MRANGELLI Pb-Zn-As PROSPECT, COBAR DISTRICT, NEW SOUTH WALES

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LOCATION

The Mrangelli Pb-Zn-As prospect is located at 31°33'S, 145°37'E, 25 km W of Cobar; Cobar 1:250 000 sheet, SH55-14.

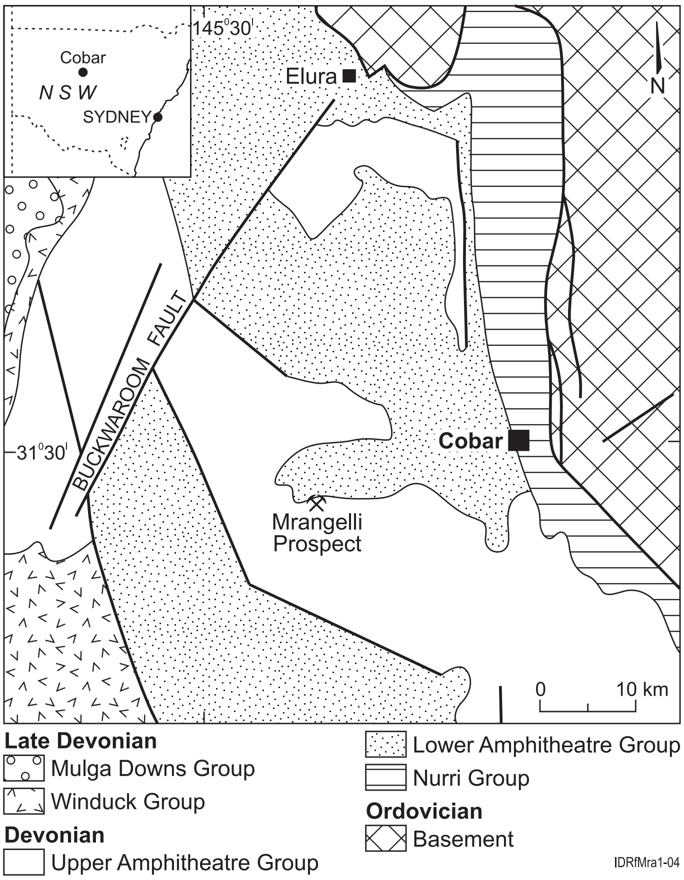

Figure 1. Location of the Mrangelli Prospect in relation to nearby mines and regional geology (after Glen, 1987).

DISCOVERY HISTORY

Mrangelli was discovered in the late 1970s by Dampier Mining Co Ltd and Electrolytic Zinc Co as outcropping silicified sandstone containing minor amounts of preserved primary sulphides, mainly pyrite. Further mineralization was delineated by soil and rock chip geochemistry. A regional lag survey and RAB drilling by Dominion Mining Ltd in 1992 outlined additional Pb-Zn-As±Au anomalies in the area (Wake, 1993). The best RC intersection is 4 m at 0.75% Pb and 3.81% Zn at 94 m depth. A range of geochemical sampling media (soil, lag and vegetation) would have defined this target that has no geophysical expression. Peak Gold Mines Pty Ltd are currently exploring the prospect.

PHYSICAL ENVIRONMENT

The prospect covers around 10 km^2; outcrops of silicified sandstone form a series of ridges with up to 30 m of relief. Between the ridges is a mixed colluvial and aeolian pediment, typically 1-2 m but up to 5 m thick, which overlies partly stripped residual regolith. Down the slope, the pediment is progressively overlain with Quaternary alluvium. Slopes rarely exceed 5°. The climate is semi-arid and is within the transition from summer- to winter-dominant rainfall (350 mm pa). Mean temperature ranges are 20-34°C in January and 5-16°C in July. Extensive land clearing has removed the native vegetation, now largely replaced by an acacia-eremophila-cypress pine association with dense cypress pine and bimble box in the drainages. The land is principally used for grazing.

GEOLOGICAL SETTING

The Mrangelli prospect is at the boundary between the Upper and Lower Amphitheatre Group (Figure 1), specifically between the turbiditic CSA Siltstone and the sandstones of the Biddabirra Formation (Amphitheatre Group; Glen, 1987) of the Devonian Cobar Supergroup (Figure 2). The sandstones are generally fine to medium grained and quartzose. Low-grade, regional metamorphism has resulted in overgrowths and recrystallization of quartz and suturing of grain boundaries. The prospect lies on the Amphitheatre Dome, within a zone of ENE-trending anticlines and synclines, and is crossed by NE-striking faults. Deformation fabrics, including pressure solution cleavage, are preserved in a number of outcrops and in lag derived from the sandstones and siltstones.

REGOLITH

The regolith at Mrangelli is dominantly residual with a discontinuous veneer of transported material (Gibson, 1996). Weathering of more permeable lithologies generally extends to 80 m; a thick pallid saprolite is overlain by up to 5 m of a discontinuous mottled zone. Weathering of disseminated sulphides has produced a distinct spotting in the strongly silicified Biddabirra Formation sandstone, but does not generally extend below 20 m depth. Locally, disseminated sulphides are preserved in more massive zones of silicification. Although some sedimentary units and structures are ferruginized, there is no ferruginous duricrust.

The pediment is a mixture of massive red earths with a significant aeolian content and patchy development of lag. This lag includes variable amounts of lithic and ferrolithic clasts, pisolitic lag, vein quartz, and gravel with calcrete and silcrete clasts. From erosional to depositional landforms, the average size of the lag and its ratio of lithic to pisolitic clasts decrease, whereas the ratio of magnetic to non-magnetic components in the lag increases. The lithic and pisolitic lag clasts commonly display laminated, ferruginous rims.

Surrounding drainages are filled with up to 15 m of kaolinitic, silt-dominated alluvium. At the base and along the sides of the alluvium are lenses of buried ferruginous lag that are strongly magnetic.

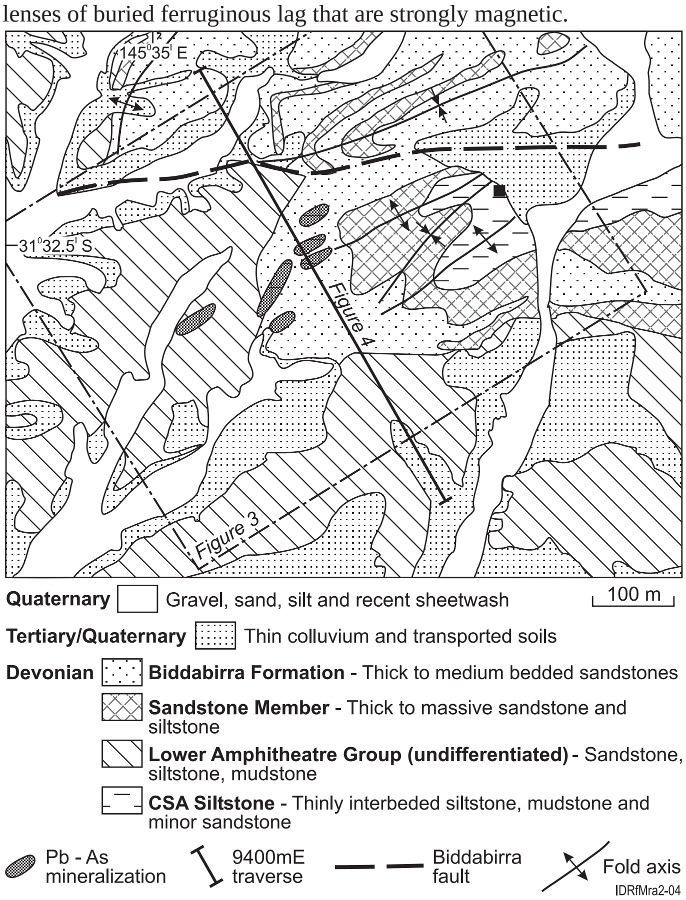

Figure 2. Geology and regolith of the Mrangelli Pb-Zn-As Prospect, the mineralization, the outline of Figure 3 and the traverse of Figure 4.

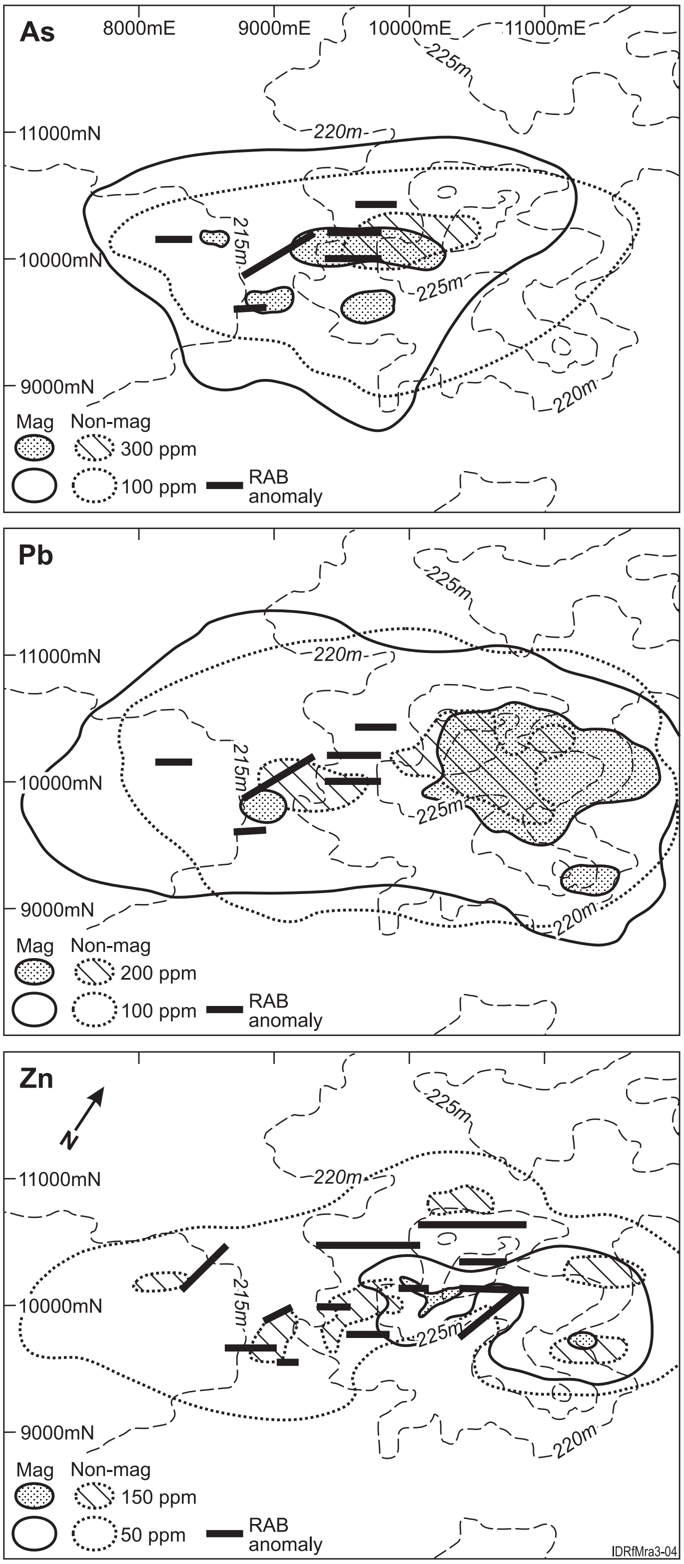

Figure 3. Comparisons between As, Pb and Zn contents of magnetic and non-magnetic lag (2-11 mm). Local grid used.

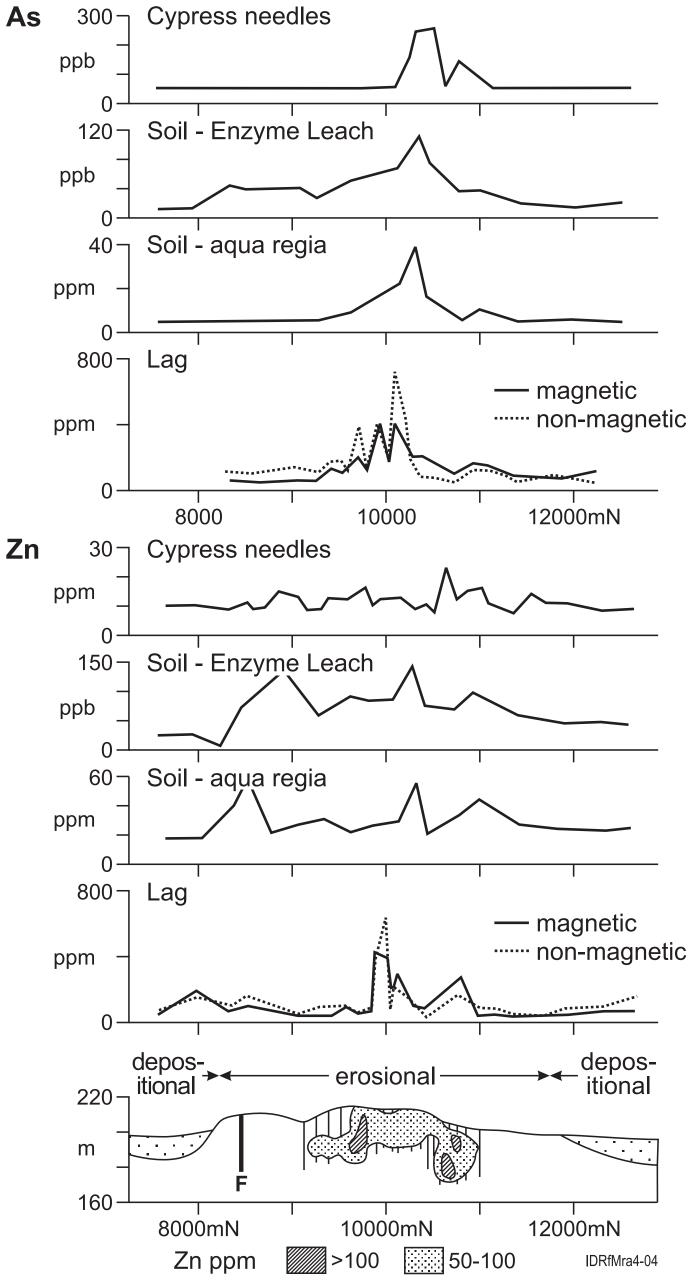

Figure 4. Comparisons between As and Zn contents of lag (magnetic and non-magnetic), soil by aqua regia extraction and enzyme leach extraction, and white cypress pine needles along line 9400mE. The regolith geology is based on surface mapping and RAB drilling. The fault is the inferred position of the Biddabirra Fault. Local co-ordinates used.

Soils on ridge crests, gentle slopes and alluvial flats of the Cobar Pediplain include lithosols and massive red earths. The drainages also contain some calcareous red earths with hardpans and stone layers. Calcrete is common along seepages near the base-of-slope and along the bases of drainages.

MINERALIZATION

Wake (1993) considers the mineralization to be a variant of the Cobar Style, developed in association with silicified fault zones which lie sub-parallel to major regional faults splays. The primary Pb-Zn-AsAu sulphide mineralization appears to be in discrete, structurally controlled zones as veinlets and disseminated sulphides within silicified siltstones. In less silicified zones, the sulphides have been replaced by Fe oxides or completely removed by weathering. In the saprolite, goethite, hematite and maghemite coat quartz grains, completely replacing the matrix of the siltstones and sandstones and filling cavities and fractures.

Thin zones of sub-economic Pb mineralization (Pb to 0.24% and As to 0.07%), defined by RAB drilling and rock chip sampling, extend for 800 m and are 50-200 m wide (Figure 3). Zinc mineralization (up to 0.59% Zn) is more extensive. There is no indication of supergene enrichment. The inferred Biddabirra Fault on line 9400mE (Figure 4) may be mineralized, as it shows a geochemical response (see below).

REGOLITH EXPRESSION

A broad halo of disseminated relict sulphides has been armoured by silicification. Fragments of this halo have been mechanically dispersed, which limits the use of surface lag geochemistry for defining discrete bedrock targets but lag geochemistry is a valuable indicator of the general site of mineralization. Lead (>100 ppm) and As (>50 ppm) anomalies in lag and soil (Wake, 1993) cover a 6 km^2 area and form the surface expression of mineralization. Within this broad envelope, Pb-Zn-As anomalies in soil outline more discrete zones, 50-200 m wide and up to 800 m long, that are not generally apparent in the lag. Other sampling media along line 9400mE (Figure 4) include residual regolith from RAB spoil, Cypress needles and soil (Alipour *et al.*, 1997; Cohen *et al.*, 1998).

Saprolite
In the residual regolith (saprolite), anomalous Zn and As concentrations are present between 9200 and 11000mN (Figure 4). Arsenic concentrations are elevated across this zone, whereas anomalous Zn concentrations are confined to the centre of the anomaly, extending from bedrock to surface. Arsenic, Pb and Zn are depleted in the top 1.5 m, except for the core of the main Pb-Zn anomaly, whereas Mn is enriched.

Soil
There is a distinct As anomaly in soil (250 mm depth) at 9500–10500mN (Figure 4) using both aqua-regia- and enzyme leach-extraction. Weak As anomalies (about 30 ppb) extend S to near the Biddabirra Fault in the enzyme leach data. The patterns of aqua regia- and enzyme leach-extractable Zn are very similar and indicate down slope dispersion of the anomaly. Aqua regia-extracted Zn in soil is also anomalous over the Biddabirra Fault (45–60 ppm Zn against a background of 35 ppm).

Lag
In ferruginous lag near outcropping mineralization, the maximum As concentration is 2000 ppm compared to a background of 50 ppm; Pb concentrations are 510 ppm and 60 ppm respectively. Zinc concentrations show a greater anomaly to background contrast in non-magnetic than magnetic lag above bedrock mineralization (Figure 4). Zinc anomalies in magnetic lag are limited to areas close to outcropping, silicified mineralization in the centre of the site and the northern edge. The down-slope anomaly in the soils is not present in the lag. In contrast, Pb and As show broad, generally low contrast anomalies in the magnetic fraction whereas Pb generally has local spot highs in the non-magnetic fraction within broad, weakly anomalous zones. The ratio of Fe contents of magnetic versus non-magnetic lag is about 2-3. The relationship between Fe and other trace metals in both lag components suggests loss of Zn but retention of Pb and As in the magnetic lag.

Vegetation
White cypress pine needles show a prominent As peak (0.10–0.15 ppm against a background of <0.05 ppm) between 10100mN and 10400mN, about 200 m N of the main As anomaly in saprolite. Zinc concentrations in white cypress pine needles range from 7 to 22 ppm with a weak, single-point peak (22 ppm) at 10400mN, coinciding with the maximum As (and Pb) concentrations in the same medium.

The mineralization, regolith and geochemical characteristics of the Mrangelli prospect are similar to those of other deposits in the region that are also covered by thin transported regolith, including Gowrie and Yarrawonga (Alipour, 1996) and McKinnons (Cohen *et al.*, 1998; Shen, 2001 and McQueen *et al.*, this volume).

REFERENCES

Alipour, S., 1996. Geochemistry and Morphology of Lag in the Cobar Region of New South Wales and its Application in Mineral Exploration. University of New South Wales, PhD thesis, 515 pp. (Unpublished)

Alipour, S., Cohen, D.R. and Dunlop, A.C., 1997. Geochemical characteristics of lag in the Cobar Area, NSW. Journal of Geochemical Exploration 58:15–28.

Cohen, D.R., Shen, X.C., Dunlop, A.C. and Rutherford, N.F., 1998. A comparison of selective extraction soil geochemistry and biogeochemistry in the Cobar area, New South Wales. Journal of Geochemical Exploration 61:173–189.

Gibson, D.L., 1996. Cobar Regolith Landform 1:500000 map. CRC-LEME, Canberra.

Glen, R.A., 1987. Geology of the Wrightville 1:100000 Sheet 8034. Geological Survey of NSW, Sydney, 257 pp.

McQueen, K.G., Rugless, C.S. and Williams, R.E. (this volume) McKinnons gold deposit, Cobar District, New South Wales.

Shen, X.C., 2001. Geochemical Dispersion in Residual and Transported Regolith in the Cobar Region of NSW. PhD thesis, University of New South Wales, 314 pp. (Unpublished)

Wake, B.A., 1993. Combined first annual reports for exploration license 4254–4259 and 4457 of Dominion Mining Limited, Department of Mineral Resources, Sydney, 33 pp.

SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Indicator elements	Analytical methods	Detection limits (ppm)	Background (ppm)	Threshold (ppm)	Maximum anomaly (ppm)	Dispersion distance (m)
Primary mineralization	Pb	AR–AAS	5			1800	Minimal
	Zn	AR–AAS	2			5200	
	As	Hyd–AAS	2			700	
	Au	FA	0.01			0.19	
Saprolite and saprock	Pb	AR–AAS	5		60	700	<20
	Zn	AR–AAS	2		30	150	
	As	Hyd-AAS	2		40	200	
Gossans and ironstone	Au	FA	0.001			5	Minimal
Soil - <180 µm	Pb	AR–AAS	5		100	4220	200
	Ba	AR–AAS	30		250	3080	
	As	Hyd–AAS	2		100	3020	
	Au	AR-AAS	0.002		0.002	0.010	
	Au	ENZ	0.0005		0.001		<50
	As	ENZ	0.010		0.010	0.120	
	Pb	ENZ	0.005		0.020	0.250	
	Zn	ENZ	0.005		0.025	0.190	
Lag - undifferent-iated	As	Hyd-AAS	2		50	2000	1500
	Pb	MxA– AAS	1		60	510	
Lag - magnetic	Pb	AR-AAS	5		150	180	2500
	Zn		2		90	680	200
	Cu		5		30	80	
	Mn		5		150	280	
	As	Hyd-AAS	2		440	600	2000
Lag - non-magnetic (without qtz)	Pb	AR-AAS	5		200	430	2000
	Zn		2		150	1140	1000
	Cu		5		60	80	
	Mn		5		200	620	
	As	Hyd-AAS	2		230	1430	1500
Vegetation (cypress pine needles)	Au	INAA	0.0003		0.0003	0.0012	
	As	ICP-OES	0.02		0.04	0.25	
	Zn	ICP-OES	2		5	25	

Key: AR–aqua regia; MxA–mixed acids; FA–fire assay with solvent extraction; Hyd–mixed acid digest with hydride extraction; ENZ–Enzyme Leach.