	280	1.6%	3-90	<5
12 m @	2865	215	1.05%	3-130	<5
26 m @	1365	220	1.0%	0.5-155	<5

XRF analysis; detection limits 5 ppm.