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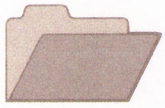

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GEOCHEMICAL ORIENTATION SOIL-LAG TRAVERSE AT THE EDWARDS CREEK BASE-METAL PROSPECT, STRANGWAYS RANGE, NORTHERN TERRITORY

M.S. Skwarnecki and S.J. Fraser

CRC LEME OPEN FILE REPORT 84

January 2002

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(CSIRO Exploration and Mining Report 747R/CRC LEME Report 149R, 2000.
Second impression 2002)

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CRC LEME is an unincorporated joint venture between CSIRO-Exploration & Mining, and Land & Water, The Australian National University, Curtin University of Technology, University of Adelaide, University of Canberra, Geoscience Australia, Bureau of Rural Sciences, Primary Industries and Resources SA, NSW Department of Mineral Resources-Geological Survey and Minerals Council of Australia.
Headquarters: CRC LEME c/o CSIRO Exploration and Mining, PO Box 1130, Bentley WA 6102, Australia

This report presents outcomes of research by CRC LEME for Gutnick Resources NL as support for their search for Witwatersrand style Au deposits in the Ngalia and Amadeus basins, Northern Territory. The Project was commenced in April 1999, concluded in 2000 and was led by Dr I.D.M. Robertson. Agreement was reached between Gutnick Resources NL and CRC LEME on 19th December 2001 to release CRC LEME Reports 144R, 148R and 149R into the public domain through the CRC LEME Open File Report series. It is intended that publication of the reports will be an additional factor in transferring technology to aid the Australian mineral industry.

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PREFACE AND EXECUTIVE SUMMARY

This study is part of a collaborative research initiative between Gutnick Resources N.L. and CRC LEME. The CRC provided a geochemical and regolith research background to a major exploration program being undertaken by Gutnick Resources N.L. for Witwatersrand-style gold mineralization in the sediments of the Ngalia and Amadeus Basins. The objectives were to map and characterise the regolith within the Amadeus and Ngalia basins at reconnaissance and local scales and to understand its development. Then, to translate this into sampling and exploration strategies. This report covers an orientation study around a small base metal deposit to investigate dispersion of a large range of pathfinder elements into the lag and soil, contributing to more informed decisions on exploration techniques.

At the Edwards Creek Prospect, Au-poor base-metal mineralisation consists of disseminated sphalerite, galena, chalcopyrite and pyrite in marble, enveloped in gneisses of the Strangways Metamorphic Complex. Soil-lag samples were collected along a traverse across the gossan. Seven size fractions for each sample were analysed for a broad range of elements by ICP. Silver, As, Bi, Cu, Mn, Mo, Pb, S, Sb, Se, Sn, W and Zn indicate the mineralised zone. The best responses for Ag, Bi, Cu, Mn, Mo, Pb, S, Sb and Se are in the 6-2 mm fraction, Sn and W are best displayed 1-0.25 mm fractions and Au by the <75 μm fraction. The responses for As and Zn are similar in all fractions. The preferred sampling medium is the 6-2mm fraction of the soil, although the <6 mm fraction is a satisfactory compromise which would simplify sample preparation.

Weathering is slight and dispersion is largely mechanical. Dispersion from the mineralisation is limited, many elements displaying single-point anomalies. A few, notably Cu, Pb and Zn show a slight rise in concentrations in samples adjacent to the single maximum. Dispersions are 40-50 m wide at best and in some cases substantially less. This emphasises the need for closely-spaced samples to detect small targets in such an erosional terrain.

I.D.M. Robertson
Project Leader

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ABSTRACT

At the Edwards Creek Prospect, base-metal mineralisation occurs in Yambah granulite within the Strangways Metamorphic Complex. Disseminated sphalerite, galena, chalcopyrite and pyrite occur in marble, enveloped by cordierite quartzite and cordierite-garnet-quartz-sillimanite-biotite gneisses. These rocks occur within a regional package of quartzofeldspathic gneisses, felsic and mafic granulites, and amphibolites.

Seven soil-lag samples were collected along a traverse 175 m in length across the gossan. The lag consisted dominantly of gossan, cordierite quartzite, felsic gneisses, pegmatite, and mafic granulite. Seven size fractions (bulk <6 mm, 6-2 mm, 2-1 mm, 1-0.5 mm, 0.5-0.25 mm, 0.25 mm-75µm, and <75 µm) for each sample were analysed for Ag, As, Au, Bi, Ca, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Rb, S, Sb, Sn, Te, U, W, and Zn by ICP-MS and ICP-OES, following mixed acid digest (except Au and Hg: dissolution in aqua regia).

The mineralised zone is characterised by anomalous Ag, As, Bi, Cu, Mn, Mo, Pb, S, Sb, Se, Sn, W and Zn. The best responses for Ag, Bi, Cu, Mn, Mo, Pb, S, Sb and Se are in the coarsest fraction (6-2 mm) whereas, for Sn and W, the best fractions are the intermediate (1-0.5 mm and 0.5-0.25 mm). For Au, the best response is in the <75 µm fraction. For As and Zn, the response is somewhat similar in each fraction.

The results indicate that, overall, the best responses are in the coarse and intermediate fractions (commonly the 6-2 mm fraction). The preferred sampling medium would be the 6-2 mm fraction, although a compromise would be the <6 mm fraction, which would simplify sample collection. Au search would require the <75 µm fraction.

Weathering is slight and dispersion is largely mechanical, as shown by the optimum coarse fractions. Dispersion from the mineralisation is very limited. Many elements display single-point anomalies, directly over the strike extension of the mineralisation, but a few, notably Cu, Pb and Zn show a slight rise in concentrations in samples adjacent to the single maximum. Dispersions are 40-50 m wide at best and in some cases substantially less. This emphasises the need for closely-spaced samples to detect small targets in such an erosional terrain.

1. INTRODUCTION

1.1 Location

The Edwards Creek Prospect is located about 60 km north-northeast of Alice Springs, in low hills along the northern margin of the Strangways Range at 23° 00'37", 134°01'31" (Figure 1).

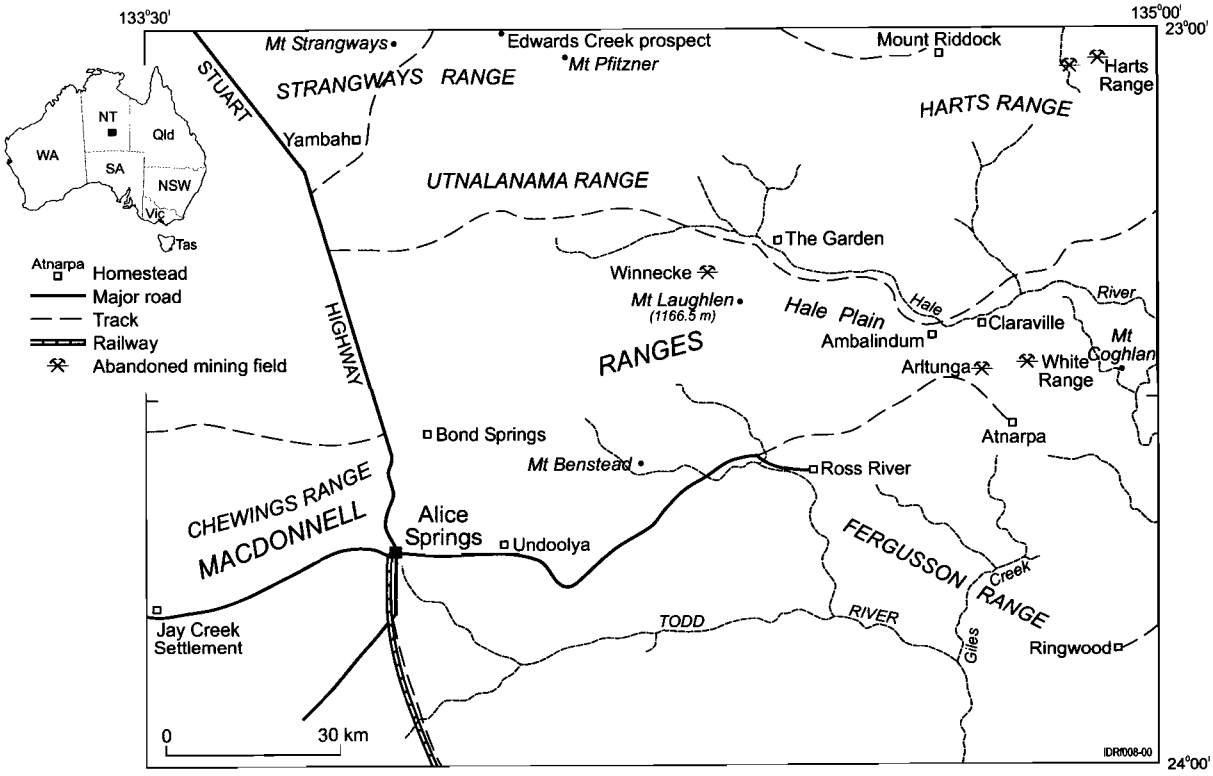


Figure 1. Location map of the Edwards Creek Prospect.

1.2 Objectives

The objectives of the soil-lag orientation traverse were to:

(i) determine the geochemical signature of the mineralisation;
(ii) establish the best sampling procedure.

2. GEOLOGICAL SETTING

At the Edwards Creek Prospect, base-metal mineralisation similar to that at Oonagalabi (Warren and Shaw, 1985) is hosted by rocks tentatively assigned to the Yambah granulite (Shaw and Langworthy, 1984). The Yambah granulite, which occurs in the central part of the Strangways Metamorphic Complex, has been assigned to Division 1 of the Central Zone of the Arunta Province (Shaw and Langworthy, 1984).

The geology of the prospect has been described by Warren and Shaw (1985; Figure 2) and the following summary is taken partly from that account. Outcrops with Cu, Pb and Zn minerals occur over a strike of 1 km along the western limb and northern axial zone of an upright south-plunging synform. A prominent siliceous 'gossan' (with malachite staining) occurs along the crest of a ridge (Figures 3 and 4). The gossan may be a true gossan, or a siliceous zone over sulfide-bearing marble as at the Pb-Zn occurrence 200 m south of the gossan (Figure 2).

Here, marble with disseminated fine-grained pyrite, chalcopyrite and galena, and very coarse-grained, honey-brown sphalerite is capped by a thin layer of silicified material.

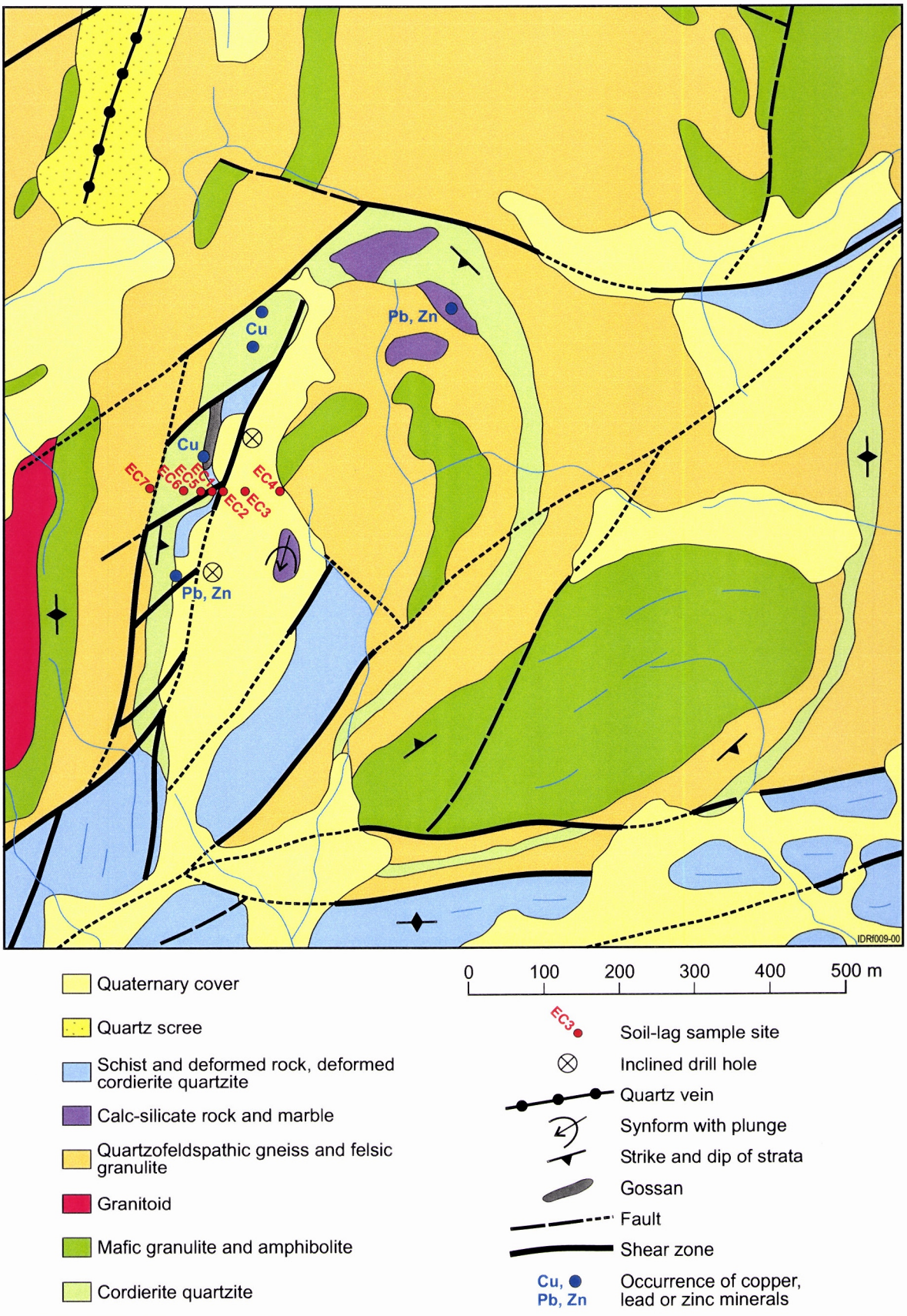


Figure 2 . Geological map of the area surrounding the Edwards Creek Prospect (after Warren and Shaw, 1985), showing soil-lag samples.

The nearby country rocks are cordierite quartzites and, not visible in outcrop but intersected by drilling, cordierite-garnet-quartz-sillimanite-biotite gneisses. These occur within a regional sequence of quartzofeldspathic gneisses, felsic and mafic granulites, and amphibolite (Figure 2).

3. REGOLITH GEOLOGY

The Edwards Creek prospect occurs in a watershed. First-order creeks run parallel to north-striking ridges at the prospect and flow into larger east-west and north-south, second-order drainages. The larger, second-order creeks drain into two main, north-south creeks, Mueller Creek in the east and Edwards Creek in the west, which drain northwards into the Sandover River. The valley floors of the second-order creeks contain alluvial deposits.

The gossan is on the crest of a prominent north-striking ridge, which slopes steeply to the west and shallowly to the east, where the hill slope is mantled by thin, patchy colluvium. There appears to be little or no deeply-weathered regolith preserved in the area and the terrain belongs to an erosional regime. The surface lag is derived from lithologies which outcrop locally (mafic granulite, amphibolite, felsic gneiss and granulite, marble, quartzite, gossan).

4. SAMPLE COLLECTION AND PREPARATION

Seven samples were collected from a traverse across the gossan. The mid-point of the traverse (sample EC1) was collected adjacent to the gossan. The other samples (see Appendix 1) were collected over a distance of 175 m across strike (Figure 2), at sample spacing of 10-15 m close to the gossan, expanding to 25-50 m further out.

Lag was swept from the surface with a plastic brush and pan and about 0.3 kg of the 6-2 mm fraction was screened out (plastic and nylon sieves) and bagged on site. At the same site, soil was sampled from a shallow hole (to 20 cm depth) from which about 0.3 kg of bulk sample (<6 mm) and about 2 kg of <2 mm material were collected. The <2 mm fraction was further sieved in the laboratory (also using plastic/nylon sieves) into 2-1 mm, 1-0.5 mm, 0.5-0.25 mm, 0.25 mm-75 µm, and <75 µm fractions. A reference sample of each fraction was retained. A 100 g aliquot of each fraction was milled to <75 µm using a low-contamination K1045 ring mill (Robertson et al., 1996) with quartz washes between samples.

Soil pH was measured at each sample site using the soil pH test kit, developed by CSIRO and produced by Inoculo Laboratories in Melbourne.

5. GEOCHEMICAL ANALYSIS

5.1 Digestion and analysis

The milled aliquots were analysed in random order by inductively coupled plasma mass spectrometry (ICP-MS) and optical emission spectrometry (ICP-OES) by UltraTrace in Perth. The respective element suites were:

(i) Au, Hg: digestion in aqua regia (mixture of nitric and hydrochloric acids) on a nominal 40 g sample, and analysis by ICP-MS;
(ii) ICP-MS suite (Ag, As, Bi, Mo, Pb, Rb, Sb, Se, Sn, Te, U, W): sample digestion with hydrochloric, nitric and hydrofluoric acids, with a final dissolution in hydrochloric acid (mixed acid digest);
(iii) ICP-OES suite (Ca, Cu, Cr, Fe, K, Mg, Mn, Na, Ni, S, Zn): sample digestion with hydrochloric, nitric and hydrofluoric acids, with a final dissolution in hydrochloric acid (mixed acid digest).

Figure 3. A general view of the siliceous gossan along the crest of the ridge at the Edwards Creek Prospect. The gossan has formed over marble with disseminated galena, sphalerite, pyrite and chalcopyrite

Figure 4. A close-up view of the siliceous gossan at the Edwards Creek Prospect showing malachite staining which has been derived from the weathering of chalcopyrite in the underlying marble. Malachite occurs as small patches coating the gossan or along fractures. Malachite staining is the only visible evidence for sulphides at depth.

5.2 Quality control

Pulped in-house weathered rock reference materials (CSIRO Standards 6 and 9) were placed into the analytical stream to monitor precision. The results are given in Appendix 3 and indicate that the replicate analyses are generally in good agreement with preferred values.

6. SOIL-LAG GEOCHEMISTRY

6.1 Background and peak concentrations

Background and peak values for the elements in each fraction (Table 1) were estimated from the graphs of element distributions along the traverse (Figures 5A-X). Sample populations are small, so the results should be treated with caution.

6.2 Lag lithologies

The lag types on the traverse comprise:

(i) fragments of gossan, abundant over the gossan outcrop, but decreasing with distance down the eastern slope. Rare on the western slopes of the ridge;
(ii) cordierite quartzite lag, along the steep western slope and in the vicinity of the gossan. None noted on the eastern slope;
(iii) felsic gneisses, on the eastern slope of the ridge;
(iv) minor quartz-feldspar-mica pegmatite. This may be responsible for the Mo-W-U peaks on the western slope;
(v) quartz (rare, adjacent to the gossan), amphibole-chlorite schist (minor amounts in the vicinity of the gossan, on the eastern slope), and mafic granulite (common, at the eastern end of the traverse).

6.3 Geochemistry

6.3.1 Elements associated with mineralisation (Ag, Au, As, Bi, Cu, Mn, Mo, Pb, S, Sb, Se, Sn, W, Zn)

Dispersion from the gossan is limited. Many elements display single point anomalies directly over the gossan but, because some peaks are extreme, they tend to mask slight rises in adjacent samples. This is particularly evident for Cu, Pb and Zn. Dispersions are only about 40-50 m wide at best and, in some cases, probably substantially less.

Silver

All concentrations are below the lower limit of detection (0.5 ppm), except for a single point peak in all fractions except for samples in the bulk <6 mm, 2-1 mm, 1-0.5mm and 0.5-0.25 mm fractions over the gossan (Figure 5A) with maxima of 0.5-1.0 ppm.

Arsenic

A weak peak occurs over the gossan (Figure 5B) in all fractions except 0.5-0.25 mm and 0.25 mm-75 μm. Peak concentrations vary between 5.5 and 8.5 ppm over a background between 3 and 4.5 ppm. The best anomaly contrast occurs in the coarser fractions.

Gold

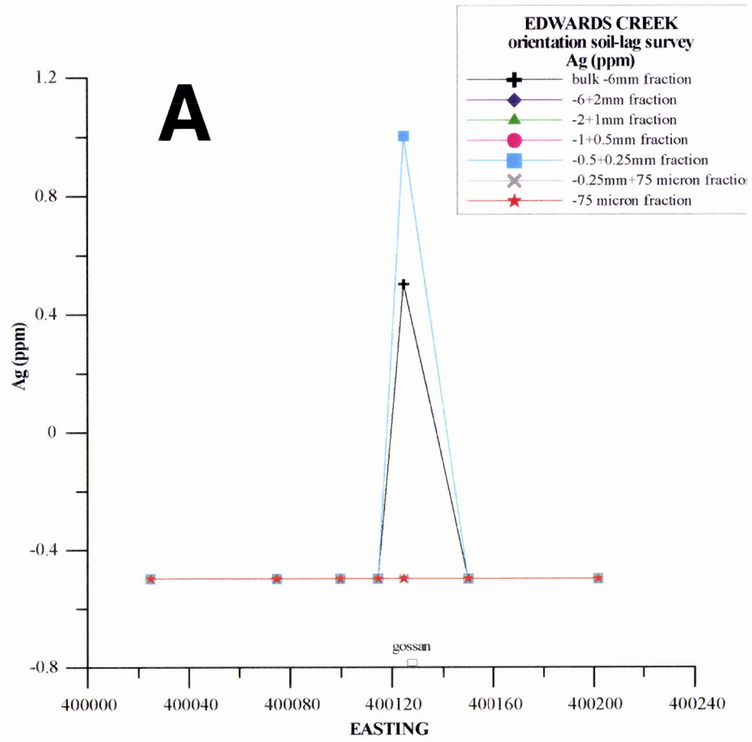
An ill-defined and weak single point peak in Au concentrations occurs over the gossan (Figure 5C), only in the <75 μm fraction (a peak of 4.5 ppb over a background of about 1 ppb or less).

Bismuth

A distinct single point peak occurs in the same sample on the gossan (Figure 5D), with maxima of 8.1-15.9 ppm over a background of less than 2 ppm. Concentrations are similar for each fraction, although the greatest contrast is in the bulk <6 mm and coarsest fractions.

Table 1
Edwards Creek Prospect - soil and lag
Peak and background concentrations for mineralisation-associated elements

Element	Units	bulk <6 mm		6-2 mm		2-1 mm		1-0.5 mm		0.5-0.25 mm		0.25 mm-75 mm		< 75 mm	
		background	peak	background	peak	background	peak	background	peak	background	peak	background	peak	background	peak
Ag	ppm	<0.5	<0.5	<0.5	1	<0.5	1	<0.5	1	<0.5	1	-	-	-	-
As	ppm	3	8.5	3	6	4	6.5	4	5.5	4	4	4	4.5	4.5	5.5
Au	ppb	<1	2.25	<1	1.5	<1	1.5	<1	?	<1	2	<1	2	<1	4.5
Bi	ppm	<1	15.9	<1	11.3	0.6	11.4	0.7	10.9	1.5	10.3	1.2	8.1	1.7	10.3
Cu	ppm	<50	930	<50	907	<50	897	<50	960	<50	923	<50	764	<60	884
Mn	ppm	<1000	3750	<1000	5570	<1000	5750	<1000	4850	<1000	3920	<1000	2460	<1000	1370
Mo	ppm	1	2.2	1.4	3.4	1	3.2	1	3	1.2	2.4	1	1.6	1	1.4
Pb	ppm	<50	1410	<25	2320	<25	2050	<25	1690	<25	1220	<50	669	<50	566
S	ppm	70	120	100	250	60	100	60	100	60	140	70	150	110	170
Sb	ppm	0.2	0.6	0.2	1.2	0.2	0.8	0.2	0.8	0.2	0.6	0.2	0.4	0.2	0.6
Se	ppm	4	36	3	26	4	24	4	19	6	17	7	15	6	13
Sn	ppm	5	11	4	8	5	7	5	8	5	11	5	12	5	9
W	ppm	<5	9.5	<5	9.5	<5	10.5	<5	17	<5	21.5	<5	12.5	<5	11.5
Zn	ppm	<300	7280	<200	5130	<250	6090	<250	8450	<300	10300	<350	9060	<350	7410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-0.25mm+75 micron fractio
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Ag (ppm)
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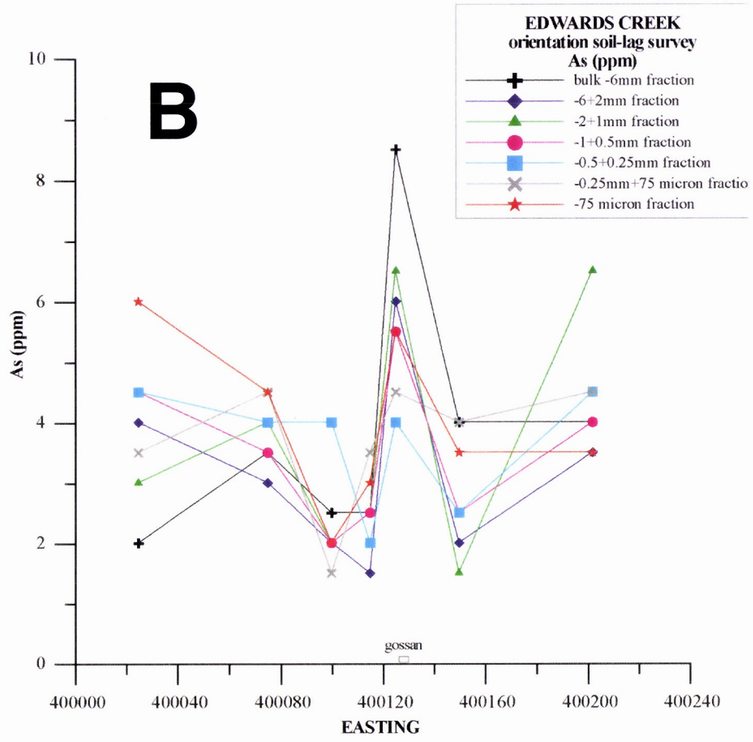
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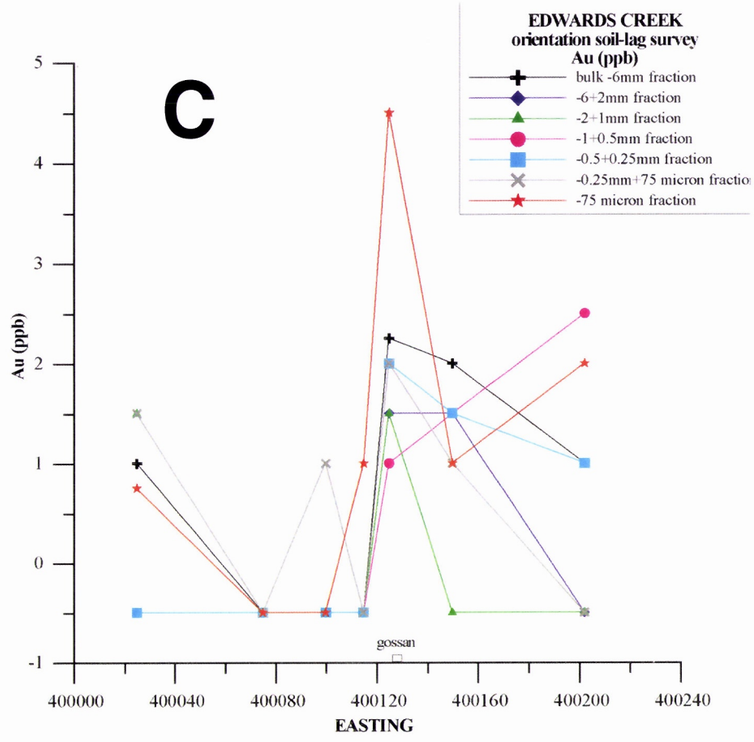
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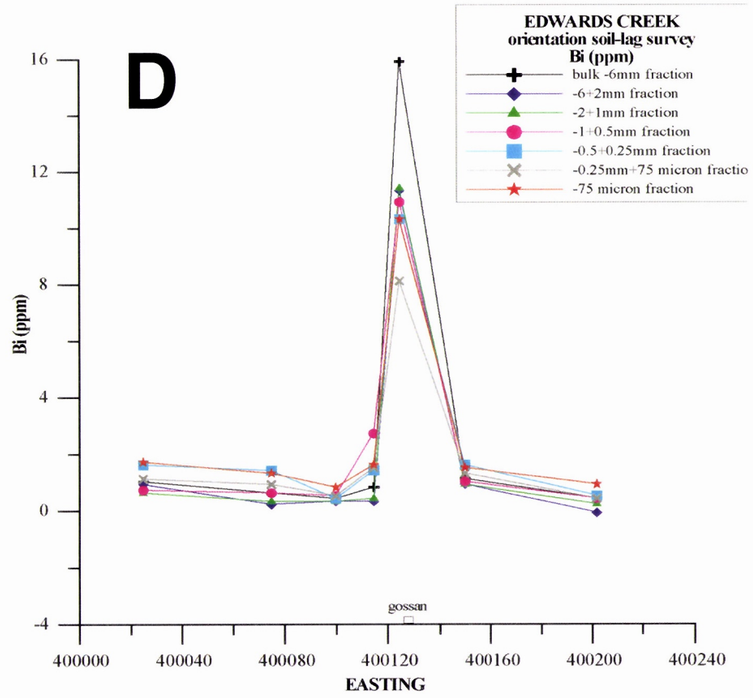
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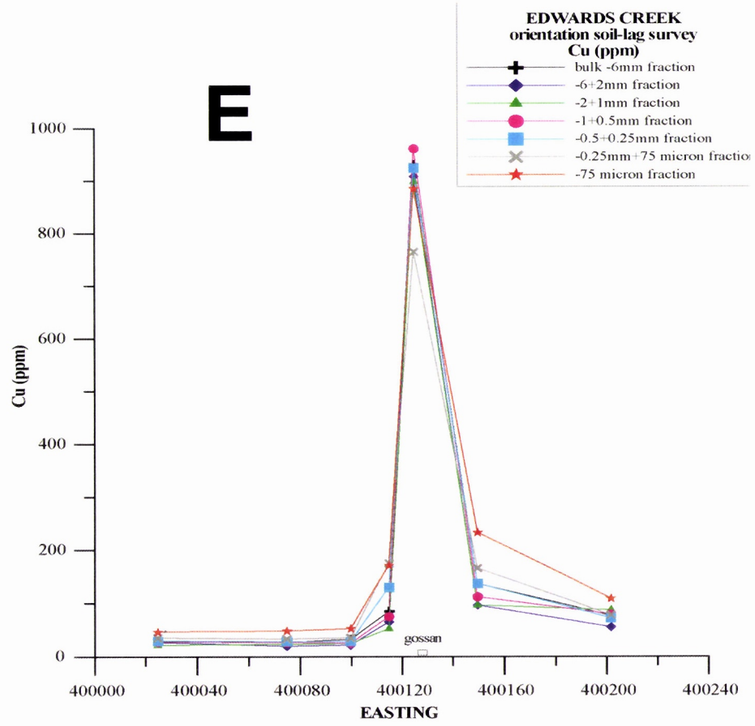
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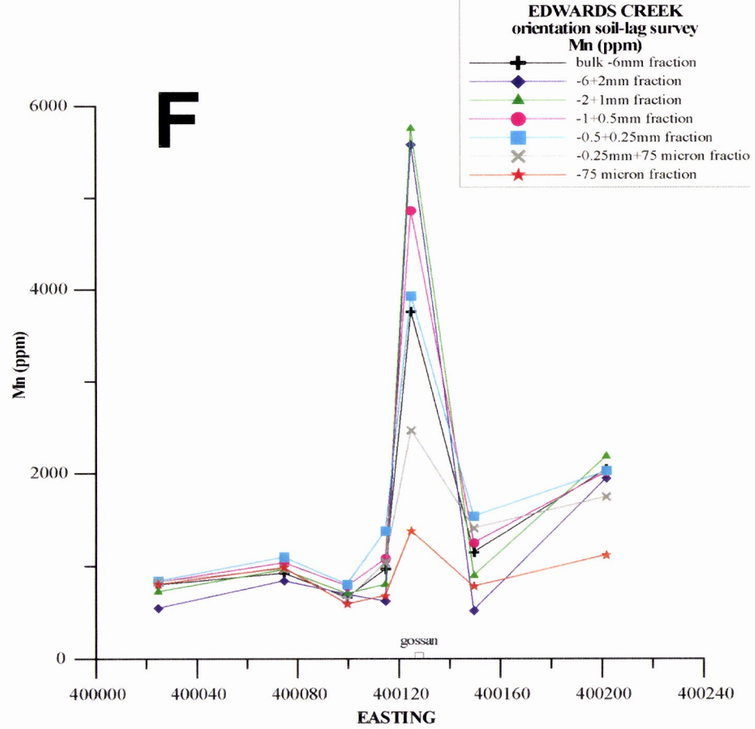
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Mn (ppm)
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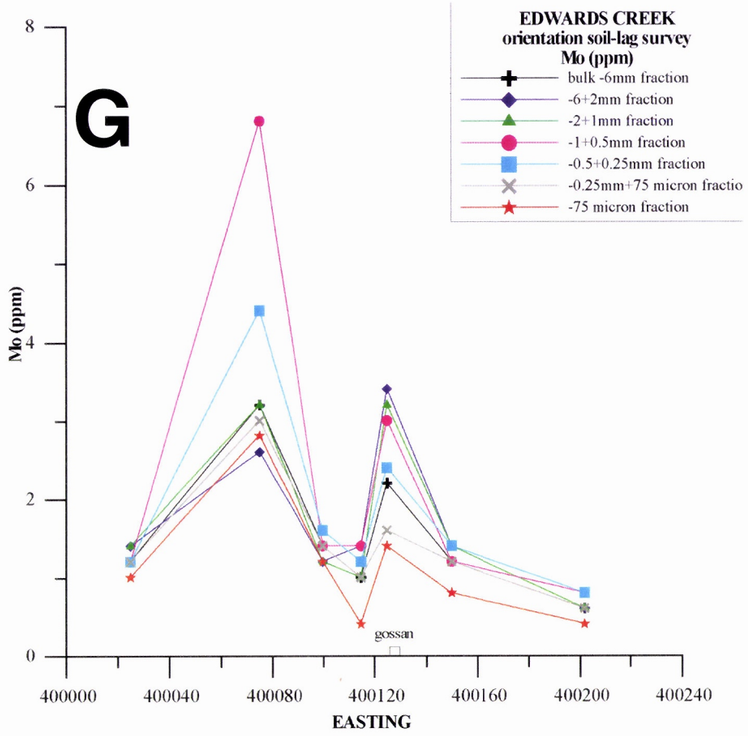
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-0.25mm+75 micron fractio
-75 micron fraction
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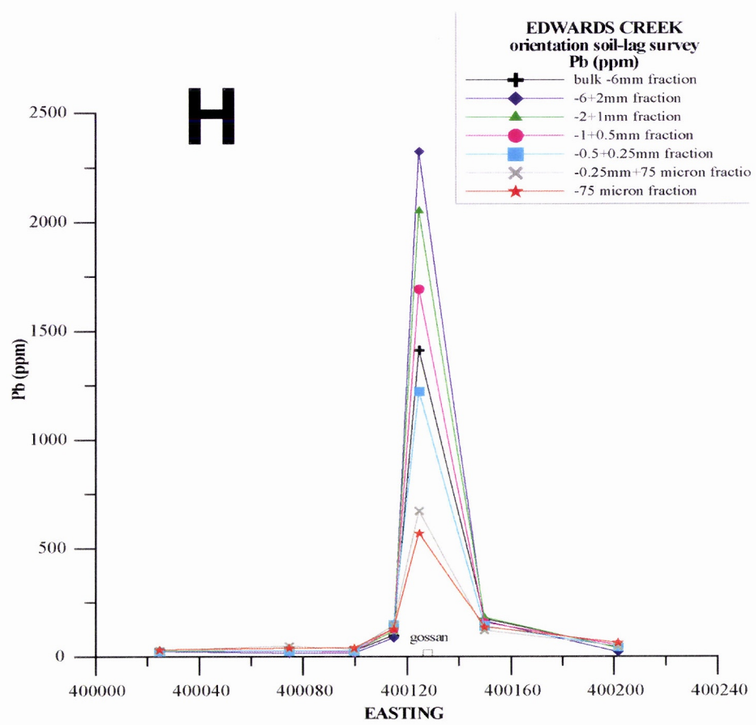
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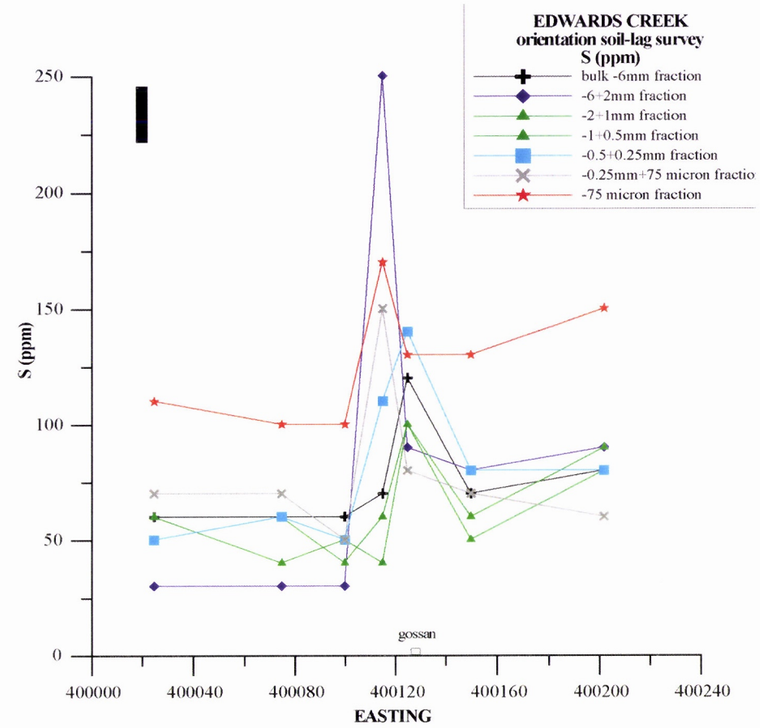
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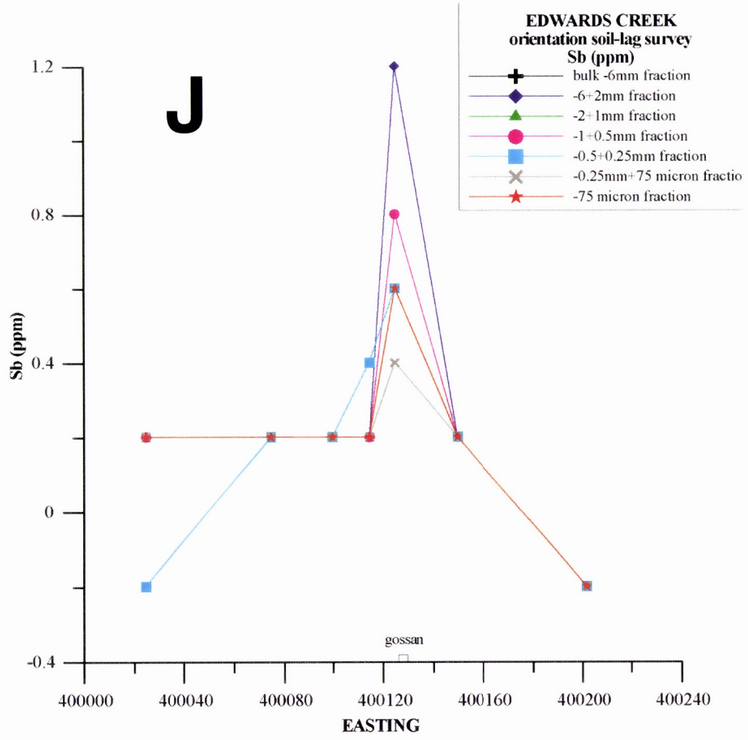
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-75 micron fraction
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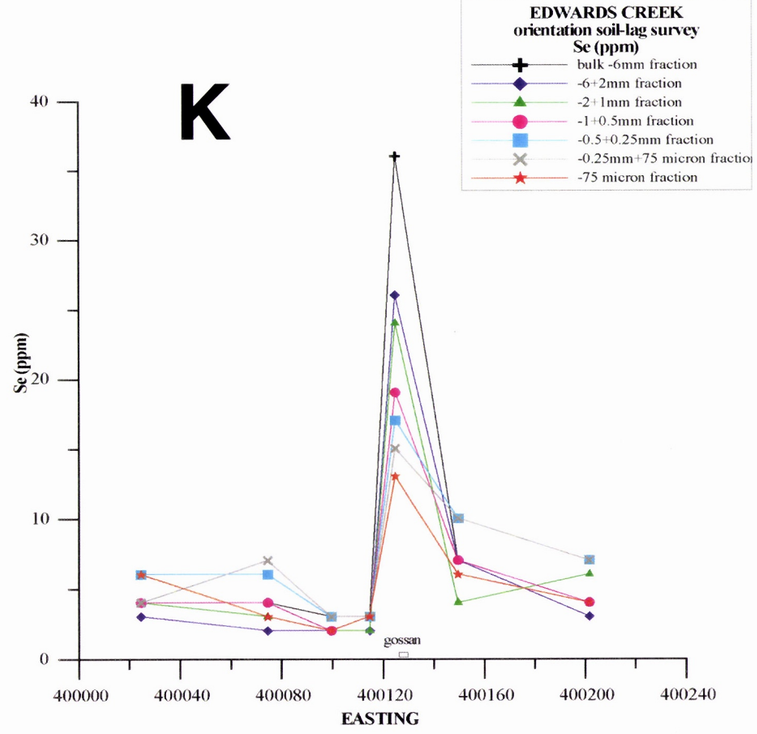
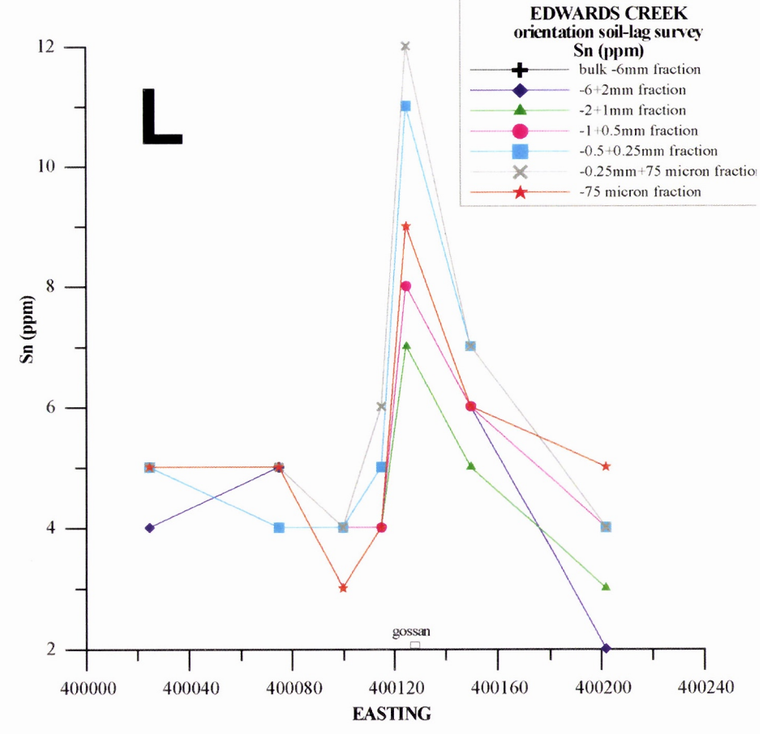
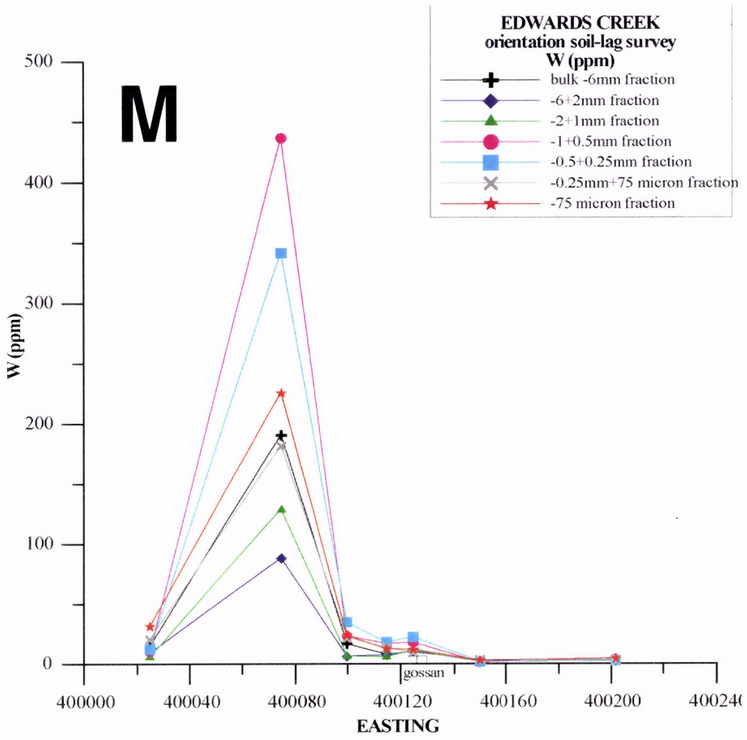
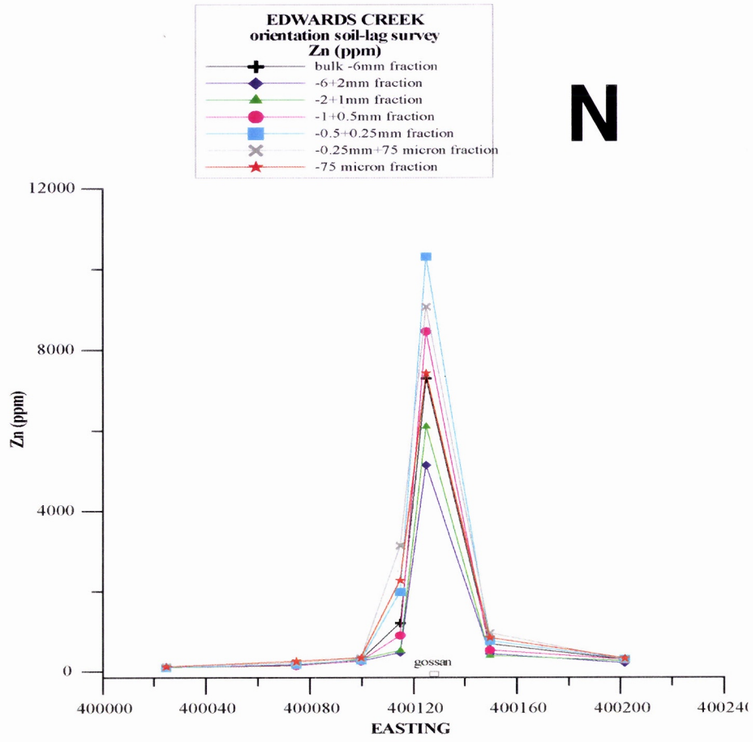
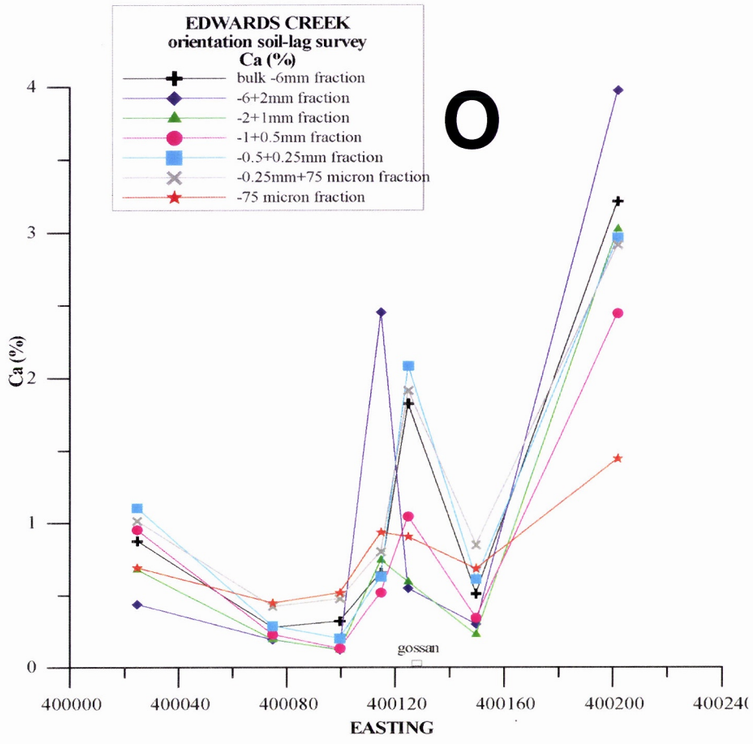
EASTING
gossan

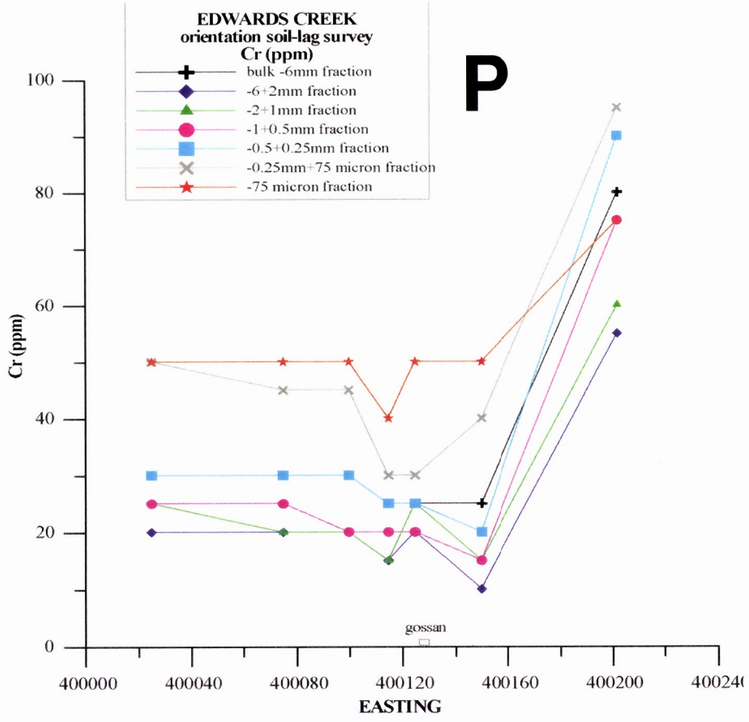

K
EDWARDS CREEK
orientation soil-lag survey
Se (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fractio
-75 micron fraction
Se (ppm)
0
10
20
30
40
400000
400040
400080
400120
400160
400200
400240
EASTING
gossan

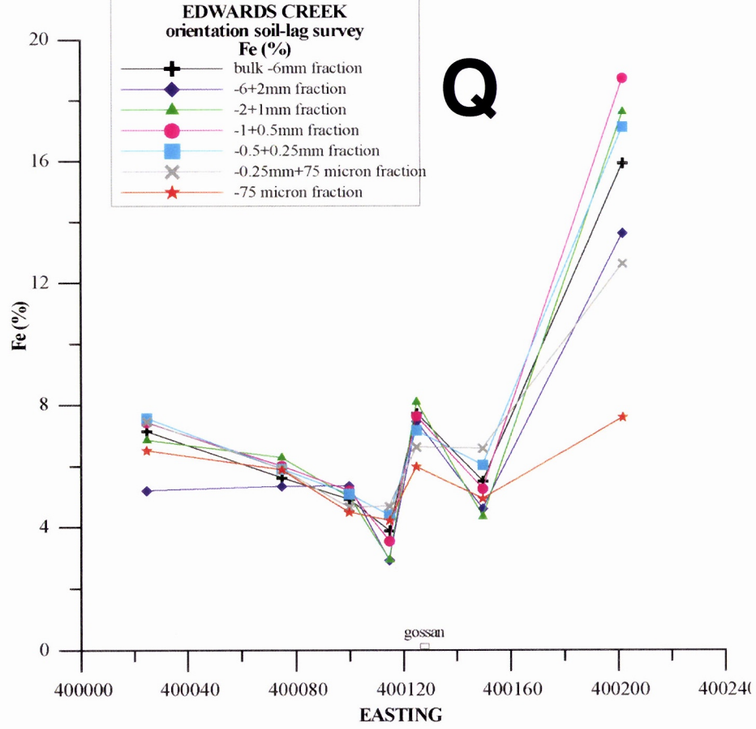

L
EDWARDS CREEK
orientation soil-lag survey
Sn (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fractio
-75 micron fraction
Sn (ppm)
2
4
6
8
10
12
400000
400040
400080
400120
400160
400200
400240
EASTING
gossan

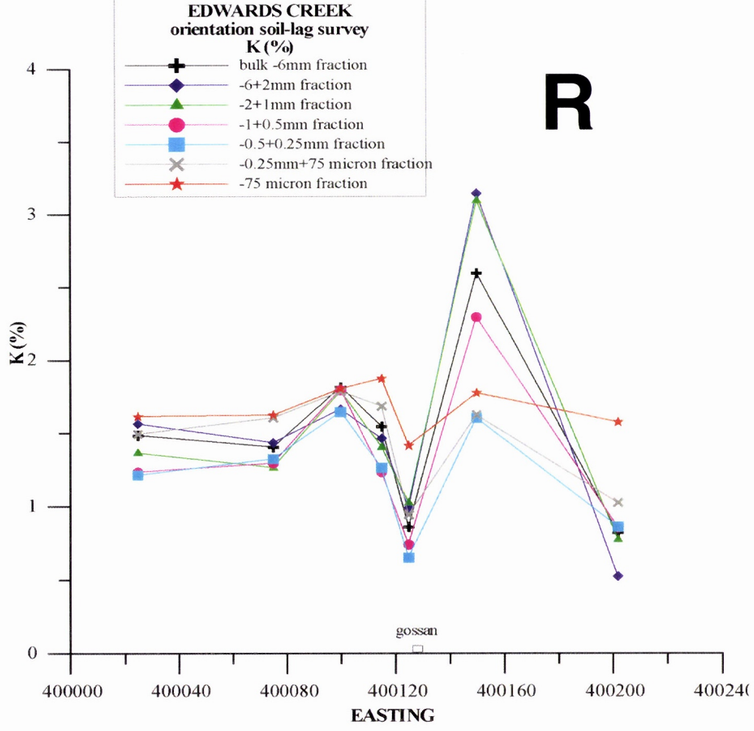

M
EDWARDS CREEK
orientation soil-lag survey
W (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
W (ppm)
EASTING
gossan


N
EDWARDS CREEK
orientation soil-lag survey
Zn (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
Zn (ppm)
EASTING
gossan

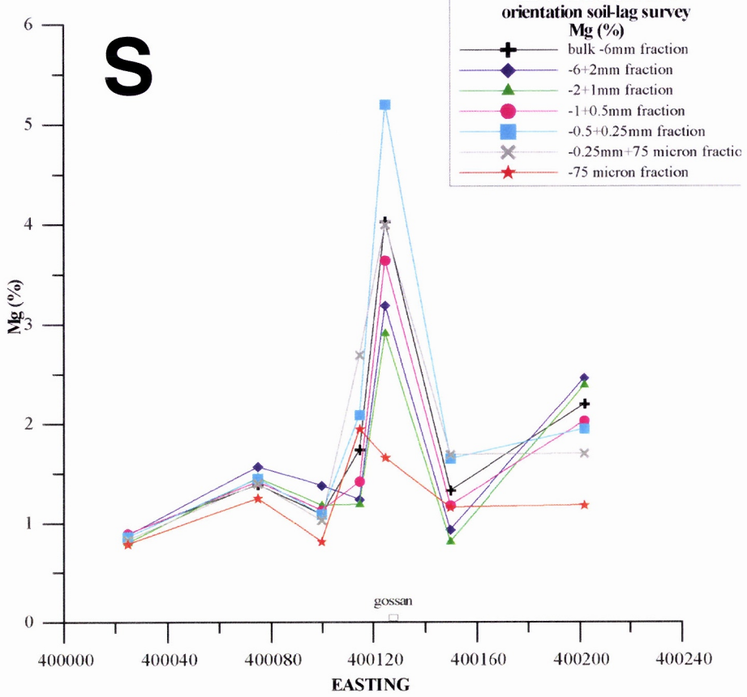

O
EDWARDS CREEK
orientation soil-lag survey
Ca (%)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
Ca (%)
EASTING
gossan


P
EDWARDS CREEK
orientation soil-lag survey
Cr (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
Cr (ppm)
EASTING
gossan

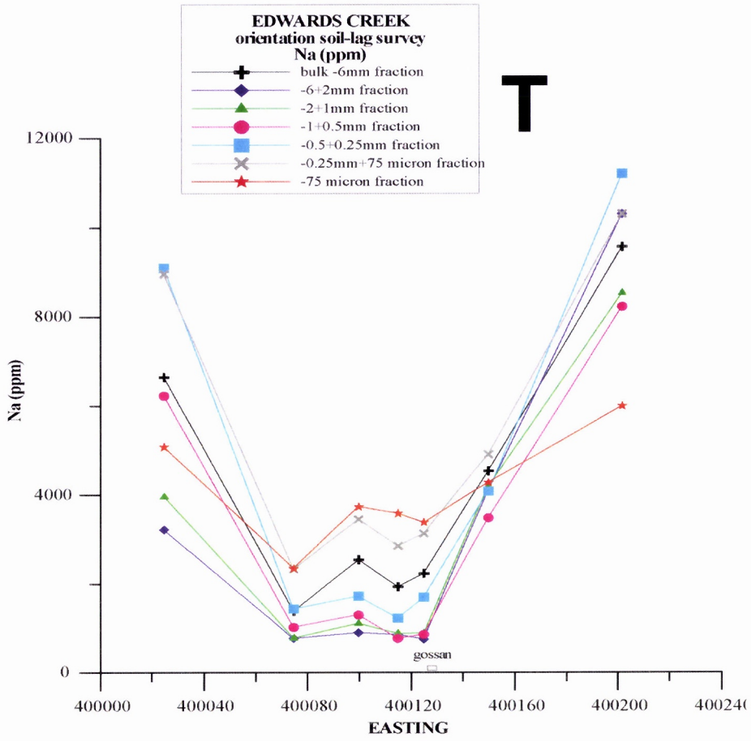

Q
EDWARDS CREEK
orientation soil-lag survey
Fe (%)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
Fe (%)
EASTING
gossan


R
EDWARDS CREEK
orientation soil-lag survey
K (%)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
K (%)
EASTING
gossan

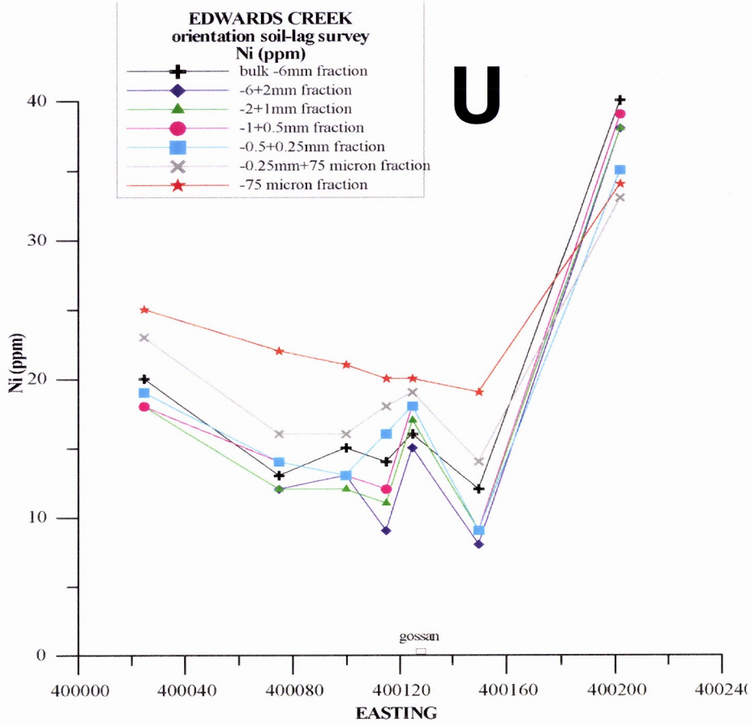
S


EDWARDS CREEK
orientation soil-lag survey
Mg (%)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fractio
-75 micron fraction
Mg (%)
EASTING
gossan

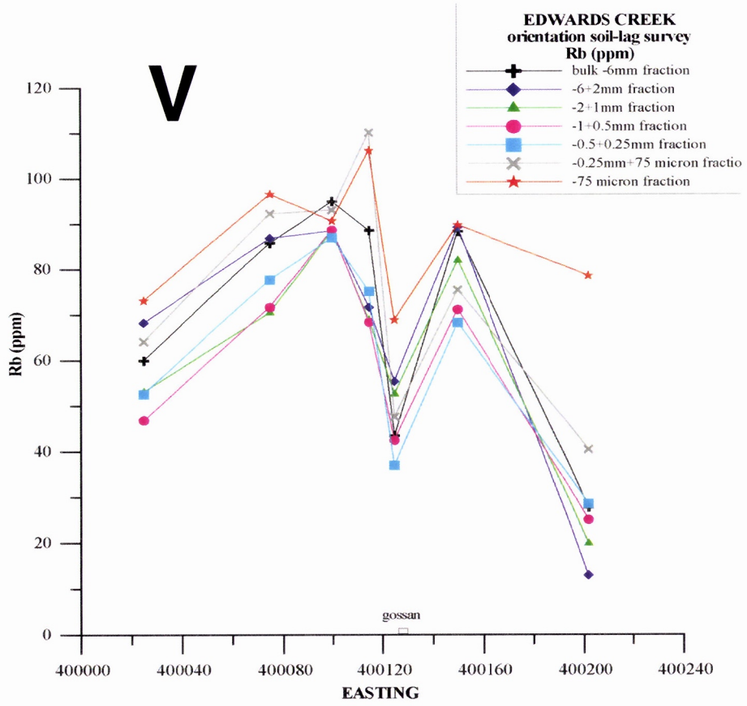
T


EDWARDS CREEK
orientation soil-lag survey
Na (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
Na (ppm)
EASTING
gossan

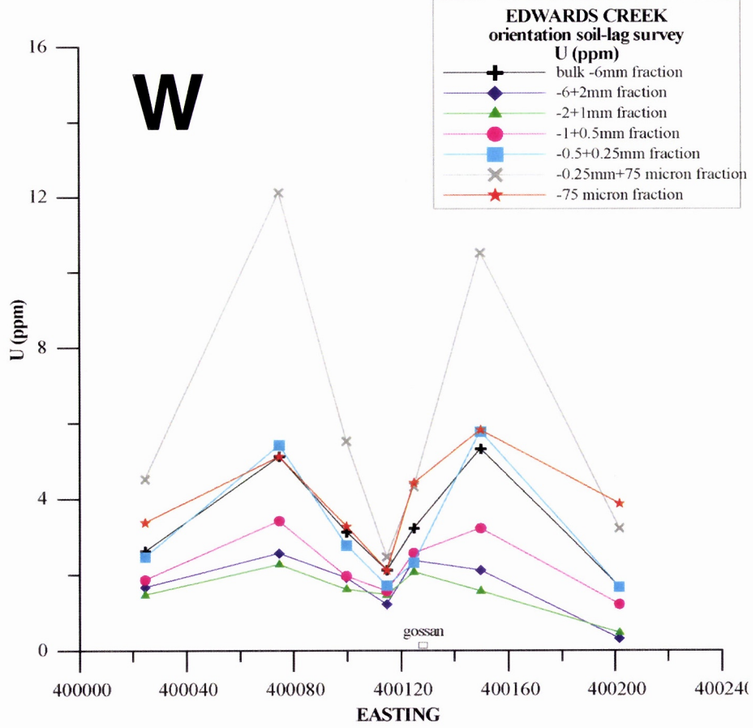
U


EDWARDS CREEK
orientation soil-lag survey
Ni (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
Ni (ppm)
EASTING
gossan

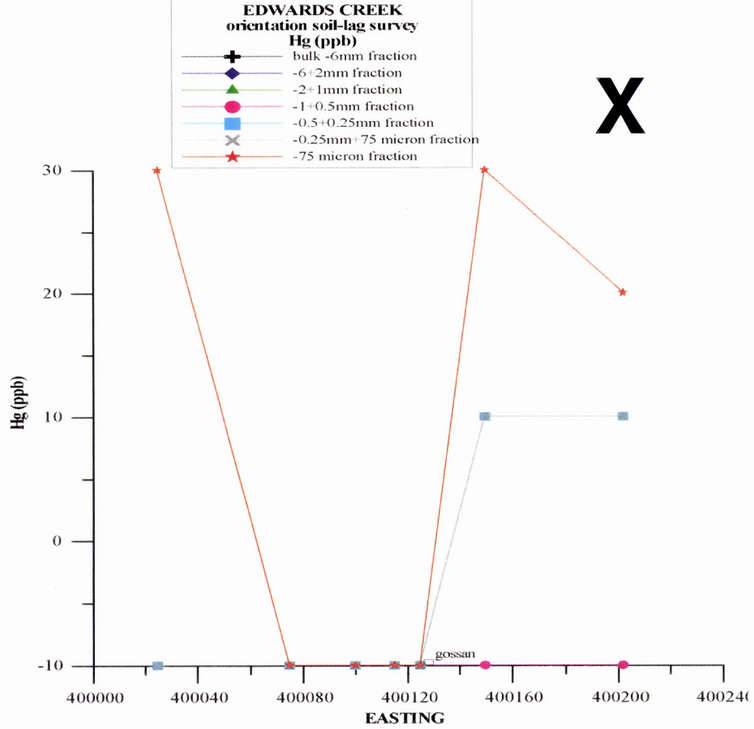
V


EDWARDS CREEK
orientation soil-lag survey
Rb (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fractio
-75 micron fraction
Rb (ppm)
EASTING
gossan

W


EDWARDS CREEK
orientation soil-lag survey
U (ppm)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
U (ppm)
EASTING
gossan

X


EDWARDS CREEK
orientation soil-lag survey
Hg (ppb)
bulk -6mm fraction
-6+2mm fraction
-2+1mm fraction
-1+0.5mm fraction
-0.5+0.25mm fraction
-0.25mm+75 micron fraction
-75 micron fraction
Hg (ppb)
EASTING
gossan

Copper

There is a prominent peak (764-960 ppm) over the gossan and a significant rise above background in the adjoining samples (Figure 5E), compared to backgrounds (<60 ppm). The response tends to be slighter greater in the coarser fractions.

Manganese

Manganese shows a peak over the gossan (Figure 5F), with significant concentrations in the coarse fractions but not in the finer fractions (<.25 mm). This suggests an association of Mn with the sulfidic horizon (cf. Broken Hill).

Molybdenum

Molybdenum shows two peaks (Figure 5G): a small, single point peak over the gossan and a larger peak about 45 m to the west of the gossan (which may be related to a previously unreported occurrence of scheelite in pegmatite). The Mo probably occurs in the scheelite (as an intermediate member of the scheelite-powellite series), rather than as a discrete Mo mineral (such as molybdenite). Over the gossan, the greatest Mo concentrations occur in the coarse fractions, whereas over the scheelite-bearing horizon, the greatest concentration is in the 1-0.5 mm fraction, presumably reflecting the grain size of the scheelite. Over the gossan, peaks range between 1.4 and 3.4 ppm (depending on the size fraction) over backgrounds of less than 1.6 ppm. Peak to background ratios are greatest for the coarse fractions.

Lead

Lead shows a distinct peak over the gossan (Figure 5H) and a slight rise above background in the adjoining samples, with the greatest concentrations in the coarse fractions. Peak concentrations reach 1200-2200 ppm in the 6-0.25 mm fractions, with backgrounds of less than 50 ppm but only reach 500 ppm in the <75 μm fraction. Peak to background ratios are greatest for the 6-2 mm and 2-1 mm fractions.

Sulfur

Sulfur forms a peak over the gossan (Figure 5I). Maxima in the coarsest and the two finest fractions occur 10 m west of the gossan for reasons that are not clear. Background concentrations are greatest in the two fine fractions and they show the least anomaly contrast. The peak to background contrast is greatest for the 6-2 mm fraction (200 ppm).

Antimony

Antimony forms a very weak single point peak over the gossan (Figure 5J), with the peak to background contrast optimum in the 6-2 mm fraction (1.2 in a background of about 0.2 ppm). Background concentrations are difficult to determine but are close to or below the lower detection limit.

Selenium

Selenium forms a prominent single point peak over the gossan (Figure 5K), with the greatest concentrations and peak to background ratios in the 6-2 mm and bulk <6 mm fractions. The least effective is the <75 μm fraction.

Tin

Tin shows a peak over the gossan (Figure 5L), with the greatest concentrations in the fine and intermediate fractions. Peak concentrations are 7-12 ppm in a background of around 5 ppm.

Tungsten

A very strong peak occurs 45 m west of the gossan, corresponding to a prominent Mo peak and possibly related to pegmatite-derived lag (Figure 5M). Greatest concentrations are in the middle fractions, presumably reflecting the dominant grain size of the scheelite. If the data are plotted logarithmically (Figure 6), a small peak may be seen over the gossan on the edge of the larger peak. The peak to background ratios are greatest in the 1-0.5 mm and 0.5-0.25 mm fractions. However, in view of the highly significant interference generated by pegmatites in this area, the value of W is questionable here. Without these, W backgrounds may be as low as 1 ppm with

significant anomalies around such a base metal sulfide deposit reaching 10-20 ppm in the intermediate fractions.

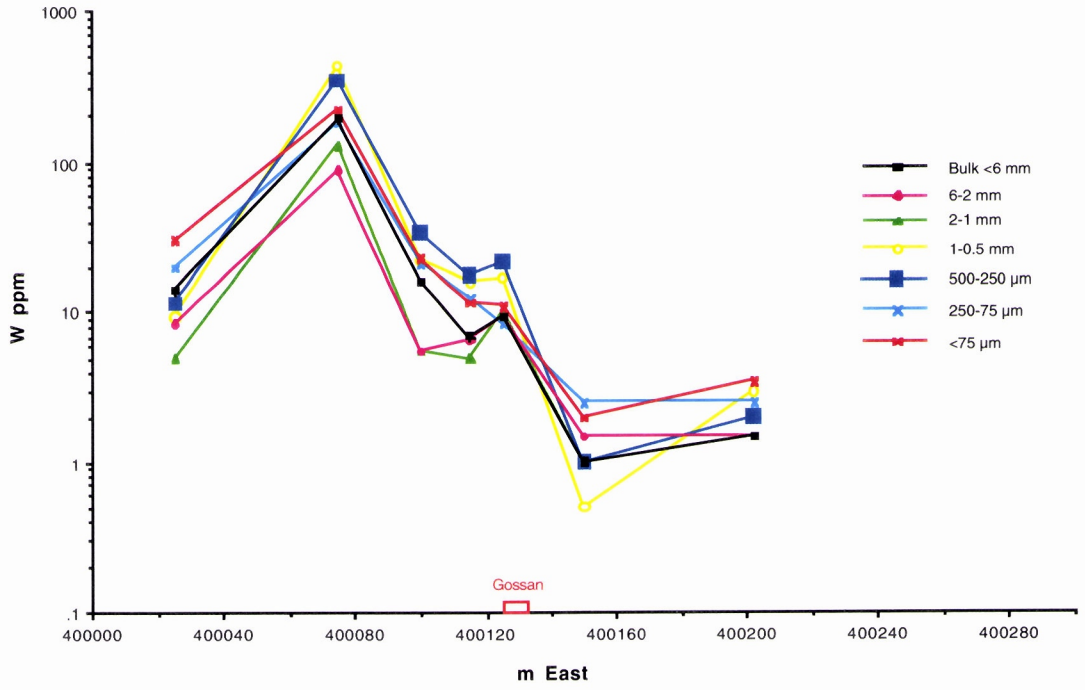


Figure 6. Tungsten concentrations plotted logarithmically to accentuate the peak over the gossan.

Zinc

A very prominent peak occurs over the gossan (Figure 5N). The very high single point maxima on the plot tend to mask an increase in zinc in adjacent samples. The greatest concentrations are in the intermediate and fine fractions, the least in the coarsest fractions. Peak concentrations vary between 5130 and 10300 ppm, over an unusually high background of <400 ppm.

6.3.2 Elements denoting lithology (Ca, Cr, Fe, K, Mg, Na, Ni, Rb, U)

The above elements are closely related to fresh rocks (pegmatite (U), felsic gneiss (Na, K, U), marble (Ca), mafic granulite (Ca, Mg, Fe, Cr, Ni)) outcropping along the traverse or contributing clasts of relatively fresh rock or saprock to the soil. Weathering is relatively unimportant and there is no calcrete.

Calcium

A peak in Ca occurs over the gossan in the intermediate fractions (1-0.5 mm, 0.5-0.25 mm, and 0.25 mm-75 µm; Figure 5O). In the bulk <6 mm, -2+1 mm and <75 µm fractions, the peak occurs 10 m to the west, and is related to marble along strike of the gossan (see Figure 2). The prominent peak at the eastern end of the traverse is due to lag derived from mafic granulite. No calcrete was noted in the samples.

Chromium

Chromium concentrations generally show little variation along the traverse (Figure 5P), apart from a distinct increase at the eastern end of the traverse, where mafic granulite lag is relatively common. Concentrations tend to be greatest in the fine fractions.

Iron
There is only a minor peak in Fe over the gossan (Figure 5Q), but there is a significant increase at the eastern end of the traverse (due to mafic granulite lag). As may be expected, significantly elevated Fe does not occur over this Pb-Zn gossan (cf. the Broken Hill gossans).

Sodium
Sodium concentrations are greatest at the extremities of the traverse (Figure 5T) and appear to be related to felsic gneiss lag. At the ends of the traverse, the greatest Na concentrations are in the intermediate fractions whereas, in the vicinity of the gossan, concentrations are greatest in the fine fractions.

Potassium
Potassium shows a generally flat pattern to the west of the gossan (Figure 5R), a decrease over the gossan, and a peak 20 m east of the gossan where lag derived form felsic gneiss is relatively common. Except where the felsic gneiss lag is common, K concentrations are greatest in the finer fractions.

Rubidium
Rubidium shows a similar pattern to K (Figure 5R) with a decrease over the gossan and at the eastern end of the traverse (where mafic granulite lag is relatively abundant; Figure 5V). Concentrations are generally greatest in the fine fractions.

Magnesium
Magnesium shows a distinct peak over the gossan (Figure 5S), where concentrations are greatest in the intermediate to coarse fractions. Laterally, concentrations are greatest in the coarse fractions. The Mg peak over the gossan is partly due to marble along strike from the gossan, and partly to lag derived from amphibole-chlorite schist.

Nickel
Nickel shows a small peak over the gossan in all except the <75 μm fraction (Figure 5U). The relatively large concentrations at the eastern end of the traverse are probably due to relatively abundant mafic granulite lag. Concentrations are generally greatest in the fine fractions, except at the eastern end of the traverse, where the reverse is the case.

Uranium
Uranium concentrations are greatest in the 0.25 mm -75 μm fraction (Figure 5W). The minor peaks in its distribution appear to be related to relatively abundant pegmatite and felsic gneiss lag.

6.3.3 Elements displaying no systematic distribution (Hg, Te)

The above elements are at very low concentrations, approaching or below detection limits. Their value is in approximating background abundances.

Mercury
Mercury shows no clear pattern in its distribution (Figure 5X). Most samples are below the lower limit of detection (10 ppb). Concentrations appear to be greatest in the finer fractions.

Tellurium
Tellurium concentrations (not plotted) are below the detection limit (0.2 ppm) for all fractions for all samples.

7. CONCLUSIONS

The objective of investigating a Au-poor multi-element base metal prospect was to better understand the dispersion of a broad suite of pathfinders which may be used in the absence of Au

which may be depleted. However, much of this dispersion is mechanical and little is due to weathering.

Soil and lag over the strike extension of the mineralised zone are characterised by elevated concentrations of As, Bi, Cu, Mn, Mo, Pb, S, Sb, Se, Sn, W and Zn; in certain circumstances, Ag and Au may also be anomalous. Gold is at very low concentrations.

The distribution of other elements (Ca, Cr, Fe, K, Mg, Na, Ni, Rb and U) is governed by the dominant lag type. To some extent, this also applies to Mn.

Concentrations tend to be greatest in the coarsest fractions, except for Sn, U and W (in the intermediate fractions) and for Au, Cr, Hg, K, Na, Ni and Rb (in the fine fractions). Concentrations for As, Ca, Fe and Zn are similar in every fraction.

The generally greater concentrations in the coarse fractions (particularly 6-2 mm) would indicate that this is the best sampling medium, inplying dominant mechanical dispersion. However, a compromise fraction would be the <6 mm fraction, which would simplify sample collection and preparation.

8. ACKNOWLEDGEMENTS

Sample sieving was by P. Thornley and milling was by J.F. Crabb. T. Naughton prepared colour artwork. I.D.M. Robertson and C.R.M. Butt provided critical review of the manuscript. All this assistance is acknowledged with appreciation.

9. REFERENCES

Robertson, I.D.M., Dyson, M., Hudson, E.G., Crabb, J.F., Willing, M.J., and Hart, M.K.W., 1996 A case-hardened, low contamination ring mill for multi-element geochemistry. Journal of Geochemical Exploration 57: 153-158.

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APPENDIX 1

DESCRIPTION OF SAMPLE SITES

APPENDIX 1
Descriptions of sample sites

Sample No	Easting	Northing	Soil pH	Sample description
EC1	400115	7455085	6.5-7	Pale orange-brown, sandy soil, with abundant gossan lag; minor amphibole-chlorite schist, quartz and cordierite quartzite lag
EC2	400125	7455085	6	Pale greyish orange-brown soil, with common gossan and gneiss, and minor quartz and amphibole-chlorite schist, lag
EC3	400150	7455085	6	Greyish orange-brown soil, with quartz and quartz-feldspar-mica pegmatite lag; minor gossan and jasper lag
EC4	400202	7455085	7	Greyish orange-brown soil with quartz, quartz-feldspar-mica pegmatite and mafic granulite lag; close to mafic granulite outcrop
EC5	400100	7455085	6.5	Greyish orange-brown soil, close to outcrop of cordierite quartzite; rare quartz lag
EC6	400075	7455085	5	Orange-brown soil, close to outcrop of cordierite quartzite; minor quartz and quartz-feldspar-mica pegmatite lag
EC7	400025	7455085	6.5	Orange-brown soil, close to outcrop of cordierite quartzite; rare gossan lag

APPENDIX 2

TABULATED GEOCHEMISTRY

APPENDIX 2
EDWARDS CREEK - TABULATED GEOCHEMISTRY

Field No	LabSeqNo	LibNo	AMG Easting	coords Northing	Method Element DetnLim Fraction	ICP-MS Au(AR) 0.5 ppb	ICP-MS Ag 0.5 ppm	ICP-MS As 0.5 ppm	ICP-MS Bi 0.1 ppm	ICP-MS Mo 0.2 ppm	ICP-MS Pb 1 ppm	ICP-MS Rb 0.02 ppm	ICP-MS Sb 0.2 ppm	ICP-MS Se 1 ppm	ICP-MS Sn 1 ppm	ICP-MS Te 0.2 ppm	ICP-MS U 0.05 ppm	ICP-MS W 0.5 ppm	ICP-OES Ca 0.001 %	ICP-OES Cu 1 ppm	ICP-OES Cr 5 ppm	ICP-OES Fe 0.01 %	ICP-OES K 0.002 %	ICP-OES Mg 0.001 %	ICP-OES Mn 1 ppm	ICP-OES Na 0.001 %	ICP-OES Ni 1 ppm	ICP-OES S 10 ppm	ICP-OES Zn 1 ppm	ICP-MS Hg(AR) 10 ppb
EC1	L15-312	15-301	400115	7455085	Bulk <6 mm	<0.5	<0.5	2.5	0.8	1	94	88.4	0.2	3	5	<0.2	2.1	7	0.652	84	25	3.86	1.54	1.73	959	0.192	14	70	1190	-10
EC1	L15-348	15-302	400115	7455085	6-2 mm	<0.5	<0.5	1.5	0.3	1.4	83	71.5	0.2	2	4	<0.2	1.2	6.5	2.45	64	15	2.9	1.46	1.23	614	0.083	9	250	455	-10
EC1	L15-331	15-303	400115	7455085	2-1 mm	<0.5	<0.5	2.5	0.4	1	114	68.7	0.2	2	4	<0.2	1.45	5	0.74	51	15	2.92	1.4	1.18	795	0.086	11	40	508	-10
EC1	L15-308	15-304	400115	7455085	1-0.5 mm	<0.5	<0.5	2.5	2.7	1.4	126	68.2	0.2	3	4	<0.2	1.55	16	0.514	74	20	3.52	1.23	1.41	1070	0.075	12	60	884	-10
EC1	L15-323	15-305	400115	7455085	500-250 µm	<0.5	<0.5	2	1.4	1.2	143	75	0.4	3	5	<0.2	1.7	17.5	0.624	129	25	4.37	1.26	2.08	1370	0.121	16	110	1970	-10
EC1	L15-344	15-306	400115	7455085	250-75 µm	<0.5	<0.5	3.5	1.5	1	141	110	0.2	3	6	<0.2	2.45	12.5	0.797	174	30	4.66	1.68	2.68	1030	0.284	18	150	3120	-10
EC1	L15-337	15-307	400115	7455085	<75 µm	1	<0.5	3	1.6	0.4	122	106	0.2	3	4	<0.2	2.1	11.5	0.931	170	40	4.2	1.87	1.94	672	0.357	20	170	2260	-10
EC2	L15-318	15-308	400125	7455085	Bulk <6 mm	2.25	<0.5	8.5	15.9	2.2	1410	43.3	0.6	36	11	<0.2	3.2	9.5	1.82	930	25	7.7	0.854	4.02	3750	0.222	16	120	7280	-10
EC2	L15-353	15-309	400125	7455085	6-2 mm	1.5	1	6	11.3	3.4	2320	55.2	1.2	26	8	<0.2	2.35	9.5	0.544	907	20	7.43	0.986	3.18	5570	0.073	15	90	5130	-10
EC2	L15-324	15-310	400125	7455085	2-1 mm	1.5	1	6.5	11.4	3.2	2050	52.4	0.8	24	7	<0.2	2.05	10.5	0.589	897	25	8.07	1.02	2.9	5750	0.087	17	100	6090	-10
EC2	L15-309	15-311	400125	7455085	1-0.5 mm	1	1	5.5	10.9	3	1690	42.3	0.8	19	8	<0.2	2.55	17	1.04	960	20	7.6	0.734	3.63	4850	0.084	18	100	8450	-10
EC2	L15-345	15-312	400125	7455085	500-250 µm	2	1	4	10.2	2.4	1220	36.8	0.6	17	11	<0.2	2.3	21.5	2.08	923	25	7.14	0.646	5.19	3920	0.168	18	140	10300	-10
EC2	L15-316	15-313	400125	7455085	250-75 µm	2	<0.5	4.5	8.1	1.6	669	47.4	0.4	15	12	<0.2	4.3	8.5	1.91	764	30	6.59	0.938	3.99	2460	0.312	19	80	9060	-10
EC2	L15-342	15-314	400125	7455085	<75 µm	4.5	<0.5	5.5	10.2	1.4	566	68.7	0.6	13	9	<0.2	4.4	11	0.901	884	50	5.95	1.41	1.65	1370	0.337	20	130	7410	-10
EC3	L15-335	15-315	400150	7455085	Bulk <6 mm	2	<0.5	4	1.1	1.2	170	88.2	0.2	7	7	<0.2	5.3	1	0.506	136	25	5.48	2.59	1.32	1140	0.453	12	70	667	-10
EC3	L15-305	15-316	400150	7455085	6-2 mm	1.5	<0.5	2	0.9	1.4	160	89.1	0.2	7	6	<0.2	2.1	1.5	0.294	95	10	4.58	3.14	0.922	512	0.409	8	80	422	-10
EC3	L15-322	15-317	400150	7455085	2-1 mm	<0.5	<0.5	1.5	0.9	1.4	177	81.8	0.2	4	5	<0.2	1.55	1	0.222	95	15	4.32	3.09	0.803	889	0.418	9	50	376	-10
EC3	L15-350	15-318	400150	7455085	1-0.5 mm	1.5	<0.5	2.5	1	1.2	153	71	0.2	7	6	<0.2	3.2	0.5	0.337	111	15	5.23	2.29	1.17	1240	0.347	9	60	514	-10
EC3	L15-313	15-319	400150	7455085	500-250 µm	1.5	<0.5	2.5	1.6	1.4	138	68.1	0.2	10	7	<0.2	5.75	1	0.607	136	20	6.01	1.6	1.64	1530	0.407	9	80	750	10
EC3	L15-349	15-320	400150	7455085	250-75 µm	1	<0.5	4	1.3	1.2	118	75.3	0.2	10	7	<0.2	10.5	2.5	0.842	165	40	6.55	1.62	1.68	1400	0.49	14	70	940	10
EC3	L15-311	15-321	400150	7455085	<75 µm	1	<0.5	3.5	1.5	0.8	133	89.6	0.2	6	6	<0.2	5.8	2	0.68	232	50	4.91	1.77	1.15	774	0.427	19	130	824	30
EC4	L15-332	15-322	400202	7455085	Bulk <6 mm	1	<0.5	4	0.4	0.6	36	27.6	<0.2	4	4	<0.2	1.65	1.5	3.21	75	80	15.9	0.814	2.19	2040	0.956	40	80	269	10
EC4	L15-340	15-323	400202	7455085	6-2 mm	<0.5	<0.5	3.5	<0.1	0.6	17	12.8	<0.2	3	2	<0.2	0.3	1.5	3.97	54	55	13.6	0.52	2.45	1940	1.03	38	90	188	-10
EC4	L15-319	15-324	400202	7455085	2-1 mm	<0.5	<0.5	6.5	0.2	0.6	35	19.7	<0.2	6	3	<0.2	0.45	1.5	3.02	86	60	17.6	0.768	2.38	2180	0.853	38	80	238	-10
EC4	L15-325	15-325	400202	7455085	1-0.5 mm	2.5	<0.5	4	0.4	0.8	49	24.9	<0.2	4	4	<0.2	1.2	3	2.44	78	75	18.7	0.85	2.02	2010	0.822	39	90	269	-10
EC4	L15-301	15-326	400202	7455085	500-250 µm	1	<0.5	4.5	0.5	0.8	41	28.4	<0.2	7	4	<0.2	1.65	2	2.96	71	90	17.1	0.856	1.94	2020	1.12	35	80	288	10
EC4	L15-351	15-327	400202	7455085	250-75 µm	<0.5	<0.5	4.5	0.4	0.6	44	40.3	<0.2	7	4	<0.2	3.2	2.5	2.91	77	95	12.6	1.02	1.69	1740	1.03	33	60	274	10
EC4	L15-343	15-328	400202	7455085	<75 µm	<0.5	<0.5	3.5	0.9	0.4	60	78.4	<0.2	4	5	<0.2	3.85	3.5	1.44	108	75	7.56	1.57	1.17	1110	0.599	34	150	310	20
EC5	L15-321	15-329	400100	7455085	Bulk <6 mm	<0.5	<0.5	2.5	0.4	1.4	22	94.8	0.2	3	4	<0.2	3.1	16	0.316	31	30	4.89	1.81	1.08	657	0.253	15	60	277	-10
EC5	L15-338	15-330	400100	7455085	6-2 mm	<0.5	<0.5	2	0.3	1.2	12	88.3	0.2	2	4	<0.2	1.9	5.5	0.119	20	20	5.32	1.66	1.37	689	0.088	13	30	235	-10
EC5	L15-346	15-331	400100	7455085	2-1 mm	<0.5	<0.5	2	0.3	1.2	22	88.3	0.2	2	4	<0.2	1.6	5.5	0.115	23	20	4.97	1.78	1.17	696	0.109	12	50	288	-10
EC5	L15-327	15-332	400100	7455085	1-0.5 mm	<0.5	<0.5	2	0.5	1.4	19	88.5	0.2	2	4	<0.2	1.95	22.5	0.127	24	20	5.17	1.79	1.12	777	0.128	13	40	245	-10
EC5	L15-314	15-333	400100	7455085	500-250 µm	<0.5	<0.5	4	0.4	1.6	23	86.8	0.2	3	4	<0.2	2.75	34	0.197	27	30	5.06	1.64	1.08	795	0.171	13	50	267	-10
EC5	L15-341	15-334	400100	7455085	250-75 µm	1	<0.5	1.5	0.5	1.4	30	92.9	0.2	3	4	<0.2	5.5	21	0.472	34	45	4.63	1.78	1.02	630	0.344	16	50	317	-10
EC5	L15-302	15-335	400100	7455085	<75 µm	<0.5	<0.5	2	0.8	1.2	36	90.5	0.2	2	3	<0.2	3.25	23	0.513	51	50	4.46	1.8	0.805	584	0.372	21	100	326	-10
EC6	L15-307	15-336	400075	7455085	Bulk <6 mm	<0.5	<0.5	3.5	0.6	3.2	22	85.6	0.2	4	5	<0.2	5.1	190	0.273	25	30	5.59	1.4	1.38	918	0.137	13	60	155	-10
EC6	L15-347	15-337	400075	7455085	6-2 mm	<0.5	<0.5	3	0.2	2.6	12	86.7	0.2	2	5	<0.2	2.55	87.5	0.186	18	20	5.31	1.43	1.56	833	0.075	12	30	133	-10
EC6	L15-328	15-338	400075	7455085	2-1 mm	<0.5	<0.5	4	0.3	3.2	20	70.3	0.2	3	4	<0.2	2.25	128	0.189	22	20	6.25	1.26	1.45	957	0.076	12	40	120	-10
EC6	L15-303	15-339	400075	7455085	1-0.5 mm	<0.5	<0.5	3.5	0.6	6.8	21	71.5	0.2	4	4	<0.2	3.4	436	0.223	25	25	5.98	1.29	1.41	1030	0.1	14	60	131	-10
EC6	L15-329	15-340	400075	7455085	500-250 µm	<0.5	<0.5	4	1.4	4.4	23	77.5	0.2	6	4	<0.2	5.4	341	0.282	27	30	5.88	1.32	1.44	1090	0.142	14	60	165	-10
EC6	L15-354	15-341	400075	7455085	250-75 µm	<0.5	<0.5	4.5	0.9	3	45	92.1	0.2	7	5	<0.2	12.1	181	0.418	32	45	5.88	1.6	1.39	964	0.232	16	70	204	-10
EC6	L15-336	15-342	400075	7455085	<75 µm	<0.5	<0.5	4.5	1.3	2.8	35	96.4	0.2	3	5	<0.2	5.1	225	0.443	47	50	5.85	1.62	1.24	978	0.233	22	100	239	-10
EC7	L15-306	15-343	400025	7455085	Bulk <6 mm	1	<0.5	2	1	1.2	21	59.8	0.2	4	5	<0.2	2.6	14	0.872	27	30	7.11	1.48	0.889	792	0.664	20	60	87	-10
EC7	L15-320	15-344	400025	7455085	6-2 mm	<0.5	<0.5	4	0.9	1.4	19	68.1	0.2	3	4	<0.2	1.65	8.5	0.435	25	20	5.17	1.56	0.872	539	0.321	18	30	82	-10
EC7	L15-310	15-345	400025	7455085	2-1 mm	1.5	<0.5	3	0.6	1.4	23	52.9	0.2	4	5	<0.2	1.45	5	0.674	20	25	6.82	1.36	0.795	718	0.395	18	60	82	-10
EC7	L15-333	15-346	400025	7455085	1-0.5 mm	<0.5	<0.5	4.5	0.7	1.2	18	46.7	0.2	4	5	<0.2	1.85	9.5	0.949	26	25	7.4	1.23	0.885	821	0.622	18	50	95	-10
EC7	L15-315	15-347	400025	7455085	500-250 µm	<0.5	<0.5	4.5	1.6	1.2	20	52.4	<0.2	6	5	<0.2	2.45	11.5	1.1	28	30	7.55	1.21	0.855	833	0.909	19	50	85	-10
EC7	L15-352	15-348	400025	7455085	250-75 µm	1.5	<0.5	3.5	1.1	1.2	25	64	0.2	4	5	<0.2	4.5	19.5	1.01	34	50	7.42	1.49	0.825	825	0.895	23	70	102	-10
EC7	L15-330	15-349	400025	7455085	<75 µm	0.75	<0.5	6	1.7	1	27	73	0.2	6	5	<0.2	3.35	30.5	0.687	45	50	6.48	1.61	0.78	795	0.507	25	110	106	30

APPENDIX 3

STANDARDS

APPENDIX 3
Standard Reference Materials

Element	Units	Standard 6					Standard 9		
		Preferred value	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Preferred value	Analysis 1	Analysis 2
Au	ppb	86	76	75	81	80	87	82	151
Hg	ppb	?	<10	<10	<10	<10	?	60	50
Cu	ppm	6	7	7	6	7	141	149	145
Fe2O3	%	0.42	0.47	0.46	0.43	0.44	65.05	70.77	70.91
Mn	ppm	8	6	6	5	2	1543	1780	1800
MgO	%	0.31	0.32	0.33	0.32	0.31	0.15	0.15	0.16
S	%	0.016	0.015	0.014	0.013	0.013	0.041	0.04	0.041
K2O	%	3.54	3.83	3.9	3.81	3.79	0.2	0.18	0.17
Na2O	%	0.4	0.42	0.46	0.42	0.42	0.04	0.04	0.03
CaO	%	0.03	0.025	0.025	0.028	0.027	0.13	0.1	0.1
Ni	ppm	9	11	9	9	9	30	46	45
Cr	ppm	120	40	50	50	30	471	445	450
Zn	ppm	5	7	9	8	12	295	332	327
Ag	ppm	0.45	<0.5	<0.5	<0.5	<0.5	0.83	0.5	0.5
As	ppm	2	2	1.5	1.5	1.5	438	456	428
Bi	ppm	0.3	0.2	0.2	0.2	0.1	1.32	1.1	1.2
Mo	ppm	3	0.6	0.4	0.6	0.6	5	4.6	4.8
Pb	ppm	10	12	12	13	14	53	49	49
Rb	ppm	109	102	103	104	102	6	4.38	4.52
Sb	ppm	12.8	7.2	7	7.2	7.2	0.6	1.2	0.8
Se	ppm	2	<1	<1	<1	<1	3	2	2
Sn	ppm	0.75	<1	<1	<1	<1	1.12	<1	<1
Te	ppm	?	<0.2	<0.2	<0.2	<0.2	?	0.4	0.6
U	ppm	1	1.15	1.15	1.1	1.1	1	2.2	2.25
W	ppm	6	2.5	3	3	2.5	9	12.5	12.5

APPENDIX 4

DIGITAL DATA DISC