MOUNT TORRENS LEAD PROSPECT, SOUTH AUSTRALIA

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LOCATION

The Mount Torrens prospect is 45 km E of Adelaide in the eastern Mount Lofty Ranges ~~at~~ at 34°53'15"S, 139°00'18"E; Adelaide 1:250 000 map sheet (SI54-09).

DISCOVERY HISTORY

Regional stream sediment sampling (<180 µm fraction) by the South Australian Department of Mines and Energy (SADME) of the Mannum A 1:25 000 sheet (Sibenaler, 1975) yielded anomalous Cu, Pb and Zn E of Tungkillo. Resampling of these stream sediments by CRA Exploration and extension of stream sediment sampling to those areas not previously sampled yielded an anomalous sample with 2100 ppm Pb in Dairy Creek. Subsequent rock-chip sampling (maximum 27.7% Pb) upstream of the stream sediment anomaly led to the discovery of gossans. Drilling has outlined an inferred resource of 0.7 Mt at 6.4% Pb, 1.6% Zn and 41 ppm Ag (Belperio et al., 1998).

GEOLOGICAL SETTING

The fault-controlled Kanmantoo Trough developed in the early Cambrian by extension along the SE flank of the Neoproterozoic Adelaide Geosyncline, following stable platform carbonate sedimentation. The marine, clastic, flyschoid sediments of the basin, and the Neoproterozoic succession to the W, were deformed (at least two phases), metamorphosed to the amphibolite facies and intruded by granites during the Delamerian Orogeny (middle to late Cambrian). They are now exposed in an arc over 300 km in the eastern and southern Mount Lofty Ranges.

The Kanmantoo Group is up to 15 km thick and forms a stack of thrust sheets of sandstones, siltstones and phyllites intercalated with pelites and minor carbonates. The lowermost sequence comprises sandstone and siltstone (Carrickalinga Head Formation), which passes up into feldspathic sandstone (Backstairs Passage Formation). An unconformity separates the Backstairs Passage Formation from the overlying upper parts of the sequence, which comprises interbedded muddy sandstone and siltstone (Tapanappa and Balquhidder Formations), and dominantly fine-grained clastic rocks of the Talisker Calc-siltstone, and the Tunkalilla and Petrel Cove Formations.

Most of the significant base-metal syn-sedimentary mineralization in the Kanmantoo Group is confined to the Tapanappa Formation (Belperio et al., 1998; Toteff, 1999). Some is spatially associated with garnetiferous exhalites (including BIF), gahnite-bearing rocks, and unusual assemblages thought to be metamorphosed alteration zones (Toteff, 1999). Sulphide mineralization in the region includes associations of Cu±Au, Pb-Zn-Ag±Au, Cu-As±Au and Fe as pyrite and pyrrhotite (Belperio et al., 1998). The regionally extensive Talisker Calc-siltstone includes the laterally extensive Fe sulphide-rich Nairne Pyrite Member. Minor Pb-Zn-Ag mineralization in carbonates and calc-silicates occurs at the base of this unit at the Mount Torrens prospect (Figure 1).

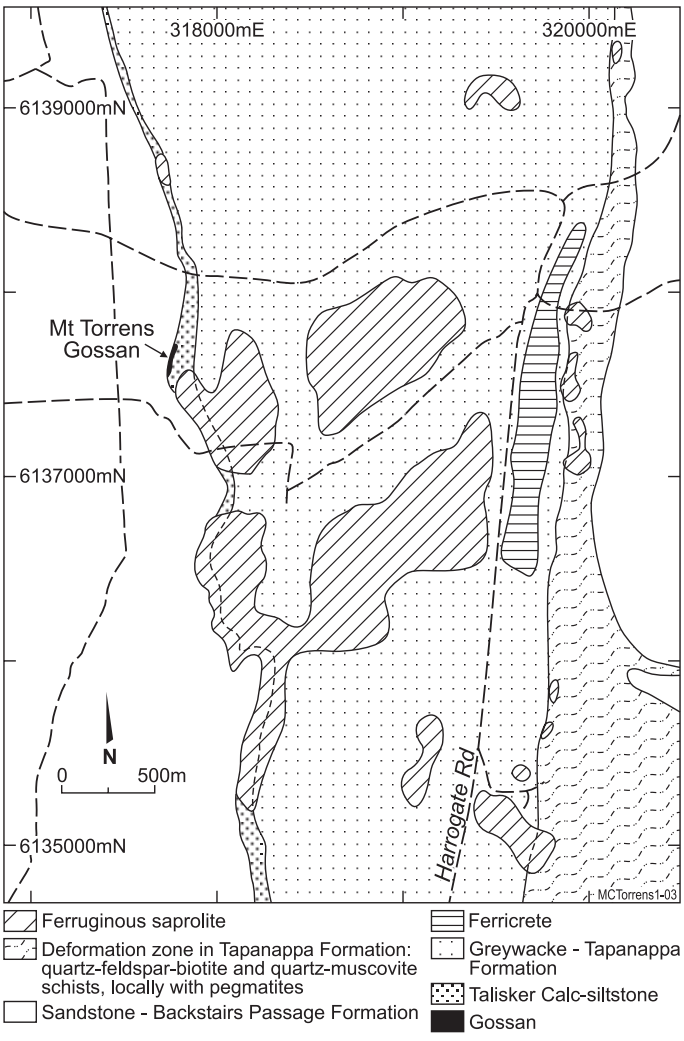

Figure 1. Simplified geological map of the Mount Torrens prospect (after Skwarnecki et al., 2002).

REGOLITH

The area is hilly, with alluvial flats along Dairy Creek and its tributaries. Apart from colluvial-alluvial flats, the regolith-landforms are erosional, and the area is covered by residual soils (Fitzpatrick et al., 1996) derived from Kanmantoo Group lithologies. Ferruginous saprolite occurs on low hills on the Tapanappa Formation and Talisker Calc-silicate and on the western slopes of hills to the E of the Harrogate road. Ferricrete, cementing colluvium-alluvium, occurs locally along valley floors.

MINERALIZATION

Under the soil anomaly, there are three main units within the Talisker Calc-siltstone at the Mount Torrens prospect. These are i) interbedded biotite-muscovite schists and biotite quartzites (Nairne Pyrite Member) that are typically pyritic, ii) garnetiferous, pyritic quartzite with biotite, muscovite, calcite, hyalophane and plagioclase, locally with minor, generally remobilized galena and sphalerite; and iii)a basal finely-bedded calc-silicate unit with massive to disseminated pyrite, sphalerite and galena, and colourless spessartite, scapolite, epidote/clinozoisite, hyalophane, plagioclase, biotite and calcite. Chlorite selvedges occur along sulphide zones. The mineralized zone at the base of the Talisker Calc-siltstone is 10 m thick and 450 m long, and varies from disseminated (barren) to massive (mineralized) pods comprising pyrite (50-70%), galena (10-25%) and sphalerite (5-10%).

REGOLITH EXPRESSION

The weathered mineralized zone is a gossan. Boxworks, after barren pyrite-rich mineralization, occur locally. In the bed of Dairy Creek, a galena-rich vein has been weathered to cerussite. In general, the gossans consist of hematite and goethite (locally with adsorbed Pb), with variable amounts of plumbojarosite, plumbogummite, cerussite, anglesite, jarosite, natrojarosite, kaolinite, gypsum, quartz, anatase, halite, iodargyrite, gorceixite, native Au and Ag. Anomalous concentrations of Ag, As, Au, Bi, Cu, Mo, Pb, S, Sb, Se, Tl, U and Zn occur in the gossans. Relative to fresh ore, the gossans appear to be enriched in Ag, As, Au, Bi, Cu, Mo, Pb, Sb and U, and significantly depleted in Cd, Mn and Zn.

Arsenic, Ba, Bi, Cd, Cu, P, Pb, Sn, Tl and Zn are anomalous in ferruginous saprolite, saline acid sulphate soils and secondary Fe and Al

oxide gels from seeps, hardened Fe-Al-Si crusts and iron-rich mottles in soils (Skwarnecki et al., 2002). These elements have dispersed laterally for distances of up to 750 m from the mineralized zone. Plumbojarosite and plumbogummite occur in jarositic mottles in sulphidic material above the mineralized zone, but are absent from similar materials lateral to mineralization.

Bulk stream-sediment sampling (<180 µm fraction; English, 1977) over parts of the 1:63 630 Adelaide and Mannum sheets yielded several Pb anomalies (Figure 2), mainly along the Nairne Pyrite Member. The most prominent anomaly (2100 ppm Pb) occurred in Dairy Creek, a short distance downstream from the outcropping cerussite-rich vein. These anomalies are locally associated with Cu and Zn concentrations in stream sediments at or above threshold (92 and 90 ppm respectively).

Bulk augered soil sampling by CRAE (upper size fraction not specified) has defined an anomaly in Pb and Cu about 2 km long and up to 100 m wide over the mineralized zone in the Talisker Calc-silicate and over the Nairne Pyrite Member. A Zn anomaly occurs to the E.

Anomalous concentrations of Cu, Mo, Pb and Zn in groundwater (Giblin et al., 1994) indicate the mineralization, with lateral dispersion of Cu, Mo and Zn up to 1000 m. Dispersion of Pb is more limited (400 m).

Within the area of Figure 1, sampling of acid sulphate soils (Skwarnecki *et al.*, 2002) indicated that these soils along the mineralized trend locally contain plumbojarosite or plumbogummite and contain greater concentrations of Bi, Cd, Cu, In, Mo, Pb, Tl and Zn relative to those soils lateral to mineralization. At the prospect scale, a geochemical halo up to 750 m in width occurs around the mineralization and is defined by anomalous concentrations of As, Ba, Bi, Cd, Cu, P, Pb, Sn, Tl and Zn in Fe oxide gels and black sulphidic material.

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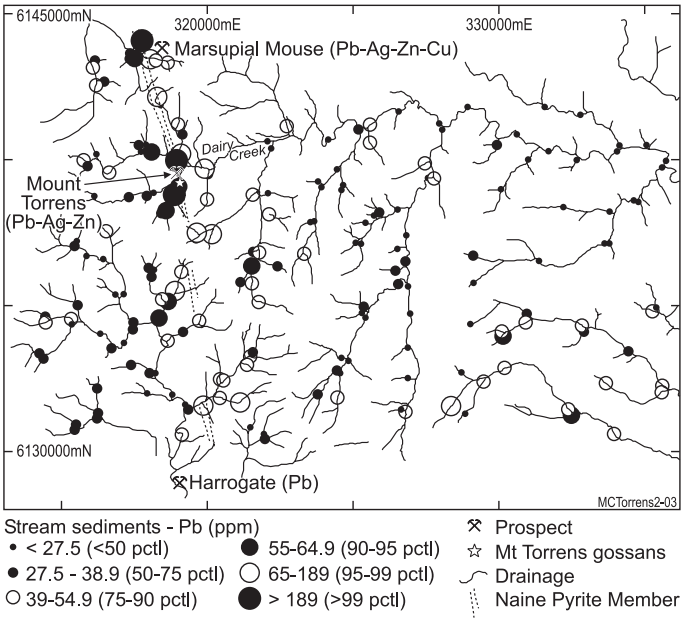

Figure 2. Distribution of Pb (ppm) in stream sediment samples (from Skwarnecki et al., 2002; data from English 1977).

SAMPLE MEDIA - SUMMARY TABLE

Sample medium	*Indicator elements*	*Analytical methods*	*Detection limits (ppm)*	*Background[2] (ppm)*	*Threshold[2] (ppm)*	*Maximum anomaly (ppm)*	*Dispersion distance (m)*
Primary mineralization	Ag	probably AAS,	1	<1	<1	63	anomalous
	Cu	digestion	2	45	217	17000	concentration
	Pb	unknown	5	24	467	142000	s restricted to
	Zn			75	430	77000	ore zones
	As					600	(<10)
	Bi	ICP-MS/ICP-				10	
	Cd	OES, mixed				1950	
	Mn	acid digest				4900	
	Mo					24	
	Sb					10	
	Tl					88	
Gossans	Ag	Au: AAS,	0.1	39	81	100	anomalous
	As	graphite	0.5	440	1200	9900	concentration
	Au	furnace, on	0.001	0.008	0.0125	0.0355	s restricted to
	Bi	aqua regia	0.1	2.8	7.5	25.5	the gossans
	Cu	digest;	2	2500	5050	7250	(<10)
	Mo	other	0.1	79	125	270	
	Pb	elements:	0.5	1400	28200	243000	
	S	ICP-MS/ICP-	50	1900	37200	60100	
	Sb	OES, on	0.5	1.25	10	36.5	
	Se	mixed acid	0.5	4	6.5	11.5	
	Tl	digest	0.1	1.8	36.5	68	
	U		0.02	4.5	13	15.5	
	Zn		0.5	155	320	2100	
B/C horizon augered soil bulk fraction by CRAE	Cu	probably AAS;	2	27.5	107.5	1220	100
	Pb	digestion	5	29.6	278	16100	100
	Zn	unknown	2	17.5	70.1	1900	100
B horizon <180 µm fraction soil by ESSO	As	probably AAS;	2	6.1	17.6	240	100
	Cu	digestion	2	9.1	27.5	195	150
	Pb	unknown	4	13.5	65.2	3500	200
	Zn		2	11.2	47.5	260	100
Regional stream sediments by CRAE	Cu	probably AAS;	2	7	30	200	300
	Pb	digestion	20	28	54	2100	700
	Zn	unknown	5	15.5	35	450	300
Groundwater[1]	Cu	ICP-MS	0.0002	insufficient	insufficient	0.1306	1000
	Mo		0.0002	data	data	0.0042	1000
	Pb		0.0002			0.0599	400
	Zn		0.0002			1.891	1000
Sulphidic materials from saline acid sulfate seeps[1]	As	ICP-MS/ICP-	0.5	7.75	20.5	55	100
	Ba	OES, on	5	410	590	800	600
	Bi	mixed acid	0.1	0.23	0.55	1	600
	Cd	digest	0.1	<0.1	0.24	0.6	100
	Cu		2	11	24	32	600
	P		5	165	370	550	600
	Pb		0.5	30	95	200	600
	Sn		0.1	1.7	4	12	600
	Tl		0.1	0.5	0.76	0.9	600
	Zn		0.5	19	54	67	750
Ferruginous saprolite	Ag	Au: AAS,	0.1	0.26	20	59	50
	As	graphite	0.5	70	1300	3100	50
	Au	furnace, on	0.001	0.0032	0.0108	0.0275	50
	Bi	aqua regia	0.1	0.6	11	21.5	30
	Cu	digest;	2	150	1070	2150	50
	Mo	other	0.1	7.1	70	230	60
	Pb	elements:	0.5	67	11200	33500	50
	S	ICP-MS/ICP-	50	1300	48000	80400	50
	Sb	OES, on	0.5	0.8	10.1	33	60
	Se	mixed acid	0.5	2.6	6.9	37.5	60
	Tl	digest	0.1	0.3	14	56	50
	U		0.02	3	6.8	9.5	50
	Zn		0.5	24	102	360	50
Hardened crusts of acid sulphate soils[1]	Ag	ICP-MS/ICP-	0.1	0.22	0.5	1.7	insufficient
	As	OES, on	0.5	26.5	60	77	data
	Bi	mixed acid	0.1	0.21	0.6	1.5	
	Mo	digest	0.1	1.8	3.2	5	
	Pb		0.5	16	110	240	
	S		50	1375	7200	23400	
	Se		0.5	<0.5	1.6	2.5	
	Zn		0.5	17	60	79	
Fe and Al oxide gels[1]	As	ICP-MS/ICP-	0.5	12	170	850	250
	Ba	OES, on	5	275	500	950	50
	Bi	mixed acid	0.1	<0.1	0.21	0.4	70
	Cd	digest	0.1	0.45	3	21	70
	P		5	285	5000	14700	70
	Pb		0.5	20.5	35	59	70
	Tl		0.1	0.28	2.5	9.5	70
	Zn		0.5	26.5	1000	1200	70

[1] based on very limited data. [2]Background determined as the 50th percentile and threshold as the 90th percentile