ELURA Zn-Pb-Ag DEPOSIT, COBAR DISTRICT, NSW

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LOCATION

The Elura Zn-Pb-Ag mine is located 43 km NNW of Cobar at 31°10'S, 145°39'E; Cobar (SH55-14) 1:250 000 map sheet.

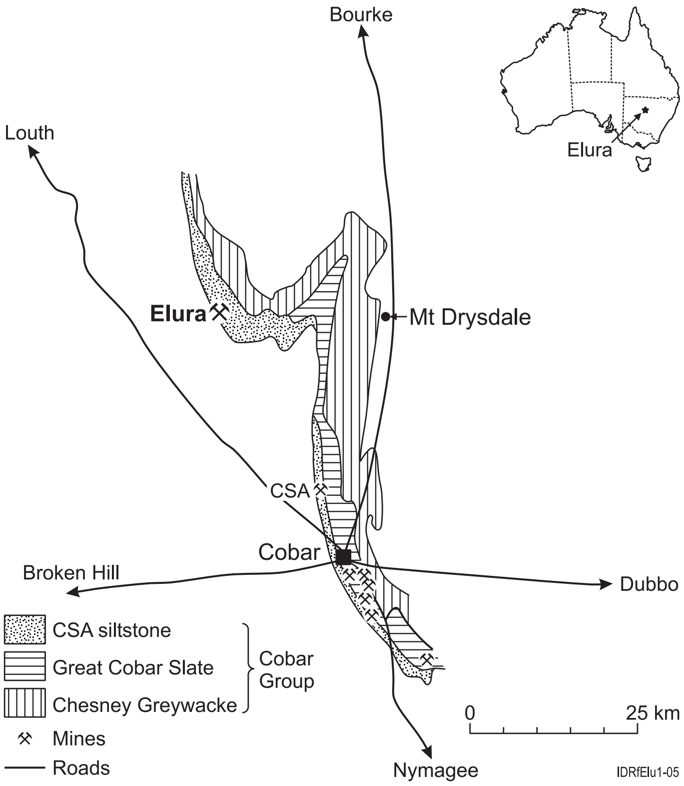

Figure 1. Map of Cobar region showing the location of Elura in relation to Cobar Group rocks.

DISCOVERY HISTORY

In 1971, the Electrolytic Zinc Co of Australasia (EZ) conducted an aeromagnetic survey over two exploration licences to the NW of Cobar, on the premise that the Cobar Group, that hosts the CSA Mine (*this volume*), continued to the N and NW, under soil cover. Previous exploration had assumed that the Cobar Group continued to the NE of the CSA Mine, towards Mt Drysdale (Figure 1). An anomaly was found at what is now Elura near the extremity of the survey. Although the Elura magnetic anomaly was not thought to lie in prospective stratigraphy, it was marked for follow up because it was a discrete "bull's eye". Ground magnetometry indicated a deep source and auger sampling was commenced. Ultimately, a Pb anomaly was defined over a strike length of 1200 m by samples from 1.8m depth spaced at 5-10 m on lines 50 m apart. Delays in processing exploration tenements allowed gravity and EM surveys to be completed but the initial drilling programme targeted the magnetic and auger anomalies. Diamond hole E1 intersected gossan at 102 m on the 12th February 1974 and sulphide mineralization at 133.5 m on the 16th February (Davis, 1980).

In retrospect, the most efficient way to find such a deposit would be to accurately locate the aeromagnetic anomaly on the ground and drill at a high angle to the magnetic field into the main part of the anomaly. The magnetic anomaly is largely due to magnetic pyrrhotite. However, non-magnetic pyrrhotite occurs extensively at the Hera prospect near Nymagee (see Skirka, *this volume*) and has been reported at the CSA mine. If the pyrrhotite at Elura had been non-magnetic, the best strategy would have been to sample lag at 500 m intervals on 1-2 km spaced lines and follow up Pb assays of greater than 60 ppm.

PHYSICAL ENVIRONMENT

The deposit lies in an area of slightly undulating low relief on the Cobar Pediplain (Stannard, 1957). The climate is semi-arid with an annual average rainfall of about 300 mm, distributed relatively evenly through the year with small peaks in late spring to early summer and late autumn to early winter. Evaporation is about 2000 mm per year (Walker, 1978), with mean minimum and maximum temperatures of 20-34ºC in January and 5-16ºC in July. At the mine site, the dominant vegetation is sparse Bimble Box (*Eucalyptus popunea*), with an understorey of *Acacia* spp. and other woody shrubs. Denser vegetation occurs along broad drainages.

GEOLOGICAL SETTING

Elura is close to the NW edge of the Cobar Basin (Figure 1), one of several intra-continental basins in the central part of the Lachlan Fold Belt. In the N part of the Cobar Basin, sedimentation advanced from basal conglomerates through sandstone and siltstone into turbidites. Near the Elura deposit, the stratigraphy passes from limestone, mudstone and sandstones, through to the CSA Siltstone (Schmidt, 1980).

The deposit occurs within the CSA Siltstone, 200 m vertically above the NNW-trending Elura Limestone. Re-activation of basin-parallel NNW-trending syn-sedimentary structures during the D1 and D2 deformations (Glen, 1994) appears to have developed splayed, fan structures, deflected against the limestone barrier and terminating in anticlines at the fault leading edges. The Elura deposit occurs within these anticlines, the ore lenses terminating against folded CSA Siltstone. Few veins or fractures penetrate far above the top of the lodes.

REGOLITH

A maghemite-bearing ferruginous lag has accumulated within or at the top of a veneer of red soil, up to 1.5 m thick, on soft, bleached bedrock. Fe oxides are developed on fractures and within discrete, elongate mottles up to 0.2 m in diameter. In places, substantial calcrete occurs down to 6 m. The weathered profile then grades into hard, white to tan saprolite, with Fe oxide developed along some bedding planes and on fractures and veins. Grey, fresh rock may occur at about 60 m but, generally, the base of weathering of the siltstones is at 80-120 m. Within the ore, the base of oxidation is at 80 m, though oxidized sulphides occur in cavities at depths of >800 m.

MINERALIZATION

The pre-mining resource was 45 Mt at 8.5% Zn, 5.3% Pb, and 69 ppm Ag. Nearly half has been mined since 1983. The ore system consists of steep, pipe-like accumulations of massive sulphide occurring in six pods (Figure 2) aligned on a NNW trend, for a strike of 650 m. Main Lode extends from close to the surface to 900 m. The five Northern Pods extend to the same depth but from 450 m below surface. Although discrete entities, the pods are connected along strike, attaining a more sheet-like morphology to the N. The ore system is enveloped by low-grade vein and stringer mineralization.

REGOLITH EXPRESSION

Main Lode

The primary ore consists of massive and siliceous assemblages of pyrite, pyrrhotite, sphalerite and galena which are completely weathered to 80 m and partially weathered for a further 20 m (Taylor *et al.,* 1984). The Elura gossan profile has an upward progression from primary to supergene sulphides through the supergene oxidate zone (sulphates, carbonates and arsenates) to the Fe oxide-dominated near surface material (ferruginous oxidate zone). The supergene sulphides are about 3 m thick and are dominated by pyrite, marcasite, anglesite, cerussite and galena, and characterized by the absence of sphalerite. The interface with the overlying oxidate zone is marked by a 150 mm band of blue-black sooty chalcocite with some digenite and enargite. At the base of the 15 m-thick supergene oxidate zone, native Ag and cassiterite occur before giving way to arsenate- and sulphate-rich assemblages. Fifty metres of hematite- and goethite-rich material (ferruginous oxide zone) extend to the surface (Scott, 2000). Iron-rich

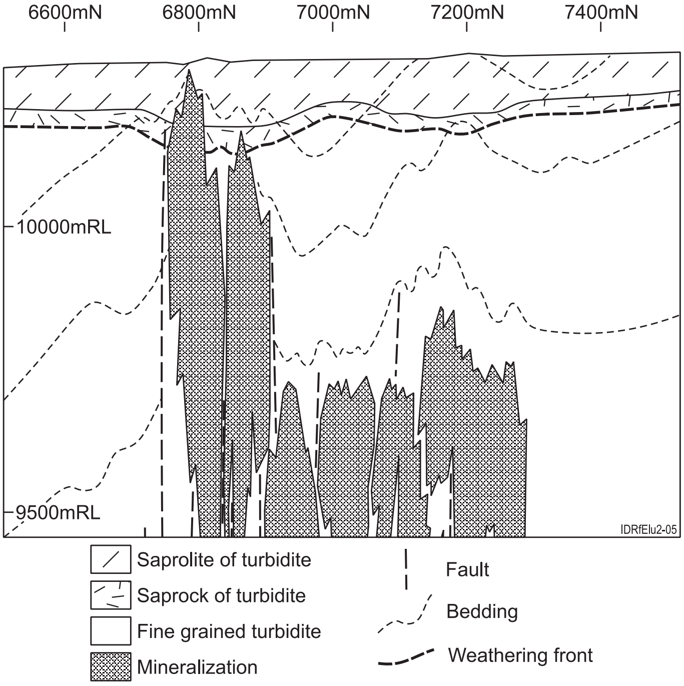

Figure 2. Section through the Elura mineralization (after Reed, 2004).

bands, formed by precipitation from groundwater passing along fractures, are enriched in As, Bi, Co, Cu, Mn, Ni and Zn, but depleted in Ba and As, relative to adjacent weathered siltstone (Taylor *et al.,* 1984).

A small patch of gossan was originally visible at surface but was not associated with anything remarkable in the topography or vegetation. Photographs of the gossan in a costean reveal Fe oxide-rich float lying on a flat red soil surface (Schmidt, 1980). The surface expression of the deposit was destroyed in 1996 when stopes collapsed to form a pit directly above the Main Lode. The walls of this pit show that the outcropping gossan was as stringer-type material above the main body of the gossan 50 m below. It is remarkable that Elura had any surface expression at all. The significant lag and soil anomalies (Figure 3) probably formed by material shed from the gossan outcrop.

Extension of the Zn soil anomaly to the SW appears to be controlled by a subtle drainage revealed as an embayment in the erosional landscape (Gibson, 1999) also shown in Figure 3**.** Lead (>50 ppm) in auger and RAB samples appears to be controlled by this feature, suggesting sub-surface dispersion of Pb in the saprolite (Figure 3). Lead (>50 ppm) in magnetic lag extends more symmetrically about the deposit, although one arm of the anomaly follows the SW drainage (Dunlop *et al.,* 1983), others extend to the NE and SE. Zinc is not anomalous in these materials. It is unclear why there is a difference in the anomaly distributions. The explanation may lie in the residual nature of the lag anomaly. This probably began to form before the current drainage pattern had developed, accumulating during landscape deflation. The auger and soil anomalies in the drainage may be the result of movement of Zn in solution over a shorter period, once the drainage had developed. The absence of a significant Zn anomaly in the lag or auger samples supports the hypothesis that Zn was moved out of the profile in solution whilst the lag anomaly was being accumulated. The main Zn anomaly was then formed by precipitation in the recently formed drainage, late in the landscape history.

Assaying for Pb in magnetic lag is the best geochemical method to find outcropping mineralization of this type, in this environment (Lorrigan, 2000). In-fill sampling around an anomaly in a regional survey (samples initially taken at 200 m intervals along lines 500 m apart) would define a coherent, significant symmetrical target in the regional data set, even without levelling for lithology. However, very careful assessment of Zn data (to allow for lithology, *e.g.,* more sandy units contain more Zn ; Lorrigan, 2000) would be required to see a small and subtle Zn anomaly in the lag data but none is evident in the auger assays.

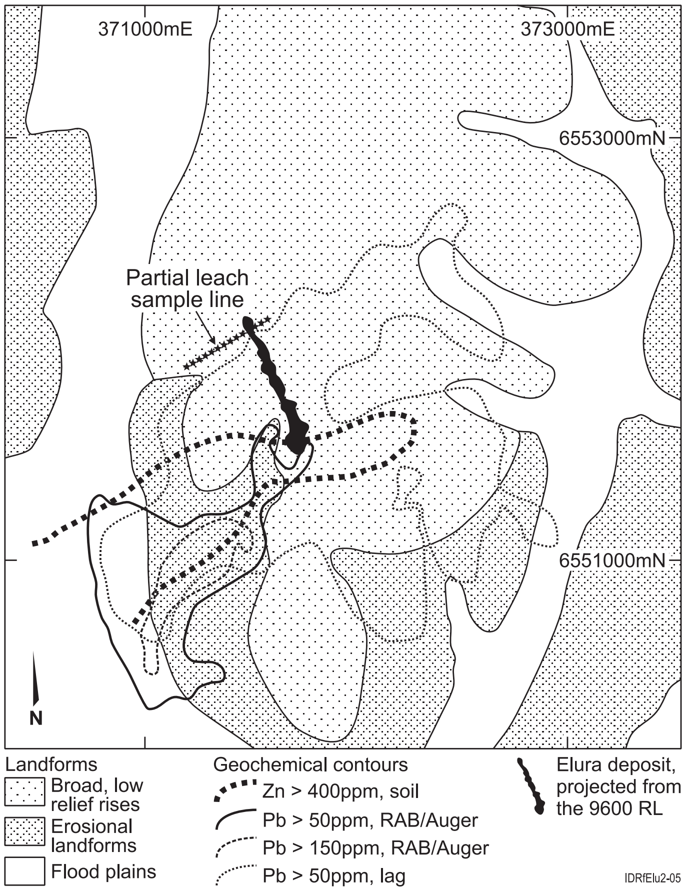

Figure 3. Geochemical anomalies and landforms at Elura (landforms after Gibson, 1999).

Northern Pods

The deep Northern Pods do not contribute to the lag, auger or soil anomalies at Elura. In 1998, a series of percussion holes, up to 140 m deep, were drilled directly above the Northern Pods. All 2 m composite samples from this drilling were analyzed for Ag, Au, As, Fe, Cu, Pb and Zn. The results of these analyses failed to provide any geochemical indication of the 7 Mt of ore located 450 m below.

Soil from directly above the Northern Pods has been investigated by complete analysis as well as by partial leach methods. The partial leach analyses show a 750 x 100 m anomaly in Zn and Cd but not in Pb. A total Zn soil anomaly is partly offset from the partial leach spike but is of a much lower order (Figure 4) and would be unlikely to attract attention in a regional data set.

The absence of Pb in the partial leach anomaly has been explained by the separation of metals in the soil column in the journey to the surface (Mann *et al*., 1997). However, recent work has indicated that anomalous Zn in soils in this area is concentrated in the finest soil fractions (Scott, 2002). The tenor of the anomaly decreases significantly with depth and can not be discerned below 0.4 m. There is also a distinct possibility that the Zn anomaly has been caused by

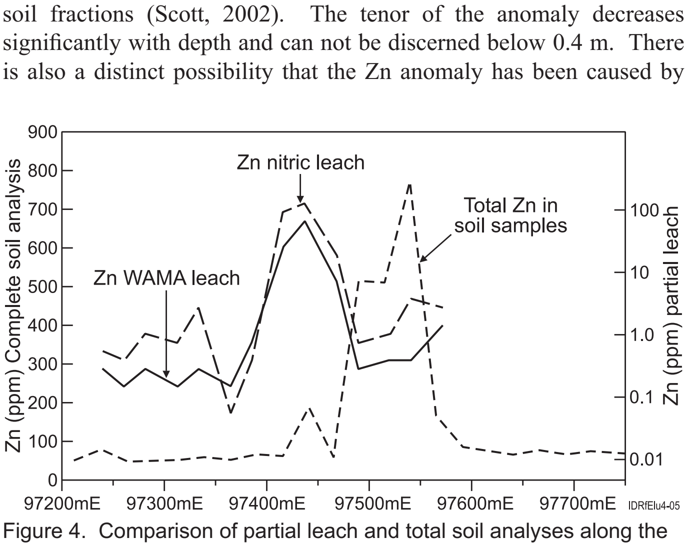

Figure 4. Comparison of partial leach and total soil analyses along the local grid section 78625N (shown in Figure 3).

contaminants blown from the mine upcast fan, 100 m away, or the surface stockpile, 500 m away. Contamination from earthworks and water makes it difficult to compare the Northern Pods site with other sites at a similar distance from infrastructure.

From the Elura data it must be concluded that surface geochemical exploration for a Northern Pods-style deposit is difficult. Partial leach assay techniques applied to samples taken on lines 200 m apart, at 25 m spacing, may be successful but this is not proven by experience at Elura. Application of the technique in other environments would also need to address the issue of the role of structure in transporting ions to surface. The structures at Elura are vertical, if the same technique were applied in an area where dipping structures occur, the anomaly may not be directly above ore.

ACKNOWLEDGEMENTS

Numerous Pasminco geologists over a 30 year period have added to the understanding of the deposit since its discovery.

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SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Indicator elements	Analytical methods	Background (ppm)	Threshold (ppm)	Maximum anomaly (ppm)	Dispersion distance (m)
Primary mineralization	Ag	AAS	60	-	980	-
	Pb	AAS	55000	-	230000	-
	Zn	AAS	85000	-	291000	-
Supergene sulphide zone	Ag	AAS	130	-	32100	-
	As	XRF	5500	-	66100	-
	Cu	AAS	1700	-	651000	-
	Pb	AAS	58000	-	362000	-
	Zn	AAS	100	-	27100	-
Supergene oxidate zone (lower saprolite)	Ag	AAS	15	-	54400	-
	As	XRF	1100	-	165000	-
	Cu	AAS	120	-	8600	-
	Pb	AAS	30400	-	403000	-
	Zn	AAS	45	-	2000	-
Upper saprolite (auger and RAB)	Pb	AAS	30	50	4300	780 (not continuous)
Ironstone lag	Pb	AAS	30	100	3200	0-800, 3400[2]
	Sb	AAS	25	90	550	3200[3]
	As	AAS	30	60	88	3200[3]
[1]Soil – total	Zn	ICP-MS	50	400	2900	>1,500[4]
	Pb	ICP-MS	30	330	3400	>1,500[4]
	Cu	ICP-MS	25	40	440	>1,500[4]
Soil - partial leach	Zn	MMI	5	1000	290	450
	Au	MMI	1	10	1.080	450
	Cd	MMI	0	4	0.470	450

[1]Soil collected after scraping away top 20 mm. [2]Extended along drainage. [3]Anomaly not coherent.
[4]Open to SW. Dispersion only along drainage.
AAS and ICP-MS determined after a 4 acid digestion.