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564001

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89-3044 V1/2

MINES	
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ANNUAL REPORT 1988/89

EL 24/85

WILSON RIVER - RILEY KNOB

WESTERN TASMANIA

NOT RECORDED

CALLINA N.L.

PREPARED BY:

DR. R. BLANKS
CONSULTING METALLURGIST

89-3044 VOL 1/2

001

ANNUAL REPORT 88/89

EL 24/85 - RILEY KNOB

AREAS A & C - WILSON RIVER

Evaluation of the samples from Wilson River areas designated areas A and C continued through the year. A report issued by the consulting metallurgist is enclosed for your records - Chromite Report - Wilson River, April 1989, Dr. R. Blanks, Metskill Metallurgical. = appx 1

In summary the areas tested were too low in chromite reserves to allow development to proceed. The consultants recommendations that targets for additional chromite reserves be examined in the coming field season has been adopted.

BUTTON GRASS PLAIN - WILSON RIVER

While the attached report relates to the area A and C locations the preliminary examination of the button-grass plain south of these positions (south of Fowler Creek) indicated that their "recent" origin accounted for low chromite grades. Analabs report 1000 007 590 details the mineragraphy of samples processed from pits dug in the 1987/88 field season. The backhoe samples were jigged and the first hutch product dried and screened to remove over size (plus 1.4 mm). Wet shaking table concentrates from the hutch undersize were examined and reported on.

Pits 22-25 inclusive, located as shown in figure 3B Appendix F of the Metkill report dated April 1989. (Copy attached), were tested.

Table concentrates were further upgraded by removal of ferruginous material (including chromite) using a lift disc magnet. The nonmagnetic fractions for pits 23-25 were sampled and assayed. Analabs report 63,000 of 5 December 1988 shows the analytical results and their report 62982 shows the analytical data for chromite from hole 22 by processing as outlined above. Chromites from adjacent areas are also represented on the latter report. While all the concentrates show satisfactory chrome levels and low silica contents after magnetic separation the challenge of defining an economically viable resource remains. Values in base and precious metals were low for the non magnetic fractions when the assays were related to the original sample weights.

PROPOSED EXPLORATION

Based on a geological model involving transporting of moraine material from an ancient glacier, located NW of Serpentine Ridge, the ultramafic detritus is represented by areas A, C and D. Area D has not been tested previously. This is to be examined in the current season along with features (possibly remnant coarse detritals) just west of Area A and Three Mile Creek.

From the work done to date there is little upgrading of the chromite content of detrital material as shown by Area A and C data. Material of similar grade is therefore likely in Area D and adjacent locations with in-situ weathering of ultramafic moraine debris.

003

The data for Area C is more detailed than for Area A and the location of highest chromite grade and tonnage material is between 8950 and 9250N. A re-examination of pits 10, 11 and 14 already located in the zone is proposed.

Hand augering and sampling is scheduled for Area D and prospecting (as mentioned above) for locations west of Three Mile Creek.

R. F. Baker

27. 10. 59.

004

ANALYSIS REPORT

564005

Dr R Blanks,
Metskill,
203 The esplanade,
Mt Pleasant

2-11-88

1000 0 07 590

o/n 29732

Preparation of 6 polished sections and
Mineragraphic examinations of 6 non mags. (Wilson
River).

R Townend



005

Sample 23 N Mags.

*Buttergrass Plain**Hole 23
Hutch 1 Concentrate
Non Mag. (Minus 1.4 mm)*

Polished section

Chromite	major
Pyrite	major
Arsenopyrite	accessory
Marcasite	accessory
Chalcopyrite	accessory
Goethite	accessory
Galena	trace
Martite	trace
Leucoxene	trace
Sphalerite	trace
Pyrrhotite	trace
Cassiterite	trace
Bismuth.	trace

The section is dominantly composed of discrete Chromite and Pyrite. A little chromite also occurs in limonite. The chromites are fresh, subhedral, non porous and widely sized. Pyrite is fresh, single crystals and aggregates and uncommonly can be rounded.

Sphalerite, chalcopyrite and galena are inclusions in pyrite. Pyrrhotite and arsenopyrite are discrete and fresh, the latter to 0.4mm. Native Bi was included in the arsenic species. One cassiterite grain was confirmed by SEM.

006

Sample 24 N mags.

Buttergrass Plains Hole 24
 Hatch 1 Concentrate
 Non Mags (minus 0.4mm)

Polished section

Pyrite	major
Chromite	major
Limonite	minor
Marcasite	accessory
Sphalerite	accessory
Chalcopyrite	accessory
Leucoxene	rare
Galena	rare
Arsenopyrite	rare
Pyrrhotite	rare
Ilmenite	rare

The sample is about 80% opaques. These are mainly chromite and pyrite. The chromite is mainly single discrete fresh non porous grains, rarely it is included in limonite/goethite. The fresh pyrite is either a single crystal or aggregates. Galena, pyrrhotite, and sphalerite can be inclusions in pyrite. Sphalerite also occurs composite with chalcopyrite, to 0.4mm. Chalcopyrite can be a discrete mass to 0.5mm.

Arsenopyrite may be a rhomb within gangue, and marcasite are separate aggregates.

007

Sample 25 N.Mags.

*Buttergrass Plain - Hole 25
Hutch 1 Concentrate
Non Mags (Miner 1.4mm)*

Polished section

Chromite major
Pyrite major
Leucoxene accessory
Arsenopyrite accessory
Sphalerite accessory
Chalcopyrite trace
Limonite accessory
Galena trace

The ores are about 90% of the section. They are dominated by chromite almost always present as fresh single non porous crystals. Pyrite is also fresh and discrete. Sphalerite and chalcopyrite may be inclusions in pyrite, while the zinc mineral is also composite to 0.4mm with galena. Arsenopyrite is fresh in aggregates.

008

Sample H 4554

*Hudson River Tributary 4
Stream Sediment Sample 4
(Refer Hudson River Report)*

Polished section

Cassiterite	dominant
Leucoxene	accessory

The sample is about 90% ores of which the bulk appear to be Cassiterite. This occurs mostly as twinned crystals that are from 0.25 to 1mm sizes. Rare concentric "wood" tin is visible. Microcrystalline leucoxene is the main contaminant? There are some inclusions in the cassiterite, not identified, but possibly not tantalite columbite.

009

Sample H 4555

Hudson River Tributary 4

Polished section

*Stream Sediment Sample 5**Ref. Hudson River Report*

Cassiterite	major
Chromite	major
Magnetite	trace
Rutile	trace
Leucoxene	trace

This sample is a concentrate of cassiterite and chromite. Both are essentially discrete. The cassiterite may be twinned, and crystal size is quite variable. The chromite is fresh non porous and as single crystals.

Sample H 5552

Hudson River Tributary 5

Polished section

*Stream Sediment Sample 2**Ref. Hudson River Report*

Chromite	major
Cassiterite	major
Leucoxene	accessory

This is similar to sample H 4555, ie consists essentially of discrete cassiterite and chromite. The cassiterite varies in size and texture, some is possibly of a microcrystalline nature, rather like leucoxene? A few inclusions in cassiterite were not identified but may be iron oxide rather than tantalite gp.

PHOTO 1 T1 CHROMITE VARIATION. NIC UNC. F. WIDTH 0.54MM

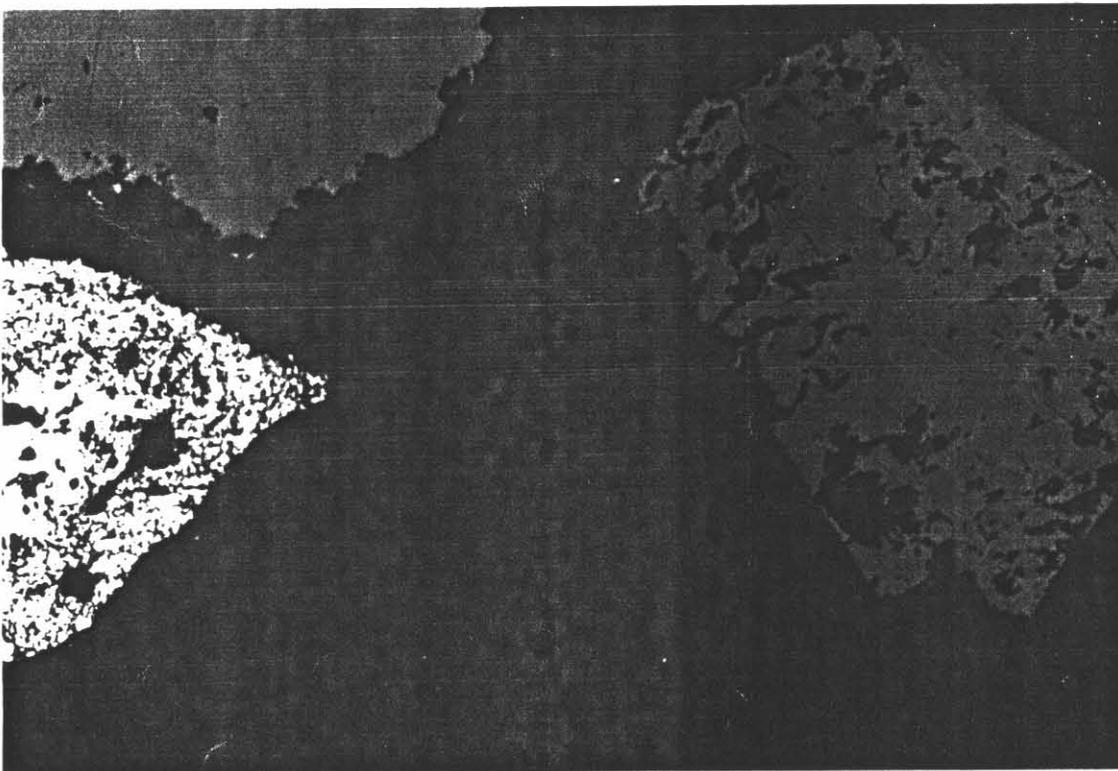
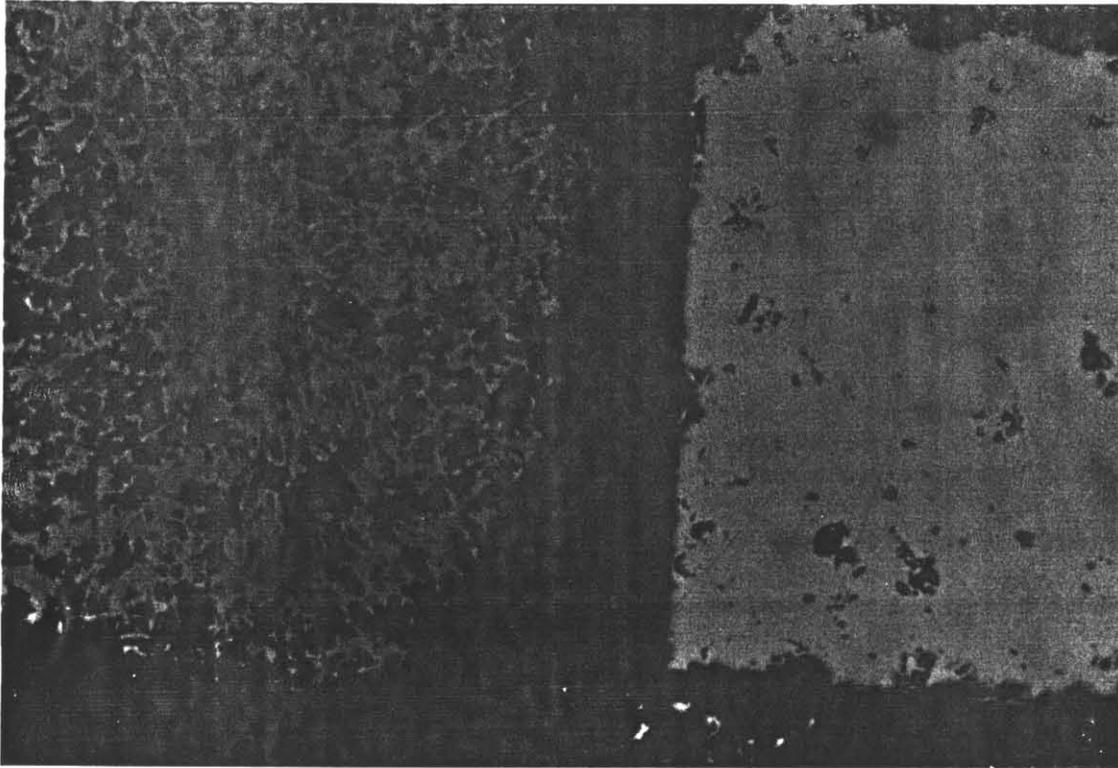


PHOTO 2 T2 CHROMITES PLUS MAGNETITE ALTERING TO MARTITE.
NIC UNC. FIELD WIDTH 0.54MM

PHOTO 3 T3 CHROMITES WITH LIMONITE RIM, MAGNETITE. NIC UNC.
FIELD WIDTH 0.54MM

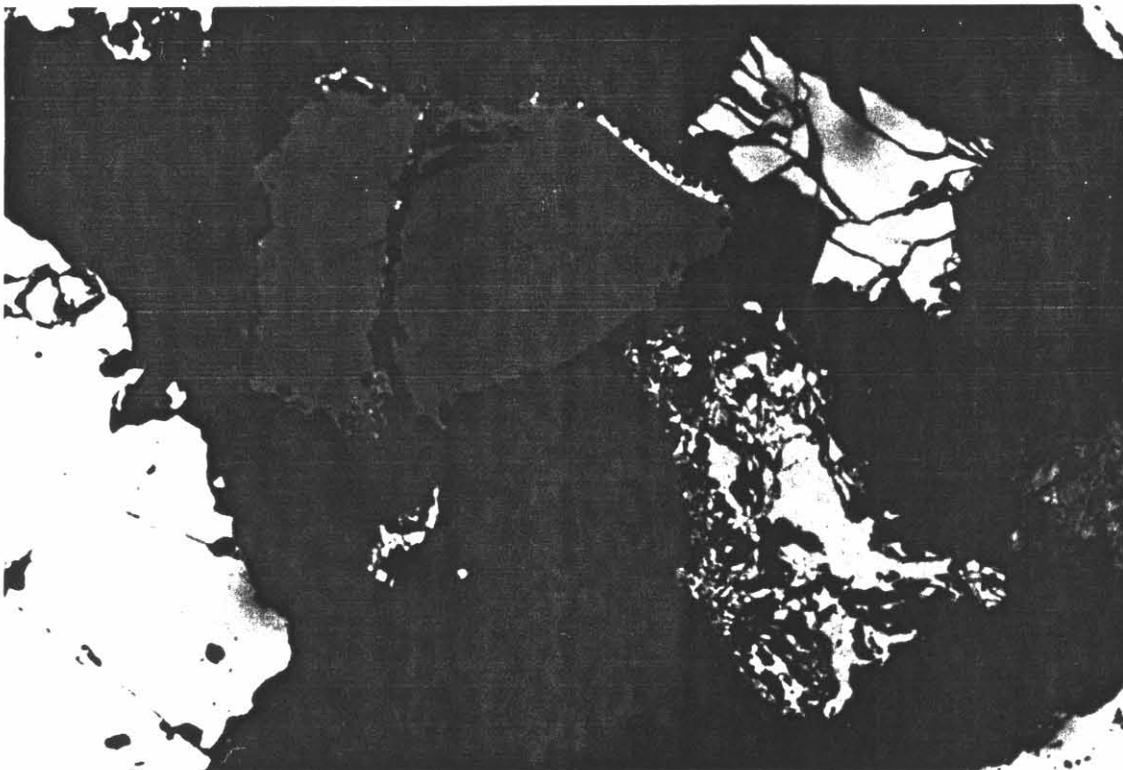


PHOTO 4 T 4 CHROMITE SUBORDINATE TO MAGNETITE.
NIC UNC. FIELD WIDTH 0.54MM

PHOTO 5 T5 CHROMITE WITH RIM OF HEMATITE. ,SEPARATE MARTITE.
NIC UNC. F. WIDTH 0.54MM

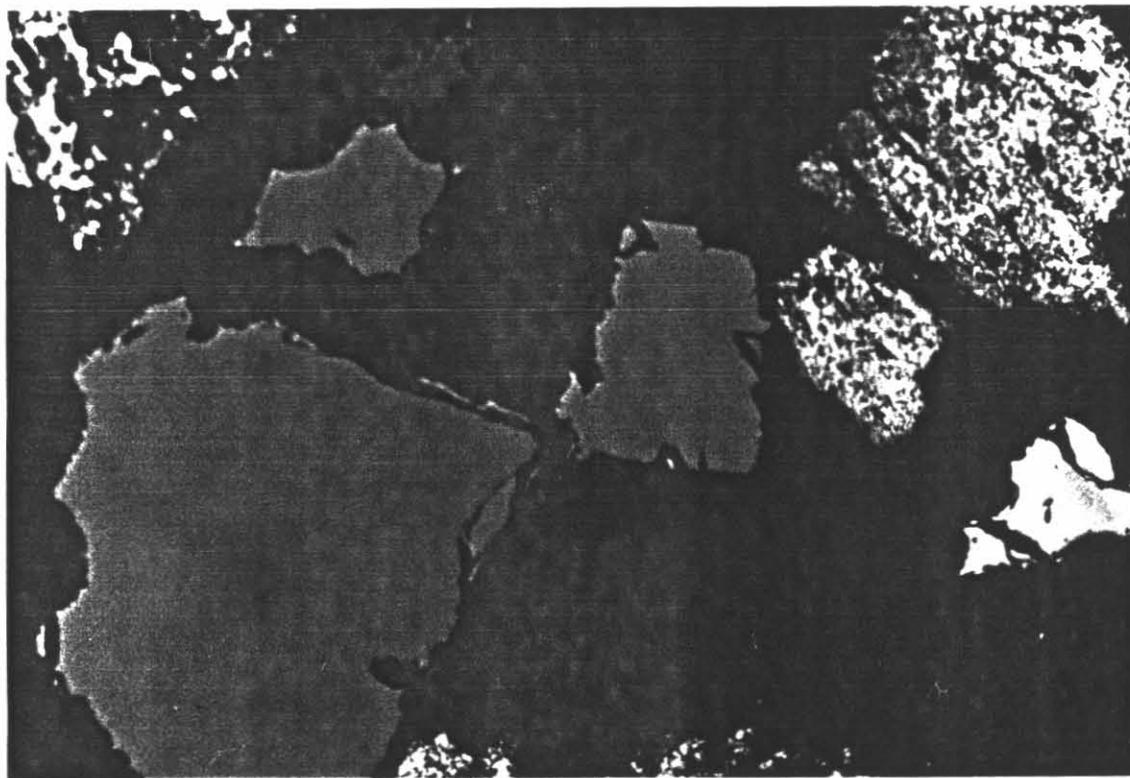
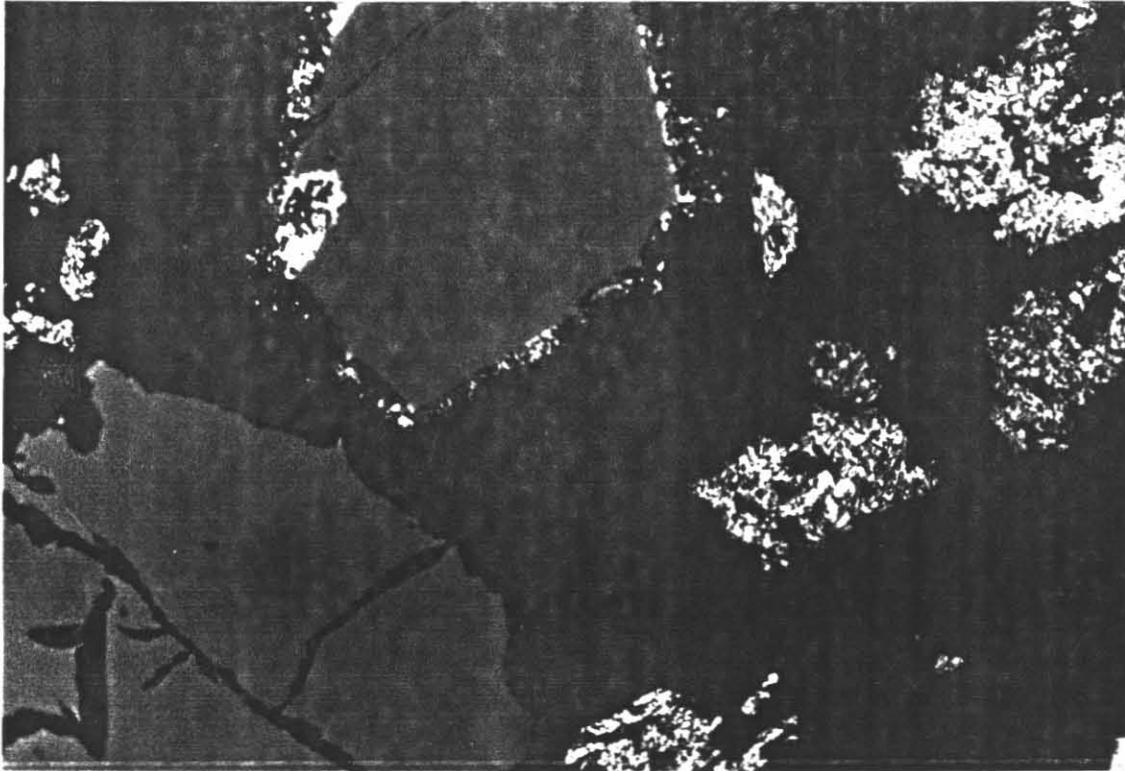
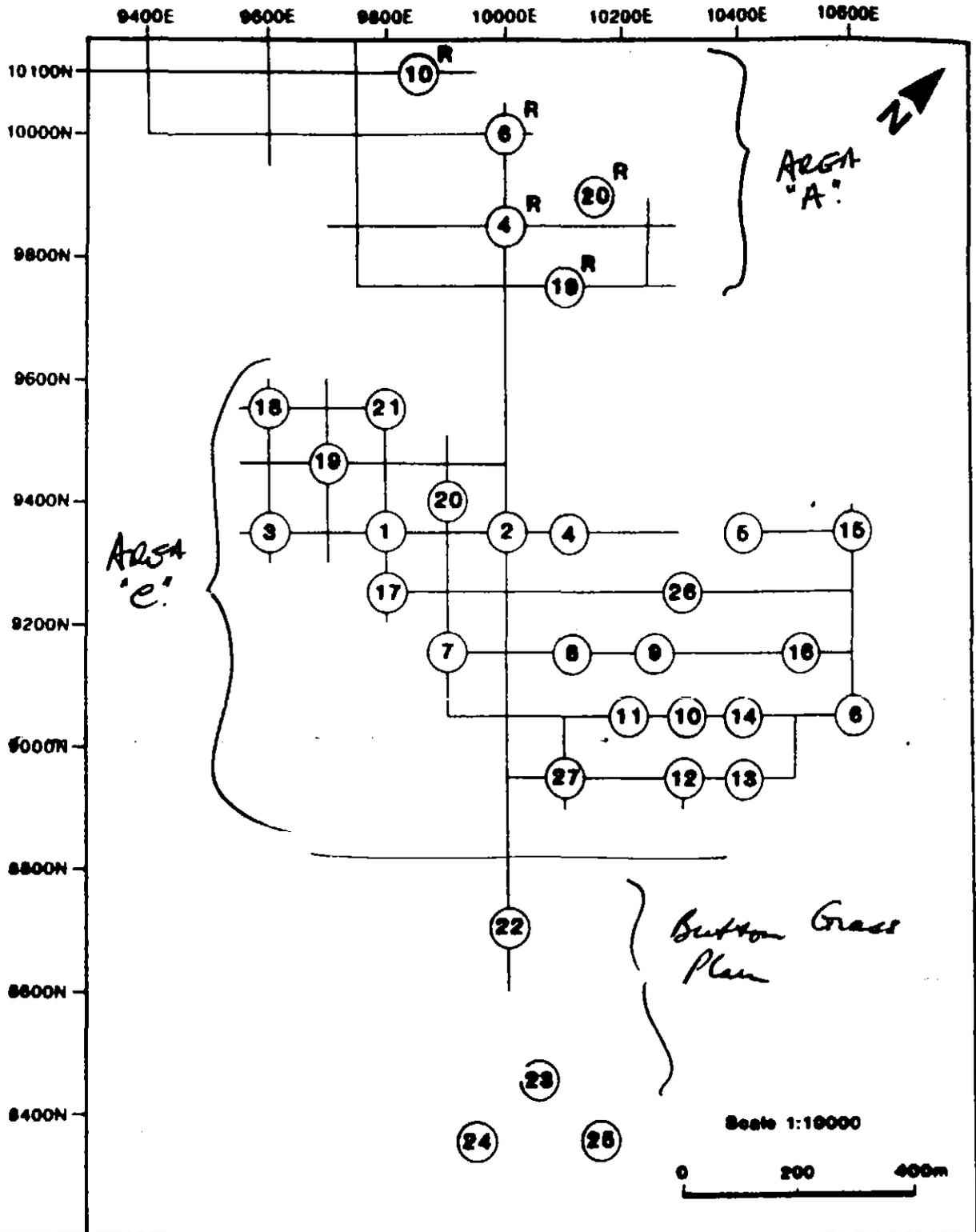


PHOTO 6 T 6 DISCRETE FRESH CHROMITE,SEPARATE MARTITE/MAGNETITE.
NIC UNC. FIELD WIDTH 0.54MM

013

CALLINA HUTTED CAMP SITE.





**CLEARED GRIDLINES SHOWING
BULK SAMPLE SITES 1988**

Note: Pits 11, 10, 14 to be resampled by hand channel sampling during current field season.

Phone 10914587999

52 Murray Road, Welshpool, N.A. 6106

Fax (09) 4582922

ANALYTICAL REPORT No.

198.0.01.63000

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

INVOICE TO: METSKILL 203 THE ESPLANADE MT PLEASANT WA 6153	ORDER No. 29733	PROJECT Wilson River
	DATE RECEIVED 24/10/88	RESULTS REQUIRED ASAP

No. OF PAGES OF RESULTS 2	DATE REPORTED 05/12/88	No. OF COPIES 1	TOTAL No. OF SAMPLES 3
------------------------------	---------------------------	--------------------	---------------------------

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
> Non Mags,23/5	Prep : 016	Au/309
> Non Mags,23/5	Prep :	Ag,Zn,Pb/101,As/114
> Non Mags,23/5	Prep :	Sb/117
> Non Mags,23/3	Prep :	Sn/401
> Non Mags,23/5	Prep :	Os,Ir/199

RESULTS TO	REMARKS
METSKILL 203 THE ESPLANADE MT PLEASANT WA 6153	


 AUTHORIZED OFFICER

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

REPORT DATE

CLIENT ORDER No.

PAGE

		198.0.01.63000	05/12/88	29733		1 of 2			
TUBE No.	SAMPLE No.	Zn	As	As	Ag	Sn	Sb	Cs	Ir
1	23 Non Mags	785	>100	750	2.5	320	20	2400.0	2100.0
2	24 Non Mags	805	>100	630	1.5	440	9	80.0	90.0
3	25 Non Mags	760	>100	280	0.5	95	3	2600.0	2600.0
4									
5									
6									
7									
8									
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11									
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16									
17									
18									
19									
20									
21									
22									
23	DETECTION	5	1	100	0.5	3	3	0.1	0.5
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppb
25	METHOD	101	114	101	101	401	401	199	199

Results in ppm unless otherwise specified
 T = element present, but concentration too low to measure
 X = element concentration is below detection limit
 - = element not determined

ANALYST
OFFICER

5/29/88

ANALYTICAL DATA

SAMPLE PREFIX REPORT NUMBER REPORT DATE CLIENT ORDER No. PAGE

SAMPLE PREFIX		REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
		198.0.01.63000	05/12/88	29733	2 OF 2
TUBE No.	SAMPLE No.	Au	Pb	Au:R	Au:R1
1	23 Non Mags	3.100	185	0.430	0.675
2	24 Non Mags	0.825	410	-	0.952
3	25 Non Mags	1.290	175	-	2.610
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23	DETECTION	0.008	5	0.008	0.008
24	UNITS	ppm	ppm	ppm	ppm
25	METHOD	309	101	309	309

Results in ppm unless otherwise specified
 T = element present, but concentration too low to measure
 X = element concentration is below detection limit
 - = element not determined

AUTHORISED OFFICER

J. Sims



ANALABS

A Division of Inco (Australia) Pty Ltd
Testing Services Australia Pty Ltd

564019

Phone (09) 4587999

52 Murray Road, Welshpool, W.A. 6106

Fax (09) 4582922

ANALYTICAL REPORT No. 198.0.01.62982

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

INVOICE TO:

METSKILL
203 THE ESPLANADE
MT PLEASANT WA 6153

ORDER No.

29730

PROJECT

Huek River

DATE RECEIVED

21/10/88

RESULTS REQUIRED

ASAP

No. OF PAGES
OF RESULTS

1

DATE
REPORTED

24/11/88

No.
OF COPIES

1

TOTAL No.
OF SAMPLES

5

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
1202/3, 1205/6, 1209	Prep : 016	Cr 203, Al 203, Si 102, Ti 02/406
1202/3, 1205/6, 1209	Prep :	Fe 203/406
1202/3, 1205/6, 1209	Prep :	MgO/104

REMARKS

RESULTS

TO

METSKILL
203 THE ESPLANADE
MT PLEASANT WA 6153

RESULTS

TO

[Empty box for results]

RESULTS

TO

[Empty box for results]

AUTHORISED OFFICER

019

ANALABS

564020

A Division of Incharge Inspection and Testing Services Australia Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

REPORT DATE

CLIENT ORDER NO

PAGE

19E.0.01.62982

24/11/88

29730

1 OF 1

LINE	SAMPLE N.	Cr203	Al203	Ti02	Si02	Fe203	MgO	
1	1202	58.9	8.86	0.16	0.3	22.0	9.75	Button Grass Plain Hole 22. Chromite Cons
2	1203	63.4	5.14	0.00	0.4	20.7	8.51	Muskhon R Trib 4 Stream Sed Sph 4 Chromite
3	1205	62.3	4.72	0.20	0.5	21.8	8.37	Muskhon River Trib 4 S.F. 2 Chromite Cons.
4	1206	61.6	5.29	0.21	0.6	23.0	8.67	Muskhon River Tributary S.S.S Chromite Cons
5	1209	54.9	9.07	0.56	0.5	26.4	9.07	Tributary Creek Chromite Concentrate.
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23	DETECTION	0.1	0.05	0.01	0.1	0.1	0.05	
24	UNITS	%	%	%	%	%	%	
25	METHOD	406	406	406	199	406	406	

Results in ppm unless otherwise specified
 T - element present; but concentration too low to measure
 X - element concentration below detection limit
 - element not determined

AUTHORISED OFFICER J. Sims

OPEN FILE

CALLINA MINING

Appendix 1

CHROMITE REPORT

WILSON RIVER, TASMANIA

April 1989

89-3044 v2/2

MINES	
File Ref. EL24/85	
- 6 NOV 1989	
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for

Callina Mining NL

by

Dr R Blanks

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89-3044 VOL 2/2

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GENERAL SUMMARY

The Wilson River chromite resource has been subjected to a significant amount of exploration and testing over the past three years.

Investigations done by processing backhoe/excavator samples through a portable scrubber/trommel/ jig plant gave fair representation of the precious metal content of the areas but were unsuitable for the accurate assessment of the chromite content of the areas examined.

Auger samples were not systematically subjected to gravity concentration prior to this investigation and the data generated for Area A is incomplete as regards an accurate chromite grade. Data generated from the samples and results enumerated in this report show that a resource of around 860,000 tonnes at an indicated grade of 2% chromite (17,200 tonnes of chromite) can be predicted for area A. This occurs in three separate ore pods

Area C auger holes were processed to define the chromite content using a flowsheet consistent with the metallurgical circuit developed from the known mineralogical data. As for area A, a series of ore pods or locations where grades were above 1% chromite was determined for Area C and a resource of similar size was defined. Area C data shows 15,200 tonnes of chromite contained in 840,000 tonnes of ore grading 1.8% chromite.

Platinoids and gold were determined from backhoe excavated pit samples and shown to be of no economic significance.

Preliminary economic studies were run for a plant located adjacent to the Wilson River ore bodies treating around 400,000 tpa of ore. These indicate that the ore reserve at 1.7 million tonnes grading 1.8 - 2.0% chromite is slightly better than break even and will return \$1 per tonne of

ore treated over a 4 - 5 year life.

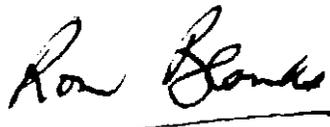
It is concluded that potential exists for an increase in ore reserves both at Wilson River and in the Chromite Creek area.

Chromite Creek has the advantage that any worthwhile chromite in this location will be clean mineral free of magnetite and goethite coatings with added values from tin, gold and platinoids.

Extensions to the known ore reserves at Wilson River will have logistic advantages despite potential contamination from iron oxides.

Additional ore reserves could dramatically improve the economic picture and signal the go ahead for chromite production.

Emphasis should be placed on examining the ore potential of specific target areas in the next field season. Budgeted cost for this work is \$50,000 for the Wilson River Area and \$35,000 for Chromite Creek.



R F Blanks
Consulting Metallurgist
Perth 12th April 1989

WILSON RIVER CHROMITE

Introduction

The work done by Callina at Wilson River was originally concerned with the viability of the establishment of an alluvial treatment plant for recovering platinoids. This was redirected toward chromite production when grades of platinoids were too low and the jigs used for upgrading produced significant levels of chromite.

While jigs are well suited to the concentration of dense heavy minerals such as gold, platinoids, and cassiterite (or wolfram) S.G.'s 6.0 - 22.0 they perform poorly on fine heavy minerals such as chromite S.G. 4.2 - 4.7.

The earlier investigation of area A at Wilson River utilized excavated bulk samples taken to 2.0 metres and processed by jigging, with screening and magnetic separation of the hutch concentrate products. Hence fine chromite levels are discounted and the depth of sampling is shallow. Auger samples were also taken to maximum drill penetration.

Processing of auger samples from Area A drilling involved dry screening at 90 micron aperture to remove fines. This was done by hand at the Wilson River campsite. The oversize material was rescreened wet on 75 micron aperture at Micron Research (after wet scrubbing) and the oversize product dried and rescreened on 0.5 and 2.0 mm. Magnetic separation was carried out on these oversize products as for the backhoe samples.

On examination of samples from this procedure only the deslimed minus 0.5 mm plus 0.075 mm product carried liberated or "recoverable" chromite. Chrome associated with the other screen sizes is either present as chrome bearing limonite/goethite or is composited with iron oxides

and clays. It is technically feasible to grind (liberate) this aggregated chromite and recover it by flotation. The combination of capital and operating costs plus slime losses is, however, unattractive on a low revenue mineral such as chromite. Major costs relate to the capital cost of grinding equipment to liberate the chromite grains and the cost of chemicals for flotation.

Platinoid levels determined from the earlier samples were low and do not warrant special consideration unless the area A province is treated for chromite recovery.

A major difficulty with the earlier chromite data, from augers holes or jig hutch products, is that a definitive system of producing a saleable product has not been established. Reliance on chromium assays is misleading as the iron oxides (limonite-goethite which is unsaleable) also contain chromium.

It has been established that chromium levels in the pure Wilson River chromite mineral suite are high - certainly above 60% Cr₂O₃. Since chromite above 42% Cr₂O₃ grade is saleable the area is attractive as a premium chromite producing location.

Examination of the jig products from area A confirmed that the alteration of the chromite grains has advanced to the stage where breakdown to iron oxides - goethite and limonite, is extensive and that very little chromite exists as free grains above 0.5 millimetre size. Below this size the occurrence of free chromite grains is much more common. Above 2 millimetre size virtually no free chromite exists and in the range 0.5 to 2.0 mm chromite is generally locked with goethite - limonite in complex grains.

Roger Townend's report on the mineralogy (attached as Appendix A)

clearly demonstrates this characteristic.

The decomposition and breakdown process also commonly leads to the chromite grains being coated and these coatings cause interference during concentration where surface effects are used. Hence cleaning to produce clean grains will be required before high tension separation (or flotation) can be used.

While magnetic separation (which is insensitive to surface coatings) has proven useful to define the precious metals levels in the samples it cannot be regarded as an effective system for concentrating chromite, where iron oxides (also magnetic) are major contaminants.

On the basis of the data available a conceptual process circuit has been drawn up to evaluate the economic picture and allow a viable flowsheet to be adopted for the treatment of drill core and excavated samples.

Conceptual Flowsheet

The schematic circuit is based on ore grades of around 2% chromite and is attached - drawing M1.

The flowsheet is based on mechanical excavation of ore and processing through a scrubber/trommel via a bin and belt feeder (or monitor). A scrubber - trommel is used to disperse clays and lightly cemented grains and remove plus 2mm material which is waste. A metal detector can be located on the oversize belt to detect coarse precious metals if warranted.

Undersize material is shown passing to 2 Knelson concentrators which recover fine precious metals. Tailings from the Knelson treatment is rescreened to remove plus 0.5 mm (finer gravels) material which is stockpiled for future treatment and the undersize pulp is pumped to desliming cyclones which remove the clays.

Further removal of clays occurs during gravity separation by spiral concentrators. Spirals operate by reverse classification so that fine heavy minerals readily report to the concentrate product.

Chromite is recovered via the spirals as a gravity concentrate along with magnetite and goethite. Wet drum magnets are used to remove magnetite from the concentrate.

Examination of the chromite from areas A and C showed that clay coatings can be present and the circuit allows for removal of these coating by attritioning at high pulp density. Because this equipment is normally rubber covered (impellers, baffles, etc) acid or chemical attritioning can be used to assist in removing these clay coatings when necessary.

The final stage of separation is done (after kiln drying) by high tension rolls - as used in the mineral sands industry. Chromite is a conductor of

electricity whereas goethite is not. Dry processing also produces a dry free flowing (sand size) chromite for marketing.

Based on mineragraphic and analytical data it can be anticipated that a plus 60 per cent chrome product assaying less than 1 per cent silica can be produced via this circuit.

Area A Resource

The report to the Callina Board on "The Evaluation of Database on the Wilson River Project" dated March 1988 by C. Browne and J. Richards indicates 1,543,750 tonnes of alluvium at 3.3% Cr₂O₃ for the top 2 metres at Area A. Relevant data from this report is attached as Appendix B.

On the basis that this grade is maintained the figures presented indicate a total of 4,116,860 tonnes of alluvial material grading 3.3% Cr₂O₃. While this equates to around 136,000 tonnes of chromic oxide (chrome) much of it is present as chrome bearing limonite/goethite.

Material above 0.5mm size contains no recoverable chromite, the top 2 metres contains 15,542 + 23,630 + 257,465 = 296,637 tonnes of less than 0.5mm material grading 13.0 % Cr₂O₃.

The balance (below 2 metres) at the same sizing and chrome content adds a further 494,435 tonnes of -0.5mm material.

It has been recognised that these figures cannot be translated to chromite content as not all chromic oxide is accounted for as chromite. In order to discount these figures and allow for chrome present in limonite, magnetite, etc an electron probe - microscopic examination of a suite of minus 0.5mm (magnetic products or reconstituted) samples was undertaken by Jiri Just and Associates. This report and the covering letter are attached - Appendix C.

Evaluation of the data presented in the report indicates ore grades from the suite of samples examined are from 0.085 to 6.55% chromite. There is some conservatism in the figures tabulated below as it is assumed that the volume % reported equates to weight % chromite - table 1.

Area "A" Chromite - Table 1

Hole	Interval (m)	Vol %	% Chromite in Interval
	-----Minus 0.5 plus 0.075mm Material-----		
21	8-10	2	0.43
25	0-2	20	6.55
25	2-4	1	0.290
25	4-7	<1	<0.21
32	0-2	10	2.42
32	2-4	15	4.65
32	4-6	15	4.65
32	4-6	15	0.75
36	0-2	5	1.32
36	2-4	14.25	4.28
36	4-6	1	0.085
48	0-2	10	1.85
55	0-2	5	1.63
58	0-4.5	10	1.65
63	0-6	20	4.57
71	0-9	15	3.11
73	0-7.5	30	3.68
82	0-2	20	4.15
82	2-4	20	5.22
82	4-6	10	2.62
82	6-8	9	2.78
85	0-2	10	1.85
85	2-4	5	1.91
85	4-6	2	0.38

Some 11 samples graded above 2% chromite and a further 6 were above 1% chromite cut off. Much of the chromite reported at plus 80 minus 150 micron size although instances where it reported in the minus 300 plus 200 micron size fraction were not uncommon. These observations confirm the fine grain size of the chromite and because of this it can be concluded that reverse classification is the best approach for gravity concentration. Hence spirals or Reichert cones are superior to jigs in this application.

This suite of samples gives fair representation of the area "A" resource. Holes 21, 25 and 36 are roughly east of the major area in a location where drill penetration was relatively poor. The enclosed figure 81 from Nick Davis' report indicates this clearly. Because of the shallow mineralized area a consideration in this north western section of the zone A resource is the clearing - stripping plus rehabilitation cost per tonne of ore treated.

Examination of the analytical data presented in Browne and Richards report relating to backhoe excavated samples in the top 2 metres of the area A location indicates significant chrome assays for the "mags 2" product of the minus 0.5mm material occurred in holes 25, 11, 24 and 27 in the north west corner of the deposit holes 8, 9, 31, 28 and 30 in the south central area plus 22 and 21 in the north east corner.

The results from auger holes 25, 36, 63, 71, 73 and 82 listed above in Table 1 confirm the north west, south central, and north east locations and extend the overall depth from 2 to 4 metres. Figures 6 and 7 show the location of these samples - Appendix B.

In addition to the work done by Jiri Just a request was made for the surplus minus 500 plus 75 micron material from auger holes 1, 12, 27, 28, 29, 38, 39, 57, 61, 74, 75, 76, to be released for examination. Unfortunately not all of the fractions were available but the attached table details those fractions reconstituted for gravity separation - Table 2.

033

9400E

9500E

9600E

9700E

9800E

9900E

10000E

Hole No.

24

21

20

19

17

16

15

14

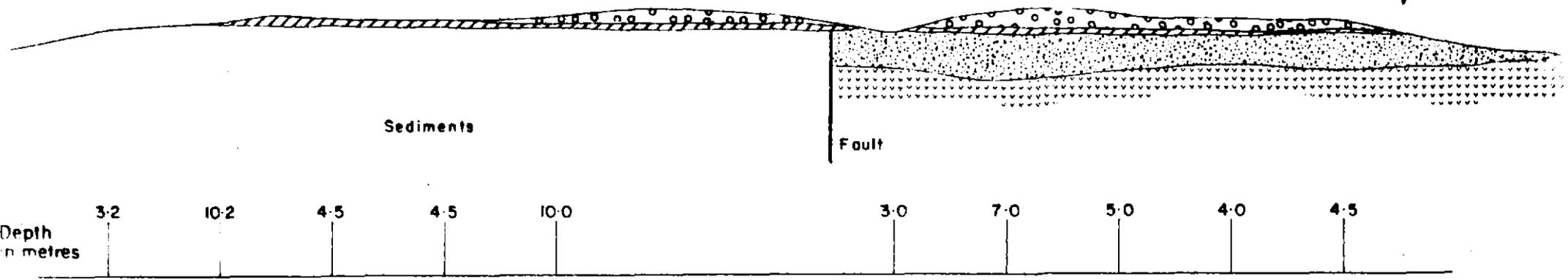
81

13

83

76

75



Sediments

Fault

Depth
in metres

3.2

10.2

4.5

4.5

10.0

3.0

7.0

5.0

4.0

4.5

5 cm

-  Gravel
-  Hardcap
-  Clay
-  Sediments
-  Serpentinite

CALLINANL	
Line 10 100N Vertical Profile	
HS = 1:2500	VS = 1:500

Figure 81

564034

Area "A" Gravity Separation/Chromite Data - Table 2

Hole	Fraction	Wt %	Cons %	% Cr ₂ O ₃ in conc	% Chromite in conc
81	Mag 2	32.51			
	Mags 1	44.77			
	Mids	6.92			
	Hi Mags	15.80			
	Calc Head	<u>100.00</u>	20.9	26.0	36.0
80	Mags 2	23.75			
	Mags 1	35.00			
	Mids	3.15			
	Hi Mags	38.10			
	Calc Head	<u>100.00</u>	37.5	17.8	22.8
30	Hi Mags	10.72			
	Mags 1	45.25			
	Mags 2	38.65			
	Mids	5.38			
	Calc Head	<u>100.00</u>	22.1	17.5	22.1
32	Hi Mags	28.06			
	Mags 1	24.08			
	Mags 2	37.62			
	Mids	10.24			
	Calc Head	<u>100.00</u>	38.8	9.35	9.20
64	Hi Mags	55.60			
	Mags 1	8.23			
	Mags 2	14.16			
	Mids	2.01			
	Calc Head	<u>100.00</u>	47.5	15.25	18.20
85	Hi Mags	84.30			
	Mags 2	15.70			
	Calc Head	<u>100.00</u>	19.4	14.35	16.7

Hole	Fraction	Wt %	Cons %	% Cr ₂ O ₃ in conc	% Chromite in conc
1	Hi Mags	60.90			
	Mags 1	37.16			
	Mags 2	1.94			
	Calc Head	<u>100.00</u>	14.9	9.3	8.6
75	Hi Mags	44.95			
	Mags 1	24.50			
	Mags 2	29.59			
	Mids	0.96			
	Calc Head	<u>100.00</u>	32.4	16.8	20.6
4	Hi Mags	43.23			
	Mags 1	37.41			
	Mags 2	16.71			
	Mids	2.65			
	Calc Head	<u>100.00</u>	22.4	15.15	18.5
3	Hi Mags	14.63			
	Mags 1	44.56			
	Mags 2	23.02			
	Mids	7.46			
	Non Mags	10.33			
	Calc Head	<u>100.00</u>	5.83	19.7	25.8
63	Hi Mags	49.59			
	Mags 1	28.02			
	Mags 2	15.92			
	Mids	6.47			
	Calc Head	<u>100.00</u>	42.7	27.5	38.5
62	Hi Mags	73.28			
	Mags 1	21.79			
	Mags 2	4.93			
	Calc Head	<u>100.00</u>	32.7	14.55	17.0

Hole	Fraction	Wt %	Cons %	% Cr ₂ O ₃ in conc	% Chromite in conc
31A	Mags 1	25.21			
	Mags 2	54.97			
	Mids	19.82			
	Calc Head	<u>100.00</u>	21.9	43.4	64.2
31B	Hi Mags	14.32			
	Mags 1	44.20			
	Mags 2	28.12			
	Mids	13.36			
	Calc Head	<u>100.00</u>	10.5	28.7	40.0
65	Mags 1	41.16			
	Mids	58.84			
	Calc Head	<u>100.00</u>	17.2	20.5	26.5
83	Hi Mags	53.85			
	Mags 1	32.19			
	Mags 2	13.96			
	Calc Head	<u>100.00</u>	37.0	23.9	32.1
57	Hi Mags	86.96			
	Mags 1	13.04			
	Calc Head	<u>100.00</u>	34.3	7.5	5.3
61	Hi Mags	26.60			
	Mags 1	33.69			
	Mags 2	34.18			
	Mids	5.53			
	Calc Head	<u>100.00</u>	35.3	36.1	52.1
39	Hi Mags	78.85			
	Mags 1	15.93			
	Mags 2	5.22			
	Calc Head	<u>100.00</u>	41.2	7.20	5.3

Hole	Fraction	Wt %	Cons %	% Cr ₂ O ₃ in conc	% Chromite in conc
29	Hi Mags	31.87			
	Mags 1	41.48			
	Mags 2	25.18			
	Mids	1.47			
	Calc Head	<u>100.00</u>	32.6	11.4	11.4
38	Hi Mags	100	14.6	8.1	6.3

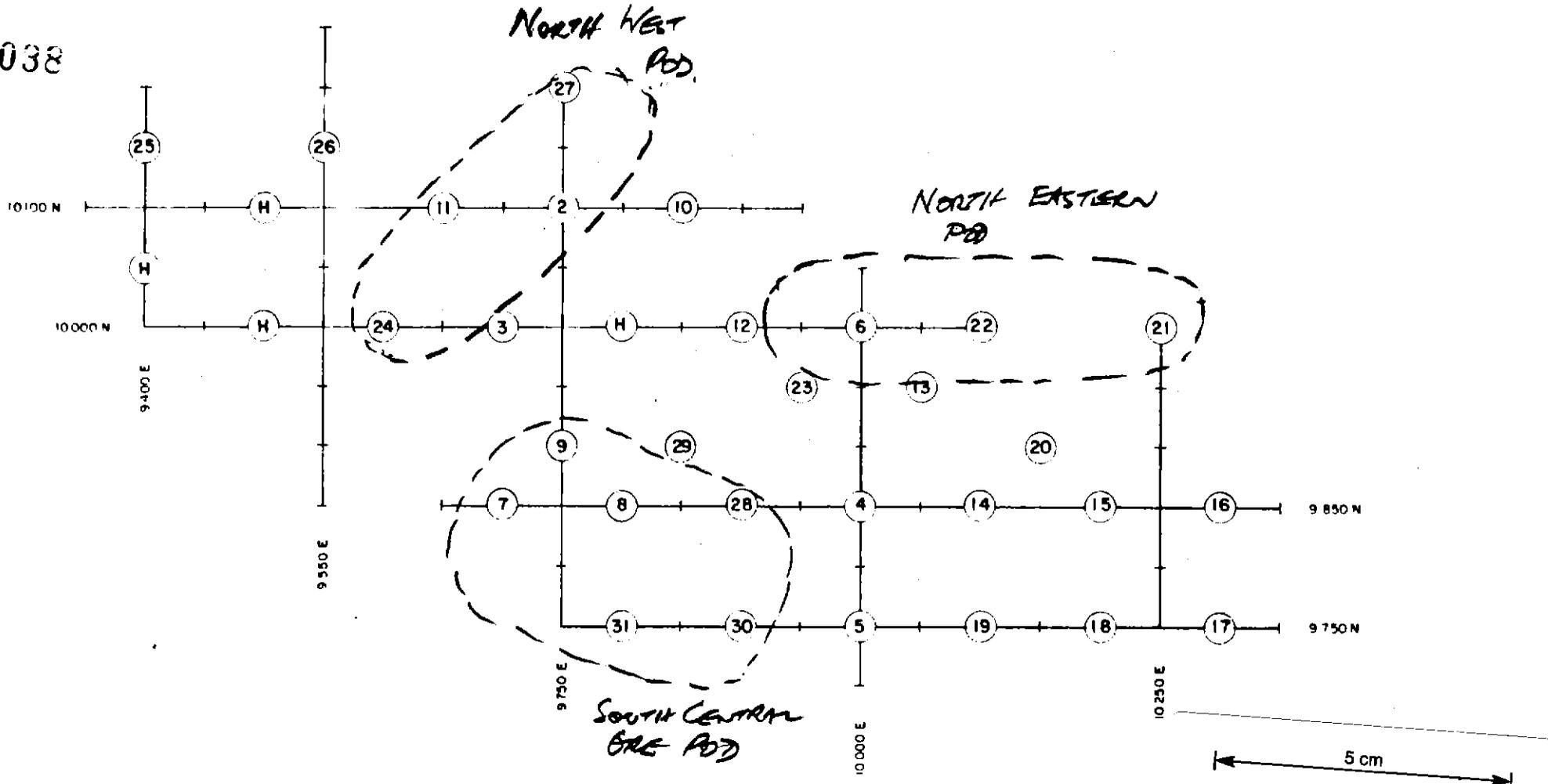
The fractions were mixed as indicated and wet tabled to collect liberated chromite in the concentrate fraction. It has been demonstrated that chrome reporting to wet table middlings and tailing is present within limonite - goethite or complexed with such material so that it cannot be classed as "recoverable" chromite. This is detailed in the mineragraphic report Appendix D.

Concentrates from the wet tabling were dried and samples split out for XRF analysis of the chrome content along with iron content.

As reported by Jiri Just and confirmed by R Townend the chrome content of limonite/goethite/magnetite averaged 4.25% Cr₂O₃ (range 3.5 - 6.5% Cr₂O₃). This value was accepted along with 65% Cr₂O₃ as the chrome content of "pure" chromite to relate Cr₂O₃ content to chromite from the gravity concentrates. This relationship depicted on graph M2 was used to convert Cr₂O₃ assays to chromite content for both Area A and Area C table concentrate products.

As shown in table 2 the best grades of chromite in concentrate were produced in holes 31, 61 and 63. These relate to the southern central and north eastern ore pods of area A - figures 6 and 7 - Appendix B..

038



For Area C : see loc. diag.
 Vol. 1.

H = Hardcap

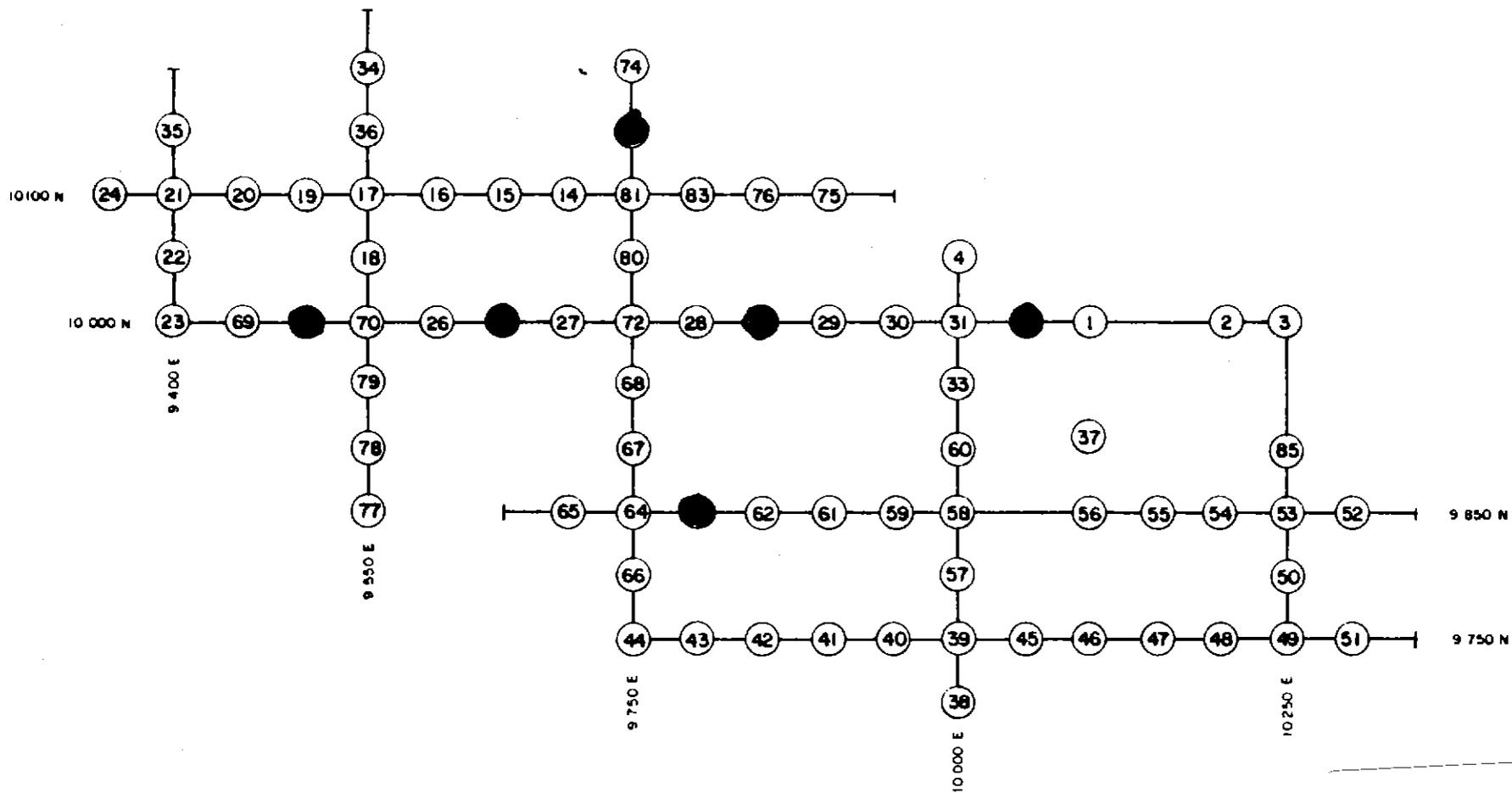
CALLINAN L.	
LOCATION OF BULK SAMPLE SITE AREA A	
H.S. = 1	9300

5000

Figure 6

564039

039



5 cm

CALLINA N.L.	
LOCATION OF AUGER DRILL HOLES AREA A	
H.S. = 18200	

567040

Figure 7

METSKILL

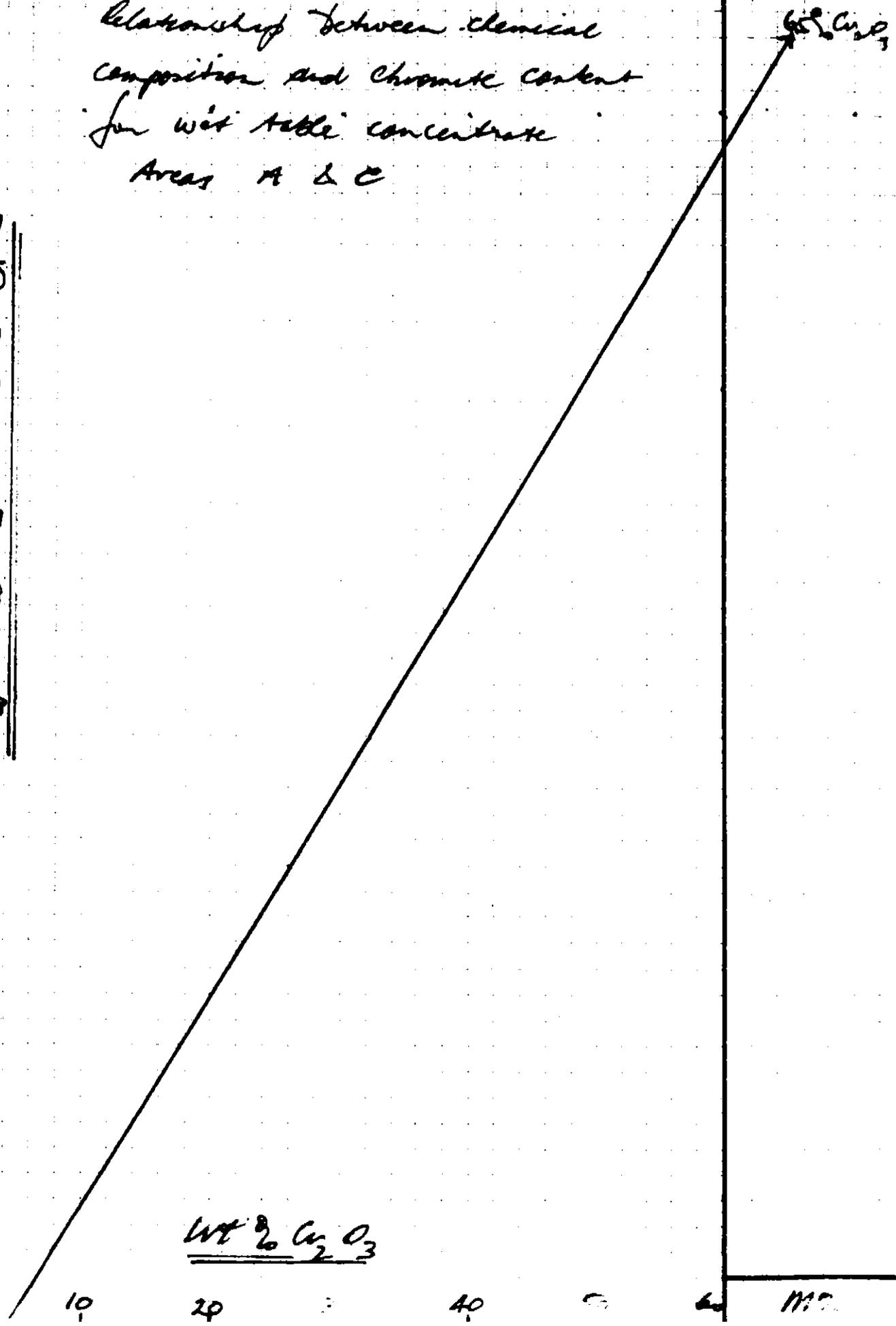
Designed	RS	GRAPH M2
Checked	✓	Date MAR 89

Project WILSON RIVER CHROMITE

Relationship between chemical composition and chromite content for wet table concentrate Areas A & C

100
90
80
70
60
50
40
30
20
10

WT % CHROMITE IN CONCENTRATE



WT % Cr₂O₃

10 20 40 60 80 100

Indicated tonnages in the three pods nominated above at an in situ density of 2.4t/m³ and 4 metres average depth are:

North Western = 300m x 125m x 4 x 2.4
= 360,000 t

Southern Central = 275 x 150 x 4 x 2.4
= 396,000 t

North Eastern = 75 x 150 x 4 x 2.4
= 108,000 t

TOTAL = 864,000 t

Grade cannot be precisely defined but is indicated at better than 2% recoverable chromite = 17,200 tonnes chromite content.

During the 1988 field programme resampling of pits 4, 6, 10, 19 and 20 was done to 4 metres depth. These samples were processed by jigging on site with transfer of the hutch products to Perth. Hutch 1 products were screened on 2.0 mm and wet tabled. The wet table concentrates were magnetically separated into "Hi" mags, Mags 1-2 and non magnetic products by successive treatment on the lift disc magnet. Pit 10 sample was not received however for the other 4 samples only sample 6 reported a clean chromite product but at a grade of 0.06% chromite. This sample relates to hole 31 in the earlier auger programme and the grade cannot be related to recoverable chromite because of the procedure used for processing the sample. Fine chromite would be lost during jigging.

Area C Resource

88-2879

The report by N. Davis dated October 1988 details the geology and related investigations on Area C conducted early in 1988. Samples from the auger drilling were transported to Perth without any processing other than packaging being conducted at Wilson River. Samples were either composited or treated individually as listed on the attached table 3.

Processing involved wet scrubbing the selected intervals in a mixer using smooth pebbles for dispersion of the clays followed by wet screening on 500 micron aperture with wet rescreening of undersize on 75 micron aperture and dry screening of the oversize on 2 mm aperture screen. Dry product weights were recorded.

The minus 500 plus 75 micron "sands" product was subjected to gravity separation on a laboratory Wilfley shaking table. Samples taken from the table products were examined by Dr Roger Townend of Analabs, Perth. Appendices D and E detail the results.

Liberated chromite was rare in the table mids and tailings products confirming the suitability of this technique for gravity concentration of the chromite. Attritioning of the table concentrate decreased the amount of composited chromite but such structures were still common especially chromite - limonite fragments. The results show that gravity separation alone will not produce a clean chromite product even with attritioning but rejectable tailings and middling products increase the concentration of liberated chromite in the table concentrate products.

The table concentrate product from each of the composites was assayed for Cr₂O₃ content by X ray fluorescence and the relationship shown in graph M2 was used to define the chromite tenor of the concentrate.

While this does not define the recoverable chromite, as the figure could include chromite locked in limonite - goethite, it gives a guide to the grade of this sands fraction.

The extent to which chromite defined by the above represent significant levels of free or liberated grains was established by modal analysis of table concentrates prepared from 5 other locations in the Area "C" zone. This data is presented in Appendix "E". Chromite in these samples was generally clean, and liberated. In a number of instances the concentrate contained significant levels of free magnetite. Magnetite has been shown to have a chrome content of 4.5% so that it does not alter the computed chromite content. From this data it can be concluded that the majority of the chromite reporting to concentrate is clean mineral.

Data from this treatment is summarised in Table 3 and grades above 1% chromite have been plotted for Area "C" on the attached drill grid plan - Figure 9.

The following list details the ore pods of mineable grade.

Area C Tonnages

Central North =	100 x 100 x 3 x 2.4 = 72000t at 1.5% chromite grade = 1080t chromite
North Eastern	= 150 x 300 x 2 x 2.4 = 216,000t at 1.8% grade = 3890 t chromite
South Eastern Pods	= 212,000 t at 1.9 grade = 4030t = 216,000 t at 2.0% = 4320 t = 127,000 t at 1.5% = 1910 t
Total Recoverable	= 15,230 t chromite = 843,000 t at 1.8% chromite grade

044

9600E 9700E 9800E 9900E 10000E 10100E 10200E 10300E 10400E 10500E 10600E

9600N

9500N

9400N

9300N

9200N

9100N

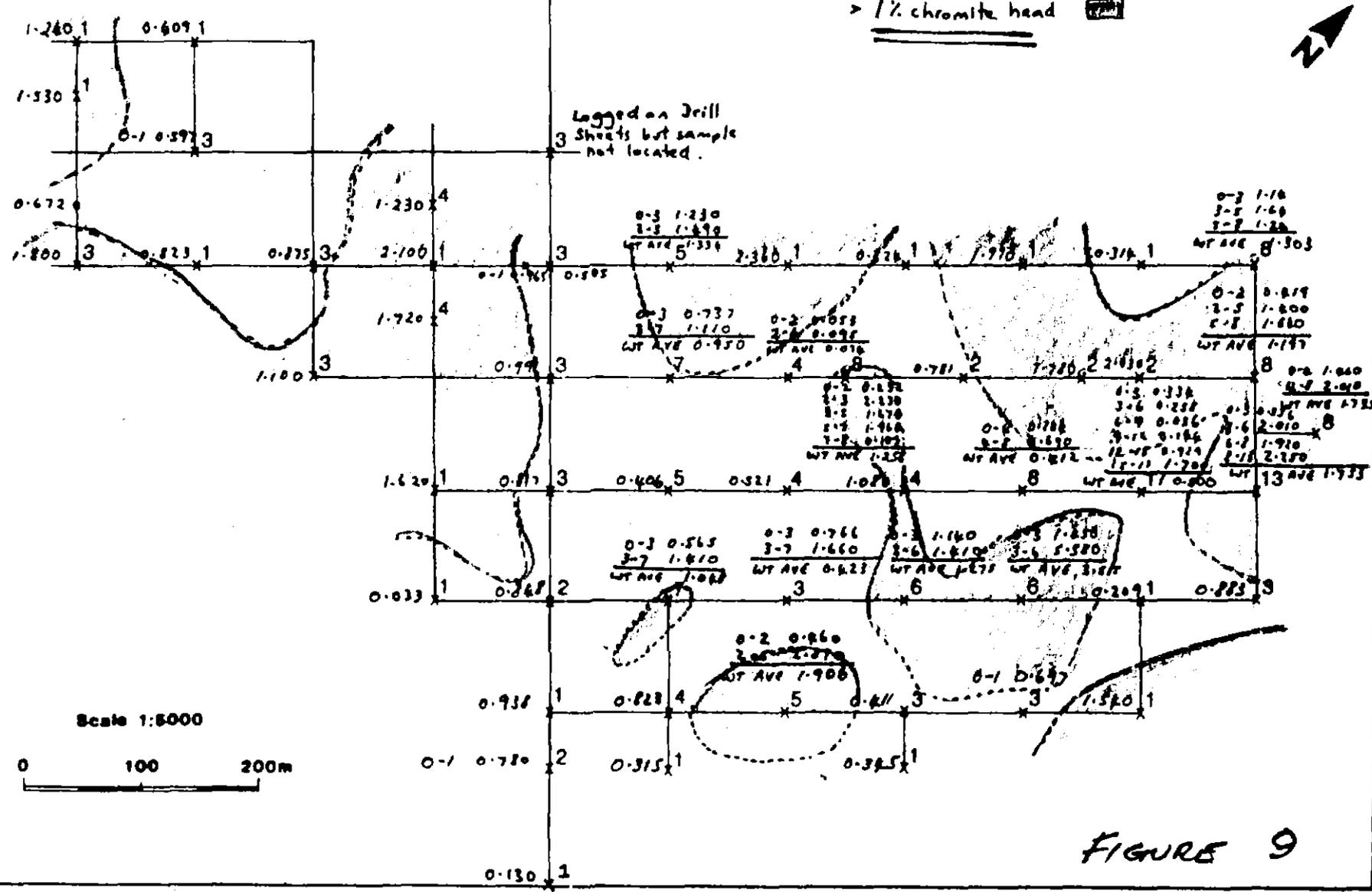
9000N

8900N

8800N

> 1% chromite head

Logged on Drill Sheets but sample not located.



Scale 1:5000

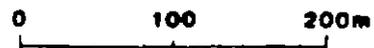


FIGURE 9

CLEARED GRIDLINES WITH DRILLHOLE DEPTHS(m) AREA C

CALLINA N.L.

564045

045

DRILL CORE SAMPLES - WILSON RIVER AREA "C"

N	E	m	Total Wt(g)	+ 500 μ		- 75 μ		- 500 + 75 μ		Table Concentrate				% Chromite Head
				Wt (g)	%	Wt (g)	%	Wt (g)	%	Wt (g)	%	% Cr2 O3	% Chromite	
	10600	3-6	7,345.3	996.5	13.60	4,766.4	64.90	1,582.4	21.50	331.0	4.51	31.1	44.5	2.010
	10600	6-8	4,896.1	438.3	8.95	3,606.7	73.70	851.1	17.40	167.0	3.41	38.6	56.2	1.920
	10600	8-13	7,986.9	1,729.1	21.70	4,443.1	55.60	1,814.7	22.70	337.2	4.22	36.8	53.4	2.250
9050	9900	0-1	3,635.1	1,661.3	94.74	23.6	1.35	68.6	3.91	6.2	0.35	8.5	9.4	0.033
9050	10000	0-2	5,467.3	3,656.8	66.90	1,203.2	22.00	607.3	11.10	145.1	2.65	23.7	32.0	0.848
9050	10100	0-3	10,141.0	4,534.1	44.70	4,458.8	44.00	1,148.2	11.32	262.0	2.58	17.2	21.9	0.565
	10100	3-7	4,228.6	1,339.2	31.70	1,879.7	44.50	1,009.7	23.90	182.3	4.30	22.4	32.8	1.410
9050	10200	0-3	7,180.3	3,686.0	51.30	2,616.4	36.40	877.9	12.30	221.9	3.09	19.1	24.8	0.766
	10200	3-7	7,270.4	1,280.3	16.50	4,741.4	65.20	1,328.7	18.30	293.9	4.04	29.1	41.0	1.660
9050	10300	0-3	6,998.6	3,735.8	53.40	2,527.7	36.10	735.1	10.50	129.8	1.85	41.8	61.5	1.140
	10300	3-6	5,553.2	1,208.8	21.80	2,599.7	46.80	1,744.7	31.40	997.0	1.80	52.2	78.4	1.410
9050	10400	0-3	6,725.3	3,488.2	51.90	2,962.0	44.00	275.1	4.10	145.8	2.17	45.0	67.0	1.450
	10400	3-6	5,367.9	981.0	18.30	3,134.3	58.40	1,252.6	23.30	316.8	5.90	62.2	94.5	5.580
9050	10500	0-1	3,086.0	2,749.2	89.10	196.6	6.37	140.2	4.54	27.4	0.89	18.4	23.5	0.209
9050	10600	0-3	7,698.0	2,103.9	27.30	4,198.7	54.50	1,395.4	18.20	150.0	1.95	31.9	45.3	0.883
8950	10000	0-1	705.9	427.6	60.60	172.7	24.50	105.6	14.90	32.0	4.53	16.5	20.7	0.938
8950	10100	0-4	7,263.0	3,576.3	49.20	3,111.8	42.80	574.9	7.92	213.0	2.93	21.2	28.1	0.823
8950	10200	0-2	5,733.4	3,953.0	69.00	1,497.0	26.10	282.8	4.93	147.3	2.57	13.3	17.9	0.460
	10200	2-5	3,447.2	389.7	11.30	2,158.0	62.60	899.0	26.10	296.9	8.61	24.5	33.3	2.870
8950	10300	0-3	7,327.5	5,210.2	71.10	1,727.3	23.60	390.0	5.32	115.9	1.58	19.9	26.0	0.411
8950	10400	0-1	6,320.1	1,676.7	26.50	3,271.5	51.80	1,371.0	21.70	88.8	1.41	34.3	49.4	0.697
8950	10500	0-1	1,288.6	908.5	70.50	205.4	15.90	174.7	13.60	37.6	2.92	36.4	52.8	1.540
8900	10000	0-1	9,233.1	4,719.5	51.10	2,434.8	26.40	2,078.8	22.50	309.9	3.36	18.1	23.2	0.780
8900	10100	0-1	3,252.3	2,742.7	84.30	351.0	10.80	158.6	4.88	44.0	1.35	18.2	23.3	0.315
8900	10300	0-1	2,384.3	2,114.4	88.70	129.2	5.42	140.7	5.90	29.6	1.24	21.0	27.8	0.345
8800	10000	0-1	4,293.2	3,048.9	71.00	508.4	11.84	735.9	17.14	111.2	2.59	7.4	5.0	0.130
8700	10000	0-1	3,635.1	1,579.9	43.50	1,064.4	29.20	990.8	27.30	141.1	3.88	20.5	27.0	1.050
8600	10000	0-1	1,177.1	744.6	63.30	236.8	20.10	195.7	16.60	54.1	4.60	22.3	29.8	1.370

Wilson River Chromite 18

564046
METS/SLK

046

DRILL CORE SAMPLES - WILSON RIVER AREA "C"

N	E	m	Total Wt(g)	+ 500 μ		- 75 μ		- 500 + 75 μ		Table Concentrate				% Chromite Head
				Wt (g)	%	Wt (g)	%	Wt (g)	%	Wt (g)	%	% Cr2 O3	% Chromite	
	10200	2-4	7,137.9	5,774.2	80.90	1,198.5	16.80	165.2	2.32	61.2	0.86	9.6	11.0	0.095
9250	10250	0-2	5,266.4	4,461.5	84.70	481.6	9.14	323.3	6.14	143.7	2.73	8.1	8.5	0.232
	10250	2-3	4,442.0	830.1	18.70	2,589.9	58.30	1,022.0	23.00	186.6	4.20	36.7	53.2	2.230
	10250	3-5	3,772.7	683.1	18.10	2,415.7	64.00	673.9	17.90	119.5	3.17	36.4	52.8	1.670
	10250	5-7	3,249.1	174.4	5.37	2,413.5	74.30	661.2	20.40	113.8	3.50	38.4	56.0	1.960
	10250	7-8	3,044.4	945.5	31.10	2,064.3	67.80	34.6	1.14	9.7	0.32	24.7	33.4	0.107
9250	10350	0-2	7,464.0	4,597.3	61.60	2,218.4	29.70	648.3	8.69	153.1	2.05	27.4	38.1	0.781
9250	10450	0-2	4,196.2	1,170.2	27.90	1,765.4	42.10	1,260.6	30.00	101.2	2.41	49.4	74.0	1.780
9250	10500	0-2	4,085.0	980.1	24.00	2,444.6	59.90	660.3	16.20	185.3	4.54	31.3	44.8	2.030
9250	10600	0-3	17,164.3	8,160.7	47.60	7,904.4	46.10	1,099.2	6.40	202.7	1.18	25.9	35.5	0.419
	10600	3-5	5,599.4	428.6	7.79	3,853.5	70.10	1,217.3	22.14	388.4	7.06	15.9	19.8	1.400
	10600	5-8	5,900.4	328.8	5.57	4,509.8	76.40	1,061.8	18.00	363.4	6.16	22.4	30.0	1.840
9200	10700	0-4	9,636.0	4,060.7	42.10	4,904.1	50.90	671.2	6.97	368.4	3.80	27.7	38.5	1.460
	10700	4-8	4,381.2	229.2	5.23	3,475.1	79.30	676.9	15.50	323.5	7.38	20.6	27.2	2.010
9150	9900	0-1	3,443.2	2,600.6	75.50	449.9	13.10	393.8	11.43	103.3	3.00	37.2	54.0	1.620
9150	10000	0-2	4,888.2	3,430.0	70.20	1,133.6	23.20	324.6	6.64	123.4	2.52	23.9	32.4	0.817
9150	10100	0-5	9,540.9	3,951.0	41.40	4,717.5	49.50	872.4	9.14	189.6	1.99	16.3	20.4	0.406
9150	10200	0-4	6,158.3	3,124.3	50.70	2,374.4	38.60	659.6	10.71	159.3	2.59	16.2	20.1	0.521
9150	10300	0-4	5,511.2	1,731.2	31.40	2,872.1	52.10	907.9	16.50	148.7	2.70	28.8	40.0	1.080
9150	10400	0-4	11,388.5	7,728.5	67.90	3,163.8	27.80	496.2	4.36	128.1	1.12	11.2	12.0	0.134
	10400	4-8	6,167.2	780.1	12.70	4,265.0	69.20	1,122.1	18.20	215.6	3.50	14.3	19.7	0.690
50	10500	0-3	11,359.0	3,794.4	33.40	5,992.2	52.80	1,572.1	13.80	157.8	1.39	18.7	24.0	0.334
	10500	3-6	9,607.0	1,655.3	17.20	6,601.9	68.70	1,349.8	14.10	551.0	5.74	6.0	4.5	0.258
	10500	6-9	9,978.6	4,911.1	49.20	3,400.4	34.10	1,667.1	16.70	143.0	1.43	4.2	2.5	0.036
	10500	9-12	6,244.2	1,895.1	30.40	3,321.9	53.20	1,027.2	16.50	116.9	1.87	7.7	7.7	0.144
	10500	12-15	6,729.0	1,186.7	17.20	4,289.1	63.70	1,283.2	19.10	329.1	4.89	13.9	19.0	0.929
	10500	15-17	4,527.9	242.0	5.34	3,574.1	79.94	711.8	15.70	208.0	4.59	26.8	37.0	1.700
9150	10600	0-3	14,408.1	10,321.6	71.60	3,039.0	21.10	1,047.5	7.27	236.5	1.64	24.8	33.9	0.556

Wilson River Chromite

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DRILL CORE SAMPLES - WILSON RIVER AREA "C"

N	E	m	Total Wt(g)	+ 500 μ		- 75 μ		- 500 + 75 μ		Table Concentrate				% Chromite Head
				Wt (g)	%	Wt (g)	%	Wt (g)	%	Wt (g)	%	% Cr2 O3	% Chromite	
9950	9800	0-1	480.7	354.9	73.80	38.2	7.95	87.6	18.20	14.5	3.02	3.7	1.0	0.030
9550	9600	0-1	1,634.6	1,040.1	63.60	404.9	24.77	189.6	11.60	29.7	2.43	35.2	50.9	1.240
9550	9700	0-1	1,560.4	1,316.5	84.40	140.5	9.00	103.4	6.63	12.4	0.80	35.6	51.4	0.409
9500	9600	0-1	779.3	526.0	67.50	143.2	18.40	110.3	14.15	16.6	2.13	48.2	71.8	1.530
9450	9700	0-1	7,376.0	4,229.3	57.30	2,102.2	28.50	1,044.5	14.20	87.5	1.19	34.9	50.2	0.597
9400	9600	0-1	1,414.2	486.3	76.60	81.6	12.90	66.8	10.50	6.8	1.07	42.6	62.8	0.672
9400	9900	0-4	5,859.7	1,959.7	36.40	331.9	61.70	581.0	9.92	121.2	2.07	41.2	59.6	1.230
9350	9600	0-3	6,628.7	3,856.4	58.20	1,867.2	28.20	905.1	13.70	251.6	3.80	33.1	47.4	1.800
9350	9700	0-1	1,390.7	1,029.1	74.00	182.8	13.10	178.8	12.90	37.4	2.69	22.8	30.6	0.823
9350	9800	0-3	9,113.4	4,656.7	51.10	3,373.7	37.00	1,083.0	11.90	170.8	1.87	32.4	46.8	0.875
9350	9900	0-1	2,530.2	1,283.6	50.70	670.3	26.50	576.3	22.80	103.1	4.07	36.1	51.5	2.100
9350	9990	0-1	2,805.9	1,828.8	65.20	828.9	29.50	148.2	5.28	71.2	2.54	27.4	38.0	0.965
9350	10000	0-3	7,833.5	4,543.1	58.00	2,680.4	34.20	610.0	7.79	77.6	0.99	35.3	51.0	0.505
9350	10100	0-3	10,195.2	5,100.9	50.00	4,044.6	39.70	1,049.7	10.30	474.5	4.65	20.2	26.5	1.230
	10100	3-5	3,294.0	409.8	12.40	1,766.9	53.60	1,117.3	33.90	237.8	7.22	16.4	20.6	1.490
9350	10200	0-1	909.1	641.8	70.60	172.7	19.00	94.6	10.40	31.8	3.50	45.3	67.3	2.360
9350	10300	0-1	898.5	536.6	59.70	151.8	16.90	210.1	23.40	12.4	1.38	18.4	23.5	0.324
9350	10400	0-1	984.6	509.9	51.80	256.2	26.00	218.5	22.20	50.9	5.97	27.5	38.2	1.970
9350	10500	0-1	587.6	464.7	79.10	61.5	10.50	61.4	10.50	15.6	2.66	10.0	11.8	0.314
9350	10600	0-3	9,647.0	5,263.1	54.50	3,565.0	37.00	819.3	8.59	174.1	1.81	42.7	62.7	1.140
	10600	3-5	4,734.0	624.6	13.20	3,342.7	70.60	766.7	16.20	193.7	4.09	28.7	40.0	1.640
	10600	5-8	4,344.5	359.5	8.28	3,109.1	71.60	875.9	20.20	145.2	3.34	26.8	37.2	1.240
Wilson River Area 200	3300	9900	7,502.5	3,181.2	42.40	3,709.6	49.50	611.7	8.15	207.2	2.77	35.6	51.4	1.720
	2250	9800	3,457.3	1,214.8	35.10	1,544.3	44.70	698.4	20.20	11.0	3.21	25.3	34.4	1.100
	2250	10000	9,398.2	2,404.5	25.60	5,715.3	60.80	1,278.4	13.60	32.7	3.44	21.6	28.8	0.991
	2250	10100	9,239.7	4,444.2	48.10	3,629.8	39.30	1,165.7	12.60	267.1	2.89	19.6	25.5	0.737
		10100	5,065.7	1,404.2	27.70	2,664.6	52.60	996.9	19.70	200.6	3.96	21.1	28.0	1.110
9250	10200	0-2	12,250.0	11,956.4	97.60	217.9	1.78	75.7	0.62	55.4	0.45	10.0	11.8	0.053

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Platinoids Evaluation - Areas A and C

Backhoe samples of 2 cubic metres loose bulk volume from 26 sites were processed at Wilson River by trommelling and jigging during - March - April 198~~9~~⁸. The minus 3.35mm concentrates produced from hutches 1, 2, and 3 were shipped back to Micron Research, Perth for processing. The sampling procedure involved digging to maximum penetration (1-4 metres) and taking a 2 cubic metre slice from one wall of the excavation. 1988
+ +

Because of the high density of the platinoids the majority of liberated grains would report to the hutch 1 product during jigging. Accordingly this product (for each of the pit samples) was processed by dry screening to remove the plus 2.0 mm oversize with wet tabling of all of the minus 2.0 mm product. Wet table concentrate was dried and the iron - chromite minerals were removed by a double pass on a lift disc magnet.

The product weight of the first magnetic product was adjusted by varying the magnetic flux over the range 0.2 - 1.0 amps field current. This equates to a field strength appropriate for the removal of magnetite or high iron chromite.

The second magnetic product was separated using a field strength of 1.5amps which equates to the flux necessary for removal of low iron bearing chromite.

Non magnetics produced via this technique are low in iron and chrome but significantly upgraded in platinoids, gold, tin and related minerals.

Analysis of the non magnetics for platinoids and gold was done by Genalysis Laboratory Services. The procedure involves fine grinding using a tungsten carbide bowl followed by fusion with collection of platinoids in a nickel sulphide button.

As a check on platinoids and gold associated with chromite or iron oxides riffle samples of the magnetics 1 and 2 samples were also assayed by the same technique. In this instance gold assays were done by fire assay and lead button collection with A.A. finish.

The attachment Appendix F details the assay data and location of the sample sites.

Results

While the level of platinoids in non mags products was significant the value of these metals relative to the ore tonnage was insignificant.

Gold values were also significant in the non mags fraction but again the quantity of non mags generated was low.

Values from platinoids and gold for areas A and C can be ignored in any economic assessment of these areas.

Preliminary Economic Evaluation

Revenue

From the ore reserve evaluation it can be concluded that a resource of around 1.7 million tonnes of ore grading 1.8 - 2.0% chromite exists in Areas A and C.

The current price for 43% Cr₂O₃ content foundry grade chromite is \$500/t ex store Perth. This suggests that a conservative ex works price for 60% Cr₂O₃ material would be \$400/tonne.

Gross revenue therefore is \$7.20/tonne of ore treated at 1.8% chromite grade - annual gross income \$2,880,000 at 400,000 tpa throughput.

Costs

From the conceptual flowsheet the operating cost for a 400,000 tpa operation on 2 shifts, 5 day week = 65 tphr throughput is computed as:

Area	Operating Cost - Directs	\$/tonne ore
Excavation	\$2.50/bcm, 2.4t/bcm (on contract)	1.042
Manning	6 operators, 2 maintenance, 1 supervisor, \$30,000 pa ea plus 30% on costs	0.878
Power	3.5 Kw hr/t at \$0.12/unit	0.420
Maintenance	7.5% pa of 1.8×10^6	0.338
Fuels	Drying, Vehicles - 475l/day, \$0.35/l	0.108
Packaging	\$50/t product (25kg bags on pellets)	0.900
Admin charges	\$1200/month (phone, fax)	0.036
Rehabilitation	Tailings Management \$78,000 pa allowance	0.195
	Total	3.917
Capital Charges	Years 1/2	\$/tonne ore
Interest	Assume 1.8×10^6 is borrowed at 20 % pa (for 2 year term)	0.90
Capital	Payback capital at end 2 year term	2.25
	Total	3.15

<u>Initial Development Costs (post 1988/89)</u>		\$
Additional Exploration on Wilson River leases		50000
Feasibility/Environmental Study		35000
Site Clearing		15000
Services/Market Studies		50000
		\$150,000
Profits:	Years 1 - 2	NIL
	Years 3 - 4 +	2,700,000
	Tax at 39%	1,053,000
	<u>Indicated Profit</u>	<u>\$1.00/tonne ore</u>

Capital Cost Estimate for 400,000 tpa Plant

Area		\$ (Installed Cost)	
Feed/Screen	Bin	25000	
	Feeder	10000	
	Trommel	250000	
	Concrete 15m ³	15000	
	Power	25000	
	Conveyors - 1	15000	
	Conveyors - 2	10000	
	Conveyors - 3	10000	
	Bins and Chutes	15000	
	SUBTOTAL	375,000	
	Undersize	Knelsons	80000
		Chutes	5000
Screens		35000	
Pump Hopper		75000	
Electrics		15000	
Gravity		Cyclones 4 x 10"	10000
	Spirals 4 x Triple	40000	
	Steelwork 20 t	40000	
	Pumps 2/1.5	10000	
	Pumps 3/2	25000	
	Attritioner	120000	
	Magnets	50000]	
	Mags Conveyor	10000	
	Pump	10000	
	Cyclones	6000	
	Bin and Feeder	8000	
		15000	
	Electrics	70000	
	Area Sump Pumps	50000	
	Concrete 15m ³	15000	
SUBTOTAL	\$689,000		

Product Packaging		
	Rotary Drier	175000
	Discharge Screw	5000
	Bucket Elevator	5000
	Exhaust Fan and Ducting	5000
	H T Rolls	95000
	Bins	25000
	Packing MC	50000
	Electrics	20000
	Shed	20000
	SUBTOTAL	\$400,000
Services Power/Water		
	Pumps	50000
	Electrics	100000
	SUBTOTAL	\$150,000
	Cost of Above	1,565,000
	Engineering - 15%	235,000
	TOTAL	1,800,000

Major Impact

From the above the profitability could be improved by:

An increase in overall grade to 2% chromite. Gross Revenue becomes \$8/tonne ore while operating cost increases by \$0.10/tonne ore. While the area C resource is well defined at 1.8% chromite there is scope for a somewhat higher figure for area A.

An increase in ex works price to \$500/tonne of chromite. At 1.8% chromite = \$9.0/tonne gross revenue

Increased reserves: doubling reserves would dramatically improve the after pay back profit for the years beyond 3 and 4.

Conclusions and Recommendations

The above evaluation makes certain assumptions as regards costs and income which indicate basically a break even/low profitability project on current reserves.

Based on relative chrome contents, since the 43% Cr₂O₃ material quoted commands \$500/tonne, at 60% Cr₂O₃ grade Wilson River material could command \$700/tonne. The potential to increase the ex works price to \$500 (as indicated) would seem realistic but should be checked out. Market acceptance of the product is vital and it would certainly be worthwhile producing chromite for market studies prior to project commitment.

Current reserves are low and the potential to increase chromite ore reserves by a factor of 50 to 100% should be progressed.

Within the present Wilson River lease held by Callina there is an opportunity to add to the reserves based on the occurrence of area D (as yet unexplored) and areas to the west of area A identified by Jack Thompson in his recent examination of the aerial photographs for the area. Relevant sections of the report are attached - Appendix G, including the plan showing the location of these new areas.

The hypothesis that the areas A, C and D are glacial moraine which has been deposited at the foot of a retreating glacier and leached in situ appears to fit all of the known facts relating to the geology of the area. The path of the glacier lies almost entirely over peridotite ultramafics explaining the absence of significant quantities of granitic ^{Sourced} ~~quartz~~ minerals.

Costs associated with exploration of these features should be budgeted at:

Exploration (includes the Field Assistant - Camp Caretaker)	\$14,000
Gridding/Drilling/Excavating	\$17,000
Testing	\$12,000
Fares, Support Costs	\$5,000
TOTAL	\$48,000

Allow \$50,000 (shown above under Initial Development Costs)

Exploration of the Chromite Creek Area has the potential to add to the reserves. The facility designed for Wilson River ore would also treat chromite bearing material from this area. Chromite Creek mineral is cleaner and not contaminated by magnetite or goethite/limonite.

Cost for this activity have been estimated at \$35,000 for the next field season. This applies to the Chromite Creek area alone and includes cutting access tracks, baseline excavation, pitting in selected areas, sample testing, support geology and evaluation. Additional expense would be involved in bringing the area to ore grade tonnage accuracy (around \$50,000) before it could form part of the ore reserves.

It must be borne in mind that proven reserves in this area would mean plant relocation as regards the ore handling/gravity separation section of the plant or alternatively trucking of ore. These are added expenses which could easily be compensated for by improved chromite grade or co-product values (tin, gold, and osmiridium) which are known to occur in the area.

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Appendix A

Dr R Blanks,
Metskill,
203 The Esplanade,
Mt Pleasant,
WA

16-6-88 .

1000 0 07 435

Preparation of 29 polished sections of
magnetic chromite products and
and analysis of chromite occurrence.

R Townend.

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Introduction

Polished sections were made of all samples. These were mostly composed of chromite and limonite goethite, with some non opaque gangue in the non magnetics. Point counting was undertaken of each briquette, with about 320 points. The results are volume %.

Results

The results are presented in the Table

057

Appendix A

Table of Point Counts, Vol%

	LIMONITE	CHROMITE	CHROMITE/LIM.	GANGUE
21B				
-0.5H.MGS.	27.1	72.9		
-0.5MAGS.1	32.3	67.3	0.3	
-0.5MAGS.2	35.7	62.0	1.9	
-0.5MIDS	61.3	38.7		
-0.5N/MAGS.	52.0	17.3		30.7
-2. H. MAGS.				
-2.MAGS.1	96.1	3.9		
-2.MAGS.1	84.1	14.6	1.2	
-2.MAGS.2 *	77.7	20.5	0.9	
-2.MIDS	90.6	8.1	1.1	
-2.N/MAGS.	98.7	0.4	0.9	
+2.H.MAGS.				
+2.MAGS.1	99.6	0.4		
+2.MAGS.1	98.3	1.7		
+2.MAGS.2	97.7	2.3		
+2.N/MAGS.	99.6	0.6		
22B				
-0.5H.MAGS	59.5	38.7	1.2	0.6
-0.5MAGS.1	54.1	42.8	3.1	
-0.5MAGS.2	57.6	41.7	0.7	
-0.5MIDS.	69.6	29.6	0.8	
-0.5N/MAGS	57.4	18.3		24.3
-2.H.MAGS				
-2.MAGS.1	97.5	1.6	0.9	
-2.MAGS.1	79.3	19.3	1.4	
-2.MAGS.2	73.1	23.3	3.6	
-2.MIDS	91.8	8.2		
-2.N/MAGS.	91.1	7.0	1.9	
+2.HMAGS.				
+2.MAGS.1	97.3	2.7		
+2.MAGS.1	99.7	0.3		
+2.MAGS.2	96.2	2.8	1.0	
+2.N/MAGS.	99.1	0.9		
22				
-0.5MAGS.2	46.8	52.2	1.0	

* also chromite lined by limonite 0.6%.

Comment.

These results show that the bulk of the chromite present is discrete from the main gangue limonite goethite. The chromite optically appears to show little variation in composition within grains. This was confirmed by SEM on sample 21B specifically for the -0.5mm sizes, where more than 20 chromites within each sample were scanned. There also appeared to be little significant difference in composition between magnetic fractions.

The association with limonite goethite usually was where small angular inclusions of chromite were within a dominant iron oxide host, notably in the coarser fractions. Examples are given in the photomicrographs. Dominant chromite with minor limonite rims was rare, as was veining by secondary limonite.

There is variation in the nature of the limonite goethite but this has not been quantified.

Table of Point Counts, Vol%

	LIMONITE	CHROMITE	CHROMITE/LIM.	GANGUE
21B				
-0.5H.MGS.	27.1	72.9		
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-0.5N/MAGS.	52.0	17.3		30.7
-2. H.MAGS.	96.1	3.9		
-2.MAGS. 1	84.1	14.6	1.2	
-2.MAGS. 2 *	77.7	20.5	0.9	
-2.MIDS	90.6	8.1	1.1	
-2.N/MAGS.	98.7	0.4	0.9	
+2.H.MAGS.	99.6	0.4		
+2.MAGS 1	98.3	1.7		
+2.MAGS 2	97.7	2.3		
+2.N/MAGS.	99.6	0.6		
22B				
-0.5H.MAGS				
-0.5MAGS. 1	54.1	42.8	3.1	
-0.5MAGS. 2	57.6	41.7	0.7	
-0.5MIDS.	69.6	29.6	0.8	
-0.5N/MAGS	57.4	18.3		24.3
-2.H.MAGS	97.5	1.6	0.9	
-2.MAGS. 1	79.3	19.3	1.4	
-2.MAGS. 2	73.1	23.3	3.6	
-2.MIDS	91.8	8.2		
-2.N/MAGS.	91.1	7.0	1.9	
+2.HMAGS.	97.3	2.7		
+2.MAGS. 1	99.7	0.3		
+2.MAGS. 2	96.2	2.8	1.0	
+2.N/MAGS.	99.1	0.9		
22				
-0.5MAGS. 2	46.8	52.2	1.0	

* also chromite lined by limonite 0.6%.

060

Comment.

These results show that the bulk of the chromite present is discrete from the main gangue limonite goethite. The chromite optically appears to show little variation in composition within grains. This was confirmed by SEM on sample 21B specifically for the -0.5mm sizes, where more than 20 chromites within each sample were scanned. There also appeared to be little significant difference in composition between magnetic fractions.

The association with limonite goethite usually was where small angular inclusions of chromite were within a dominant iron oxide host, notably in the coarser fractions. Examples are given in the photomicrographs. Dominant chromite with minor limonite rims was rare, as was veining by secondary limonite.

There is variation in the nature of the limonite goethite but this has not been quantified.

PHOTO 1 21B -2MM N/MAGS CHROMITE IN COARSE LIMONITE
NIC UNC. FIELD WIDTH 0.54MM

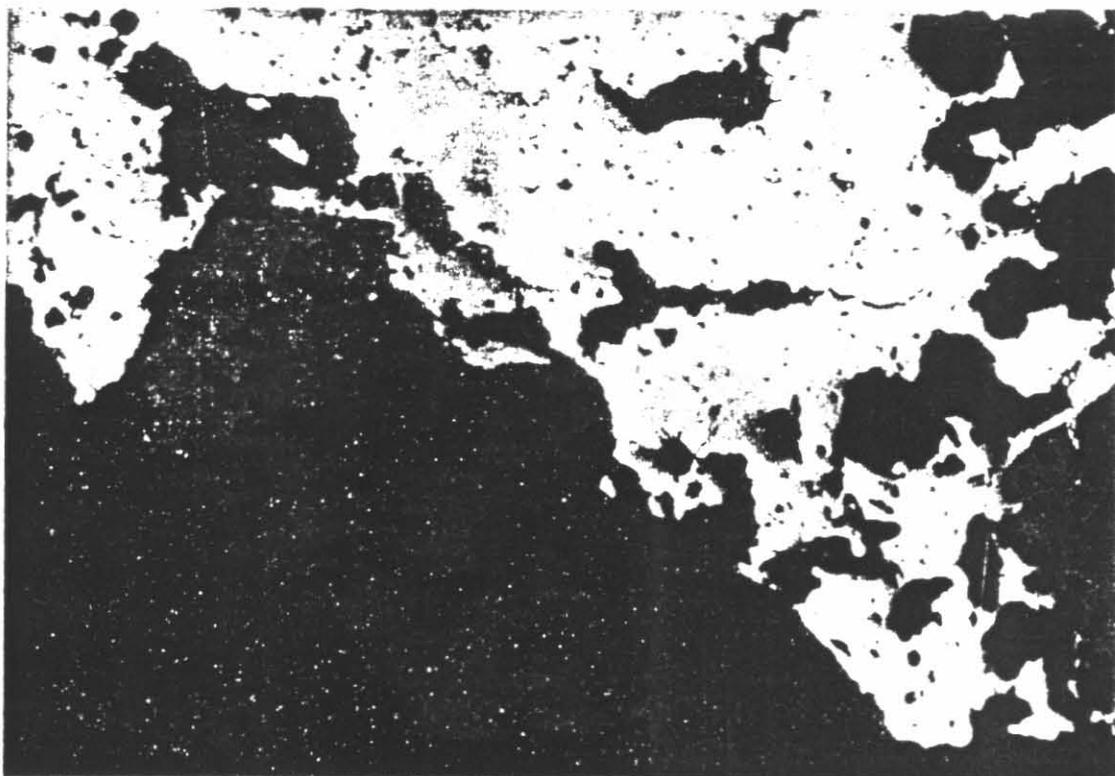
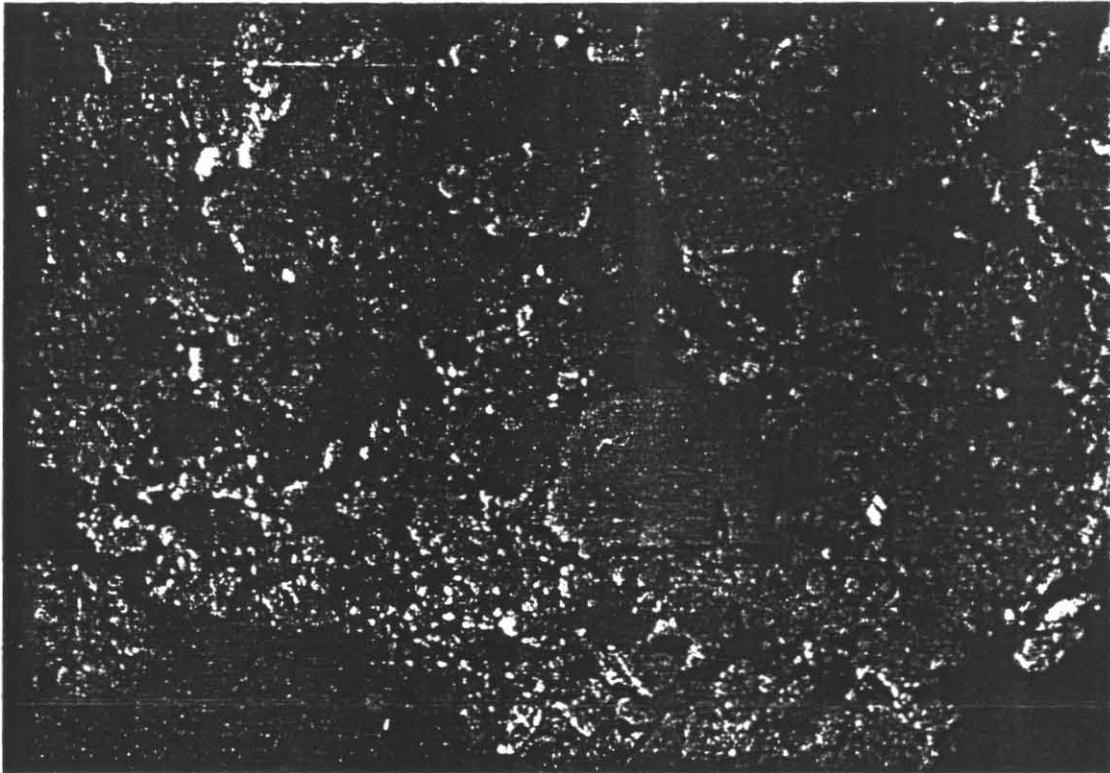


PHOTO 2 21B +2MM MAG 2. CHROMITES NEAR MARGIN OF COARSE GOETHITE.
NIC UNC. FIELD WIDTH 0.54MM

PHOTO 3 22B +2MM PARTLY REPLACED CHROMITE IN GOETHITE.
NIC UNC. FIELD WIDTH 0.54MM

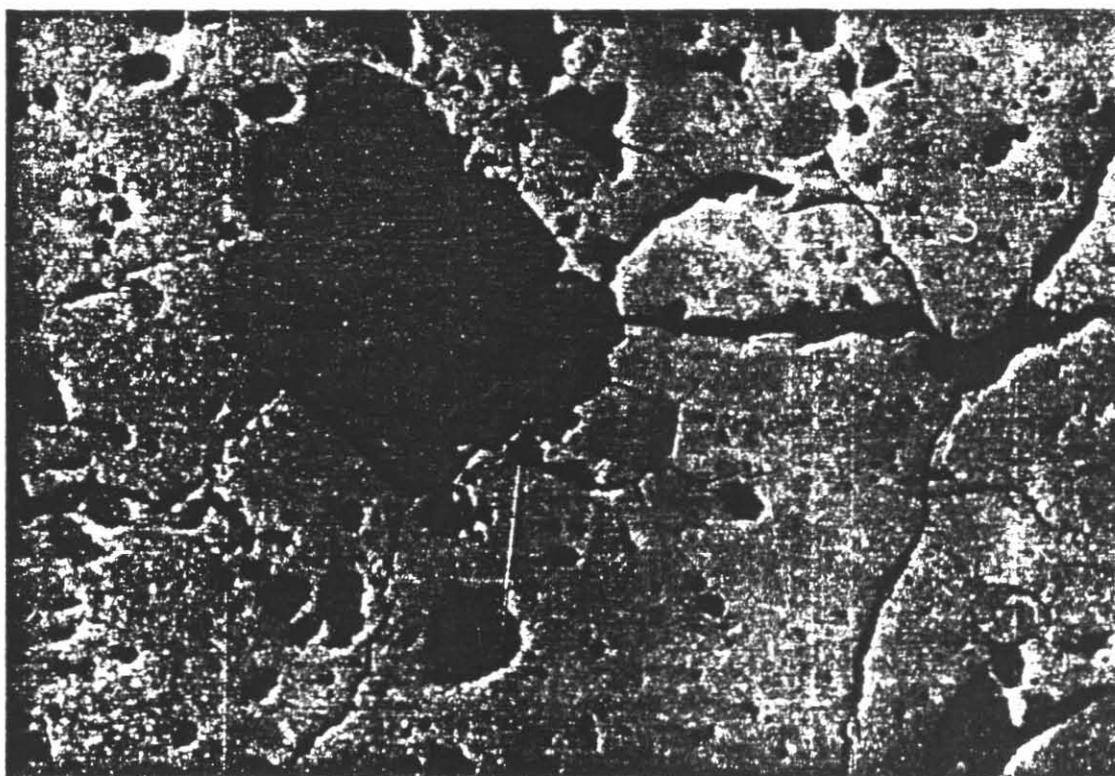
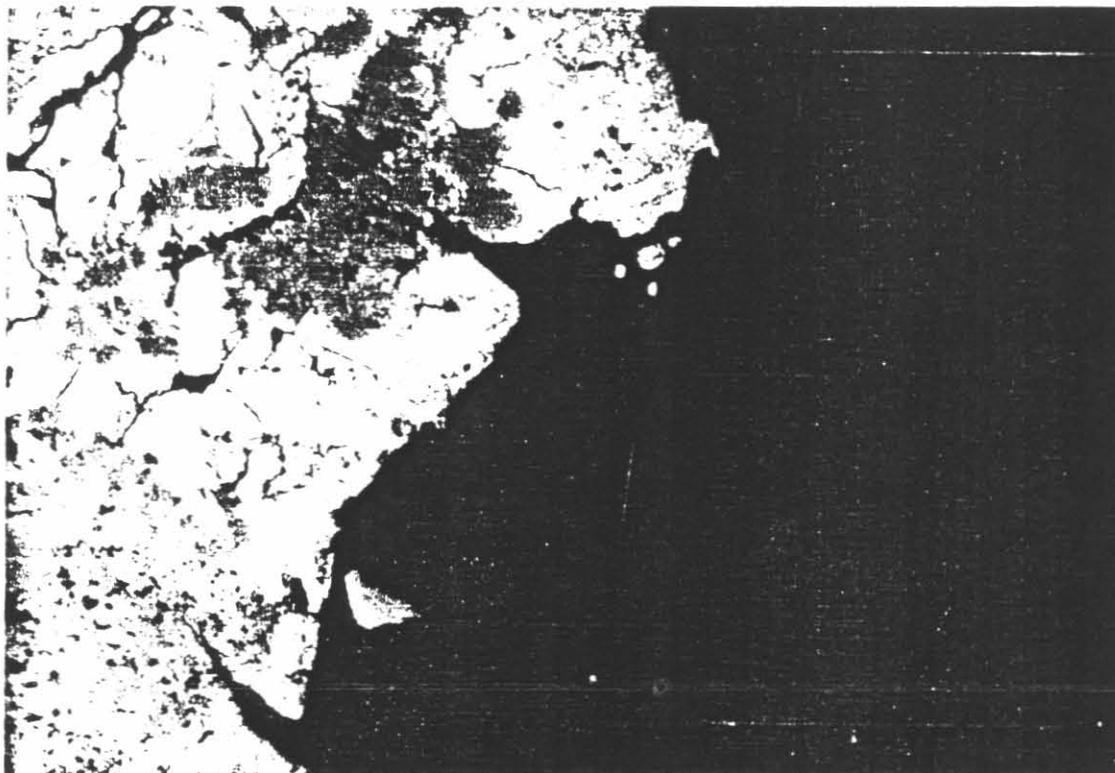


PHOTO 4 22B +2MM N/MAG. COARSE AND FINE CHROMITE IN GOETHITE.
NIC UNC. FIELD WIDTH 0.54MM

PHOTO 5.22B -2MM MAG 1 PARTLY ALTERED CHROMITE PLUS CLAY RIM.
NIC UNC. FIELD WIDTH 0.54MM.

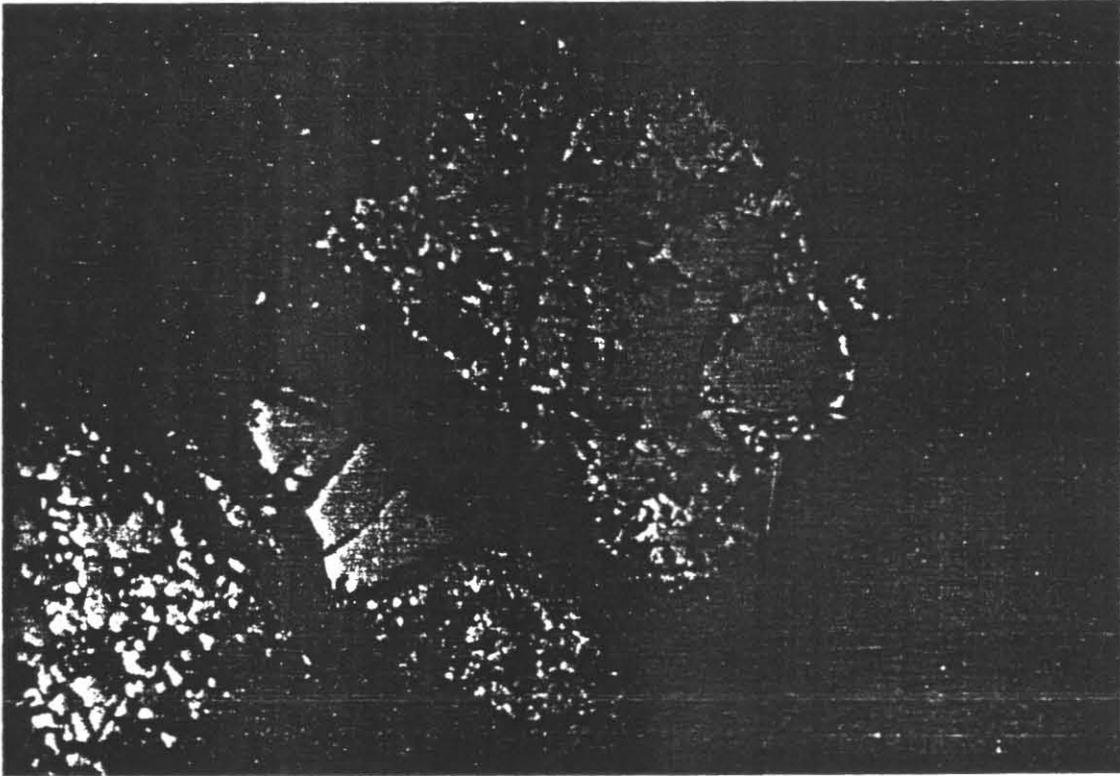


PHOTO 6.22B -2MM MAG 2. CHROMITE PARTLY REPLACED BY GOETHITE.
NIC UNC. FIELD WIDTH 0.54MM

PHOTO 7 22B B -2MM N/MAG ZONED CHROMITE. NIC UNC. FIELD WIDTH 0.54MM

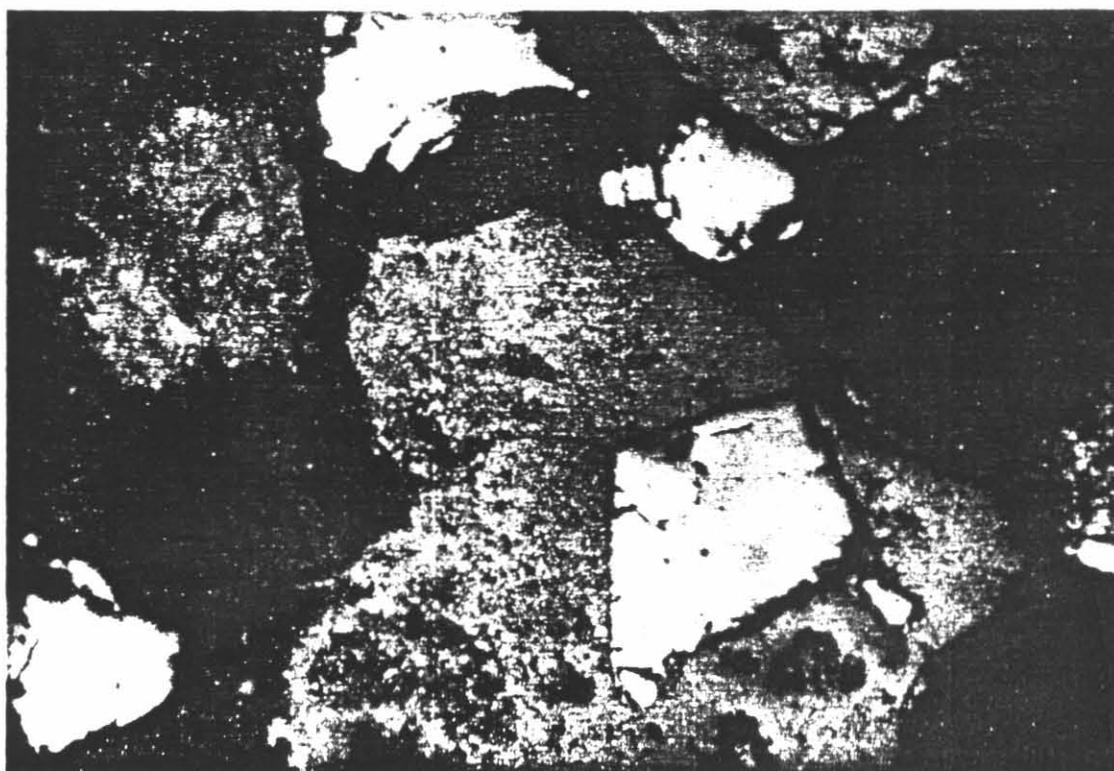


PHOTO 8 22B -0.5MM MAG 1 FREE CHROMITE, CHROMITE IN LIMONITE, FREE LIMONITE. NIC UNC. FIELD WIDTH 1MM.

PHOTO 9 22B -2MM MAG 1. CHROMITE FRAGMENTS IN COARSE GOETHITE.
NIC UNC. FIELD WIDTH 1MM.

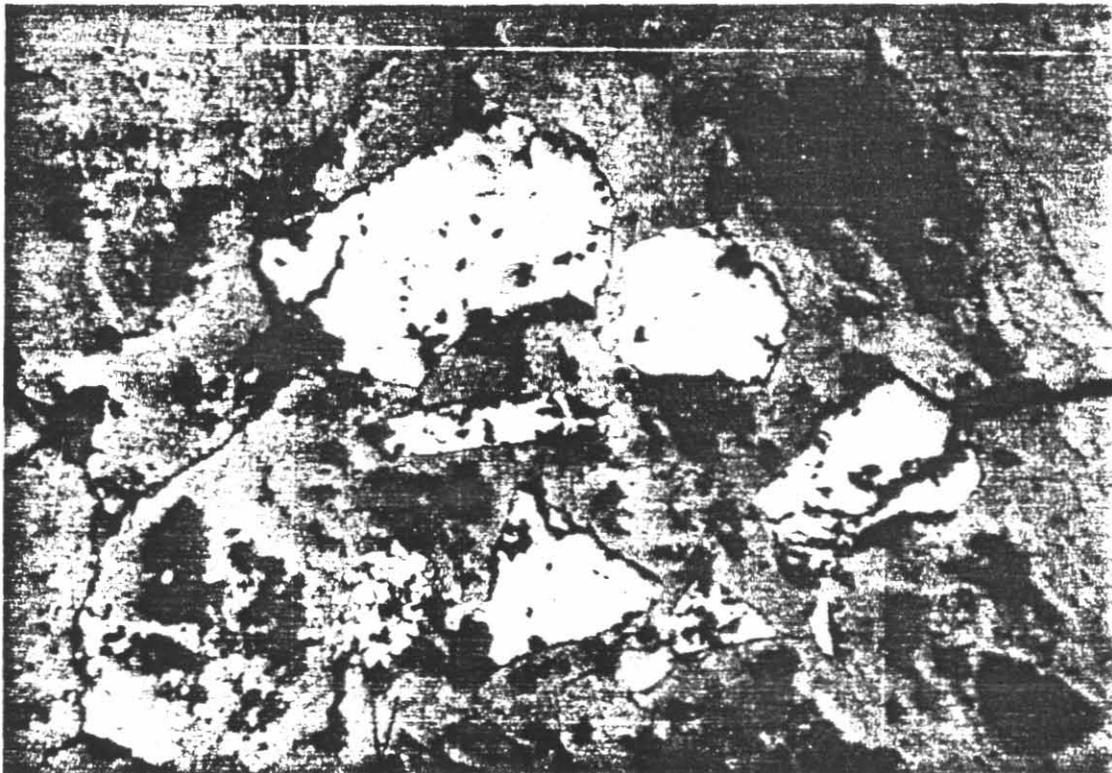


PHOTO 10 22B -2MM MIDS. CHROMITE WITH LIMONITE FORMED ALONG
FRACTURES. NIC UNC. FIELD WIDTH 1MM

1.3 Method of Evaluation

Reserve and product estimates for the material evaluated by bulk sampling (viz. the top two metres of the deposit) have been made by assigning areas of influence to each of the bulk sample sites and then by calculating a weighted average assay for the entire area. This reserve is considered to be a probable reserve although several assumptions had to be made.

The reserve for the material below two metres depth was evaluated by auger drilling. The method of assessment here has been to compare assay data for the auger holes to assay data for the bulk samples and thus make generalizations/extrapolations about the total volume. This is considered to be close to a possible resource with confidence on grades plus or minus 20%.

Broad generalizations have then been made about the possible volumes in Areas B, C and D and therefore about the total resource in the Wilson River tenement.

1.4 Summary of Results

Area A

1. Top 2 metres

<u>Product</u>	<u>Size</u> (mm)	<u>Mass</u> (t)	<u>Grades</u>		
			<u>Cr2O3</u> (%)	<u>Ir</u> (ppb)	<u>PM's</u> (ppb)
H1	<0.5	15,542 ✓	27.9 ³²	237	457
	0.5-2.0	43,044	9.9		
	>2.0	40,737	3.8		
H2,3	<0.5	23,630	20.2 ²⁶	41	95
	0.5-2.0	43,227	7.2		
	>2.0	40,956	2.7		
Tails	<0.5	257,465	11.4	91	210
	0.5-2.0	46,605	4.1		
	>2.0	1,234	1.6		
		-----	-----	-----	-----
		512,441	9.9	55	127
	>3.0 (est)	1,031,309	-	-	-
		-----	-----	-----	-----
	TOTAL	1,543,750	3.3	18	42
		-----	-----	-----	-----

- Assumes: (1) S.G. of 2.5 (Volume is 617,500 cubic metres)
 (2) Ratio of Total Precious Metals: Iridium 2.31:1
 (3) No Chrome, P.M's in oversize

067

- Note:
- (1) The effective chromite grade is 0.082 tonnes per cubic metre of alluvium
 - (2) The precious metals grades are clearly sub-economic. However, the Non-Magnetic fraction of Hutch 1, <0.5mm contain an average 1.6ppm iridium (say 3.7 ppm P.M's). This product may be worth extracting separately at little loss to overall chromite reserves.

2. Below 2 metres.

Total Volume	=	1,029,250
Total Mass	=	2,573,125

3. Total Area A

Total Volume	=	1,646,750
Total Mass	=	4,116,860

At the assumed overall grade, this represents a total of 136,000 tonnes of contained Cr₂O₃. Assuming no loss in beneficiation (or that whatever loss sustained is offset by underestimation of grades) and a product grade of 65% this gives a potential total saleable production of 209,000 tonnes of chromite.

4. Remainder of Deposit.

Area A is 25 ha in size. Average depth 6.5 metres to bedrock.

Area C is 40 ha in size. Average depth of >6.5m. Chromite values appear to be good.

Area B is 20 - 30 ha but shallow. Good chromite and P.G.E. values.

Area D is 10 - 15 ha. Unknown depth or values.

Thus, Area A probably constitutes 25% of the total available resource.

Assuming comparable grades, the total potential chromite production could be 1,000,000 tonnes.

1.5 Future Direction

The coming nine months is a critical period in the development of the Wilson River project, heightened by the dwindling cash reserves of Callina.

In addition to assembly of the data resulting from the 1988 exploration programme, several areas must be addressed and resolved within that nine month period. These are:

CSIRO
ATT: Dr Jiri Just
Division of Mineral Products
Underwood Avenue
Floreat Park

17 March, 1988

Dear Dr Jiri,

Following our discussions we wish you to further mineralogically analyse our Wilson River deposit. Twelve representative sample sites have been collected for analysis. A map is enclosed showing the sample site locations.

We wish you to make polished sections of the samples and scan each using the micron probe. We would like you to simply identify and count the relative proportions of the three chrome bearing minerals in the deposit. Your final report should also give us some indication of the relative size of the grains of these chrome bearing minerals.

The samples are all <0.5mm and have been magnetically separated into Hi Mag, Mag 1, Mag 2, Mids, and Non-Mag fractions. The samples and their proportions of the magnetic fractions are listed below:

DH 21	37405	8-10m:	<0.5mm Hi Mag	16%	x
			<0.5mm Mag 1	5%	✓
			<0.5mm Mag 2	8%	x
			<0.5mm Mids	15%	x
			<0.5mm Non Mag	56%	✓ 0
DH 25	38274	0-2m:	<0.5mm Hi Mag	8%	x
			<0.5mm Mag 1	51%	✓
			<0.5mm Mag 2	21%	✓
			<0.5mm Mids	11%	✓
			<0.5mm Non Mag	9%	✓
DH 25	38287	2-4m:	<0.5mm Hi Mag	4%	x
			<0.5mm Mag 1	7%	✓
			<0.5mm Mag 2	3%	x
			<0.5mm Mids	55%	✓
			<0.5mm Non Mag	32%	✓

Sample No. JJ 2095, DH 82, 6 - 8 m.

Minerals identified: chromite, quartz, limonite, serpentine, magnetite, nickeloan magnetite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 9
limonite etc.: 90
remainder: quartz 1

Grainsize:

chromite: mostly 50 to 150 μm , up to 500 μm
limonite etc.: mostly 80 to 200 μm , up to 500 μm
quartz: mostly < 100 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (11 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	68.26	3.85	0.53	20.25	6.83	--	0.12	0.13
Range: highest	70.38	5.79	1.70	23.13	9.68	0.65	0.27	0.18
lowest	64.96	2.52	--	17.99	3.84	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	70.38	3.22	--	19.41	6.60	--	0.27	0.12
lowest	64.96	4.68	1.70	19.32	8.85	--	0.19	--

Average composition of normal and anomalous chromite (number of analyses in brackets):

normal (4)	66.88	3.59	1.28	19.04	8.93	--	--	--
anomalous (7)	69.06	4.00	--	20.95	5.63	--	0.14	0.14

Fe oxides (2 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	1.33	78.22	1.49	5.51	0.54	0.24	2.37	0.16	--

Analyses with highest and lowest Cr:

highest	1.55	80.53	0.64	4.30	0.55	0.37	1.67	0.22	--
lowest	1.10	75.91	2.34	6.72	0.53	--	3.08	--	--

Three grains of magnetite with about 0.3% NiO and one grain of nickeloan magnetite with 6.02% NiO were found.

The sample contains abundant grains of serpentine with no detectable chromium. The 10.24% Cr₂O₃ found in one grain is most likely due to a chromite inclusion.

Sample No. JJ 2077, DH 25, 0 - 2 m.

Minerals identified: chromite, quartz, limonite, hematite, silicified limonite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 20
 limonite-hematite: 20 limonite >> hematite
 remainder: quartz 60

Grainsize:

chromite: mostly < 80 μm , up to 120 μm . ✓
 limonite-hematite: mostly 100 - 300 μm
 quartz: mostly < 100 μm

Screening would not separate chromite from quartz.

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (20 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	70.14	3.82	--	18.06	7.32	--	--	0.40
Range: highest	74.33	6.54	n.d.	21.57	9.10	1.10	0.27	0.66
lowest	66.75	1.04	n.d.	16.09	4.01	n.d.	n.d.	0.19

Analyses with highest and lowest Cr:

highest	74.33	1.04	n.d.	15.20	8.91	n.d.	n.d.	0.52
lowest	66.75	6.54	n.d.	18.75	7.44	n.d.	0.22	0.31

Average composition of normal and anomalous chromite (number of analyses in brackets):

normal (1)	69.48	2.29	n.d.	18.90	8.99	n.d.	n.d.	0.34
anomalous (19)	70.18	3.87	n.d.	18.02	7.24	n.d.	n.d.	0.40

Fe oxides (21 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average	4.40	79.71	0.95	3.99	0.23	0.28	1.44	0.21	0.28

Analyses with highest and lowest Cr:

highest	9.38	83.98	0.76	3.51	0.16	--	1.24	0.33	0.28
lowest	1.74	80.90	1.60	3.51	0.36	--	1.75	0.15	--

Sample No. JJ 2076, DB 21, 8 - 10 m.

Minerals identified: chromite, quartz, limonite, hematite,
silicified limonite

Approximate percentage (number of particles per 100 particles) of
chromite and limonite-hematite:

chromite:	2	
limonite-hematite:	15	limonite > hematite
remainder: quartz	83	

Grainsize:

chromite: 50 to 500 μm , mostly > 200 μm
limonite-hematite: mostly 200 - 300 μm , some grains up to 1 mm
quartz: mostly < 100 μm

A 150 μm screen would recover most of chromite and limonite into
the oversize fraction.

Chemical composition (in oxide wt.%) of chromite, chromiferous
limonite, and chromiferous hematite as derived from electron
microprobe analyses.

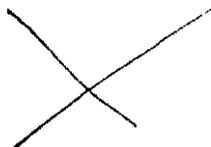
Chromite: no chromite analysed. No grains for analysis found
within acceptable time limit.

Fe oxides (6 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	3.25	81.16	0.87	3.20	0.28	--	1.96	--	0.23

Analyses with highest and lowest Cr:

highest	5.54	79.69	--	2.35	0.28	0.21	1.32	--	--
lowest	0.88	79.20	2.93	2.21	0.22	--	3.64	--	0.43



dissolution. Corrosion starts usually from the surface of the grain and proceeds along fractures and planes of parting until only disjointed pitted relicts are left. It is of interest that the ferruginous material surrounding the relicts has chromium content of about the same level as limonite particles without any visible chromite relicts. It appears that only iron and aluminium from the chromite remains in situ while chromium is mostly leached out. Fig. 1 and 2 illustrate advanced stage of chromite corrosion.

Electron microprobe investigations have also confirmed that a significant proportion of chromium is tied in iron oxides-hydroxides referred to as limonite and hematite and their mixtures with silica and aluminium oxides and hydroxides (laterite). These materials do not seem to be direct products of oxidation of chromite, they are most likely products of regional weathering and lateritisation. Chromium content in limonite varies mostly between 3 and 7% Cr_2O_3 , values over 10% are uncommon. There is not any perceptible difference in chromium content between particles containing chromite relicts and chromite-free particles. Chromium content in hematite and silicified laterite is on average lower than that in limonite and usually varies between 1 and 4% Cr_2O_3 but values up to 12% were also encountered. Chromium content in laterite (distinguished from limonite by its high aluminium content) is low, usually between 0.5 and 2.5% Cr_2O_3 . Average of all analysed grains of ferruginous material (limonite, hematite, laterite, 356 analyses) is 4.25% Cr_2O_3 . This chromium cannot be upgraded by any mechanical process and can be recovered only by leaching.

Better sampling coverage and better knowledge of local geology would be required for evaluation of distribution of chromite concentrations that might be of economic interest. I would like to stress once again that chemical analysis of the material gives indication of presence and quantity of chromite only in cases of high Cr content, as the "background" value of non-recoverable Cr could be perhaps as high as 5 - 6% Cr_2O_3 .

Detailed quantitative data on composition and distribution of the major minerals are given in descriptions of the individual samples.

DH 55	0 - 2	37392	JJ 2087	19	40	29	8	4	1234
DH 58	0 - 4.5	37408	JJ 2088	46	36	13	0	4	123
DH 63	0 - 6	37393	JJ 2089	36	41	12	5	6	123 5
DH 71	0 - 9	38272	JJ 2090	20	37	24	8	11	12345
DH 73	0 - 7.5	37455	JJ 2091	57	21	13	0	0	123
DH 82	0 - 2	38293	JJ 2092	33	42	0	0	25	12 5
	2 - 4	38297	JJ 2093	44	41	10	0	5	123
	4 - 6	38280	JJ 2094	50	41	8	0	2	123
	6 - 8	38279	JJ 2095	31	56	8	0	4	123
DH 85	0 - 2	38273	JJ 2096	35	33	25	4	4	123
	2 - 4	38288	JJ 2097	20	54	15	0	11	123 5
	4 - 6	37389	JJ 2098	35	42	18	3	2	123

One polished section was prepared from each sample and examined by means of an optical microscope ZEISS Photomikroskop II. One photomicrograph of each sample was taken at a magnification 60x for a crude modal analysis ("graincounting") to determine an approximate percentage of chromite and limonite-hematite in the sample. A conductive carbon film was vacuum deposited on the polished sections to facilitate electron microprobe analyses. The optical examination has been done before the EPMA analysis as the carbon film is difficult to remove completely and any relicts would interfere with the examination.

The samples were analysed using a MAC 400S electron probe microanalyser with ORTEC x-ray energy dispersion spectrometer. An "OXIDE" computer program by N. Ware was used for on-line data reduction.

RESULTS

The present work confirmed results of previous investigations. Two types of chromite are present in the deposit:

1. "normal" chromite, i.e. chromite with the ratio of the divalent and trivalent metals corresponding to the standard spinel formula AB_2O_4 and

2. "anomalous" chromite deficient in divalent metals and with surplus of trivalent metals.

Anomalous chromites are very rich in chromium, the average Cr_2O_3 content being over 70%. Anomalous chromites predominate over the normal chromites in all examined samples.

Chromite grains are generally massive and smooth in the polished section but some grains show evidence of corrosion or partial

INTRODUCTION

Twenty three samples of chromite concentrates from 12 drill holes at the Wilson River deposit were received for mineralogical examination and electron microprobe analyses. While the work was in progress, CALLINA N. L. advised us in early June that the mineralogical investigation was at least temporarily terminated. The report was to be written on basis of the data accumulated to that time and no further analyses and examination were to be carried out. Sample preparation and brief microscopic examination of all samples and electron microprobe analyses of 16 samples was completed to that date and photomicrographs for modal analysis of all samples prepared. This report contains results of processing of the thus obtained data.

METHOD

The samples were received as separate magnetic fractions. In order to limit the number of investigated and analysed polished mounts the original concentrates were "reconstituted" by mixing the fractions in the appropriate proportions. Fractions which represented 5 or less percent of the sample were mostly ignored.

As the analytical numbers of the samples were out sequence, the samples were processed under internal numbers JJ 2076 to JJ 2098. The correlation of the sample numbers, proportions of the magnetic fractions and the pattern of combination of the fractions are given in the following table.

Wilson River Chromite Samples

Hole	m	anal. No.	inter. No.	magnetic fractions					comb.
				HM	M1	M2	MID	NM	
				1	2	3	4	5	
DH 21	8 - 10	37405	JJ 2076	16	5	8	15	56	1 345
DH 25	0 - 2	38274	JJ 2077	8	51	21	11	9	12345
	2 - 4	38287	JJ 2078	4	7	3	55	32	2 45
	4 - 7	37451	JJ 2079	38	19	3	9	31	12 45
DH 32	0 - 2	38290	JJ 2080	21	43	25	4	7	123 5
	2 - 4	38259	JJ 2081	21	54	19	8	8	12345
	4 - 6	38284	JJ 2082	5	38	38	10	9	12345
DH 36	0 - 2	37436	JJ 2083	12	42	30	9	8	12345
	2 - 4	37422	JJ 2084	17A	30B	26C	15D	12E1	separate E2 mounts
	4 - 6	37453	JJ 2085	39	17	6	0	39	123 5
DH 48	0 - 2	38281	JJ 2086	43	24	21	5	6	123 5

REPORT ON MINERALOGICAL EXAMINATION AND ELECTRON PROBE ANALYSES
OF SAMPLES JJ 2076 TO JJ 2098 FROM THE
WILSON RIVER CHROMITE DEPOSIT

Dr. J. Just, Mineralogist

Perth, 27th June, 1988.

SUMMARY

1. Twenty three samples were received for mineralogical examination and electron microprobe analysis. All samples were examined microscopically, major minerals were determined and quantified. 16 samples were analysed by EPMA before the work was terminated on request of CALLINA N.L.
2. The examined samples consist mostly of ferruginous material (limonite, hematite, laterite) with variable amount of quartz and chromite.
3. 213 grains of chromite were analysed, the determined average Cr_2O_3 content was 70%.
4. Two types of chromite are present in the deposit:
 1. "normal" stoichiometric chromite with Cr_2O_3 content below 69%;
 2. "anomalous chromite with surplus of trivalent metals and deficit of divalent metals and Cr_2O_3 content around 71%.
5. The ferruginous minerals have elevated chromium content, the average of 356 analyses being 4.25% Cr_2O_3 . This chromium cannot be upgraded to a high grade concentrate and is not recovered when producing high grade chromite concentrate.
6. The high Cr content in the ferruginous minerals causes high "background" value which does not permit use of chemical assays as a sole means of evaluation of the deposit or of the beneficiation processes. Chromium content in a sample is not an indication of the chromite content in the sample.
7. Mineralogical examination and modal analysis are the only simple and reliable means of determination of presence and quantity of chromite in samples from this deposit.

REPORT
on
MINERALOGICAL EXAMINATION
of samples of
chromite from the Wilson River Deposit,
sample numbers JJ 2076 to JJ 2098

prepared for Messrs

CALLINA N. L.

at their request by

Jiri Just

Mineralogist

Perth, 27th June, 1988.

JIRI JUST & ASSOCIATES, mineralogical and petrological services
30 Kay Street, Scarborough, W. A. 6019, tel. (09) 341 3778

Appendix C

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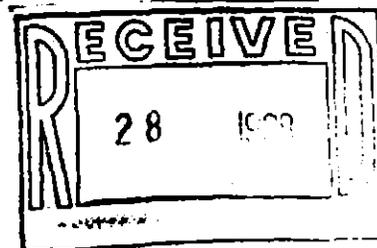
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Appendix C

JIRI JUST & ASSOCIATES
mineralogical and petrological services

30 Kay Street, Scarborough, W. Australia ph. (09) 341 3778

To

Mrs Christin Browne,
CALLINA N. L.,
100 Mill Point Road,
South Perth 6151



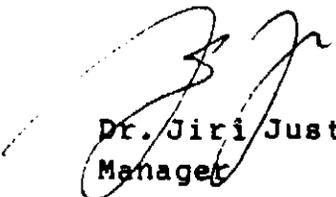
Perth, 27th June, 1988.

Dear Christin,

Please find enclosed a copy of my report on the Wilson River chromites.

In view of the unusually high Cr content in minerals other than chromite it might be advisable that your metallurgist gets in touch with me so that its implications for evaluation of the deposit and possible beneficiation processes would be clarified before any further commitment to field or laboratory work.

With best regards


Dr. Jiri Just
Manager

Encl. 1.

Appendix C

DH 25	37451	4-7m:	<0.5mm Hi Mag	38% ^{11.0}
			<0.5mm Mag 1	19% ^{0.8}
			<0.5mm Mag 2	3% ^{0.1}
			<0.5mm Mids	9% ^{0.4}
			<0.5mm Non Mag	31% ^{1.3}
DH 32	38290	0-2m:	<0.5mm Hi Mag	21% ^{0.9}
			<0.5mm Mag 1	43% ^{1.8}
			<0.5mm Mag 2	25% ^{1.0}
			<0.5mm Mids	4% ^{0.2}
			<0.5mm Non Mag	7% ^{0.3}
DH 32	38289	2-4m:	<0.5mm Hi Mag	21% ^X
			<0.5mm Mag 1	45% ¹⁵
			<0.5mm Mag 2	19% ^X
			<0.5mm Mids	8% ^X
			<0.5mm Non Mag	8% ^{2.7}
DH 32	38284	4-6m:	<0.5mm Hi Mag	5% ^X
			<0.5mm Mag 1	38% ^{1.5}
			<0.5mm Mag 2	38% ^X
			<0.5mm Mids	10% ^X
			<0.5mm Non Mag	9% ^{1.3}
DH 36	37436	0-2m:	<0.5mm Hi Mag	12% ^X
			<0.5mm Mag 1	42% ^{1.7}
			<0.5mm Mag 2	30% ^X
			<0.5mm Mids	9% ^X
			<0.5mm Non Mag	8% ^{0.5}
DH 36	37422	2-4m:	<0.5mm Hi Mag	17% ^X
			<0.5mm Mag 1	30% ^{1.7}
			<0.5mm Mag 2	26% ^X
			<0.5mm Mids	15% ^X
			<0.5mm Non Mag	12% ^{5.3}
DH 36	37453	4-6m:	<0.5mm Hi Mag	39% ^X
			<0.5mm Mag 1	17% ^{0.8}
			<0.5mm Mag 2	6% ^{0.3}
			<0.5mm Mids	0% ⁰
			<0.5mm Non Mag	39% ^{0.8}
DH 48	38281	0-2m:	<0.5mm Hi Mag	43% ^X
			<0.5mm Mag 1	24% ^{1.0}
			<0.5mm Mag 2	21% ^X
			<0.5mm Mids	5% ^X
			<0.5mm Non Mag	6% ^{1.3}

CONCLUSIONS

The investigated samples consist mostly of limonite and hematite with variable amounts of chromite, quartz, laterite, and fragments of weathered serpentinite.

Two kinds of chromite can be distinguished:

1. "normal" chromite with stoichiometric ratio of the divalent and trivalent metals, and
2. "anomalous" chromite with surplus of trivalent metals and deficient in divalent metals.

The "anomalous" chromite has higher Cr content than the "normal" chromite, mostly between 69 and 73% Cr_2O_3 . The "anomalous" chromite predominates over the "normal" chromite in all examined samples and the average of all chromite analyses (213 analyses) is very high (70% Cr_2O_3).

Limonite, hematite, and laterite present in the samples contain variable but significant amounts of chromium which is apparently present in form of chromium ions substituting for ions of trivalent iron in the lattice of hematite and goethite ("limonite"). Chromium content in limonite is generally higher than that in hematite or laterite and varies between approx. 0.5 and 13% Cr_2O_3 while hematite only exceptionally reaches 12% and laterite about 6%. The average chromium content of combined limonite, hematite and laterite (356 analyses) is 4.25% Cr_2O_3 . The high Cr content in the ferruginous material results in a high chromium "background" value which greatly interferes with evaluation of the deposit in the usual way, i.e. by chemical determination of chromium in bulk samples or magnetic fractions. Chemical determination of chromium does not give, with exception of very high values, reliable indication of presence and quantity of chromite in the sample. Values between 4 and 7% Cr_2O_3 might indicate recovery of almost 100% of the chromiferous minerals but there might not be any chromite present in the sample.

Chromium present in the iron oxides (i.e. limonite, hematite, and laterite) cannot be physically upgraded to a high grade concentrate.

Mineralogical examination comprising at least a crude modal analysis of the phases is essential for evaluation of samples from this deposit.

Sample No. JJ 2082, DB 32, 4 - 6 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	15
limonite-hematite:	65
remainder: quartz	20

Grainsize:

chromite:	mostly 80 - 150 μm , up to 400 μm
limonite-hematite:	mostly 50 - 150 μm , up to 600 μm
quartz:	mostly 50 - 100 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2083, DB 36, 0 - 2 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	5
limonite-hematite:	75
remainder: quartz	20

Grainsize:

chromite:	mostly 80 - 150 μm
limonite-hematite:	mostly 80 - 200 μm
quartz:	mostly 50 - 100 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2081, DB 32, 2 - 4 m.

Minerals identified: chromite, quartz, limonite, hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 15 ✓
limonite-hematite: 75 limonite = hematite
remainder: quartz 10

Grainsize:

chromite: mostly 80 - 150 μm ✓
limonite-hematite: mostly 100 - 200 μm , up to 600 μm
quartz: mostly 30 - 100 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (20 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	70.09	3.85	--	18.76	6.62	--	--	0.28
Range: highest	72.94	5.70	n.d.	21.47	8.59	5.25	0.18	1.32
lowest	67.39	2.16	n.d.	15.70	4.82	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	72.94	2.16	n.d.	17.18	7.44	n.d.	n.d.	0.29
lowest	67.39	2.39	n.d.	19.56	5.22	5.25	n.d.	0.19

Average composition of normal and anomalous chromite (number of analyses in brackets):

normal (1)	67.39	2.39	n.d.	19.56	5.22	5.25	n.d.	0.19
anomalous (19)	70.24	3.93	n.d.	18.72	6.69	n.d.	n.d.	0.28

Fe oxides (19 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	5.76	83.88	0.47	3.89	0.21	--	0.62	0.30	--

Analyses with highest and lowest Cr:

highest	10.20	85.27	0.23	3.59	0.22	--	0.50	--	--
lowest	3.40	80.36	0.44	4.24	0.29	--	0.72	0.35	--

DH 82	38279	6-8m:	<0.5mm Hi Mag	31%
			<0.5mm Mag 1	56%
			<0.5mm Mag 2	8%
			<0.5mm Mids	0%
			<0.5mm Non Mag	4%
DH 85	38273	0-2m:	<0.5mm Hi Mag	35%
			<0.5mm Mag 1	33%
			<0.5mm Mag 2	25%
			<0.5mm Mids	4%
			<0.5mm Non Mag	4%
DH 85	38288	2-4m:	<0.5mm Hi Mag	20%
			<0.5mm Mag 1	54%
			<0.5mm Mag 2	15%
			<0.5mm Mids	0%
			<0.5mm Non Mag	11%
DH 85	37389	4-6m:	<0.5mm Hi Mag	35%
			<0.5mm Mag 1	42%
			<0.5mm Mag 2	18%
			<0.5mm Mids	3%
			<0.5mm Non Mag	2%

As you require unbeneficiated samples, we suggest that the magnetic fractions of each sample should be combined approximately in the above proportions to achieve the original sample chemistry.

Could you provide us with an approximate costing and timing of the project before you begin the preparation and analysis of these samples? Our budget for this report is set at \$4000. In order to complete all the samples, we are prepared to sacrifice absolute accuracy for cost.

We look forward to hearing from you.

CHRISTIN BROWNE
Callina NL

DH 55	37392	0-2m:	<0.5mm Hi Mag	19% x
			<0.5mm Mag 1	40% x
			<0.5mm Mag 2	29% x
			<0.5mm Mids	8% x
			<0.5mm Non Mag	4% x
DH 58	37408	0-4.5m:	<0.5mm Hi Mag	46% x
			<0.5mm Mag 1	36% x
			<0.5mm Mag 2	13% x
			<0.5mm Mids	0% x
			<0.5mm Non Mag	4% x
DH 63	37393	0-6m:	<0.5mm Hi Mag	36% x
			<0.5mm Mag 1	41% x
			<0.5mm Mag 2	12% x
			<0.5mm Mids	5% x
			<0.5mm Non Mag	6% x
DH 71	38277	0-9m:	<0.5mm Hi Mag	20% x
			<0.5mm Mag 1	37% x
			<0.5mm Mag 2	24% x
			<0.5mm Mids	8% x
			<0.5mm Non Mag	11% x
DH 73	37455	0-7.5m:	<0.5mm Hi Mag	57% x
			<0.5mm Mag 1	21% x
			<0.5mm Mag 2	13% x
			<0.5mm Mids	0% x
			<0.5mm Non Mag	10% x
DH 82	38293	0-2m:	<0.5mm Hi Mag	33% x
			<0.5mm Mag 1	42% x
			<0.5mm Mag 2	0% x
			<0.5mm Mids	0% x
			<0.5mm Non Mag	25% x
DH 82	38297	2-4m:	<0.5mm Hi Mag	44% x
			<0.5mm Mag 1	41% x
			<0.5mm Mag 2	10% x
			<0.5mm Mids	0% x
			<0.5mm Non Mag	5% x
DH 82	38280	4-6m:	<0.5mm Hi Mag	50% x
			<0.5mm Mag 1	41% x
			<0.5mm Mag 2	8% x
			<0.5mm Mids	0% x
			<0.5mm Non Mag	2% x

Sample No. JJ 2078, DH 25, 2 - 4 m.

Minerals identified: chromite, quartz, limonite, chert,
zircon

Approximate percentage (number of particles per 100 particles) of
chromite and limonite-hematite:

chromite:	1	J
limonite-hematite:	1	
remainder: quartz	98	

No electron microprobe analyses were carried out.

Sample No. JJ 2079, DH 25, 4 - 7 m. X

Minerals identified: chromite, quartz, limonite-hematite;
zircon

Approximate percentage (number of particles per 100 particles) of
chromite and limonite-hematite:

chromite:	<1
limonite-hematite:	<1
remainder: quartz	>99

No electron microprobe analyses were carried out.

Sample No. JJ 2080, DH 32, 0 - 2 m. ✓

Minerals identified: chromite, quartz, limonite

Approximate percentage (number of particles per 100 particles) of
chromite and limonite-hematite:

chromite:	10
limonite-hematite:	80
remainder: quartz	10

Grainsize:

chromite:	mostly 80 - 150 μm , up to 300 μm ✓
limonite-hematite:	mostly 60 - 200 μm , up to 500 μm
quartz:	mostly 50 - 150 μm

No electron microprobe analyses carried out. X

Sample No. JJ 2084 B, DH 36, 2 - 4 m, mag 1 fraction.

Minerals identified: chromite, quartz, limonite, hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 20 ✓
 limonite-hematite: 75 limonite > hematite
 remainder: quartz 5

Grainsize:

chromite: mostly 50 - 100 μm
 limonite-hematite: mostly 100 - 200 μm
 quartz: mostly < 50 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (15 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	70.62	3.42	--	18.58	6.48	--	--	0.18
Range: highest	72.49	5.50	n.d.	24.07	9.36	6.50	0.17	0.34
lowest	67.44	2.19	n.d.	14.91	4.26	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
highest	72.49	2.19	n.d.	16.70	6.18	n.d.	n.d.	n.d.
lowest	67.44	3.13	n.d.	24.07	4.26	0.77	n.d.	0.21

Average composition of normal and anomalous chromite (number of analyses in brackets):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
normal (2)	68.44	3.34	n.d.	19.13	3.64	n.d.	n.d.	0.16
anomalous (13)	70.96	3.43	n.d.	18.49	6.74	n.d.	n.d.	0.18

Fe oxides (31 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	5.69	81.53	0.45	3.25	0.28	0.26	1.00	0.19	--

Analyses with highest and lowest Cr:

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
highest	12.56	72.95	0.44	2.91	0.29	--	0.66	0.19	--
lowest	1.60	95.27	0.50	1.30	0.37	--	0.96	--	--

Sample No. JJ 2084 A, DH 36, 2 - 4 m, high mag fraction. ?

Minerals identified: chromite, quartz, limonite, hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	10	
limonite-hematite:	85	limonite = hematite
remainder: quartz	5	

Grainsize: ?

chromite: mostly < 100 μm
 limonite-hematite: mostly < 100 μm
 quartz: mostly < 50 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (16 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	69.60	3.83	--	19.29	6.58	--	--	--
Range: highest	72.74	6.41	n.d.	22.31	8.43	0.63	0.26	0.30
lowest	63.03	1.68	n.d.	16.21	3.82	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	72.74	2.26	n.d.	17.58	7.35	n.d.	n.d.	n.d.
lowest	63.03	4.98	n.d.	19.84	6.24	n.d.	n.d.	n.d.

Average composition of normal and anomalous chromite (number of analyses in brackets):

normal (1)	69.72	1.68	n.d.	19.59	8.43	n.d.	n.d.	n.d.
anomalous (15)	69.59	3.97	n.d.	19.27	6.46	n.d.	n.d.	n.d.

Fe oxides (34 analyses):

Average:	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
	4.78	84.11	0.38	3.30	0.31	0.22	0.98	0.20	0.24

Analyses with highest and lowest Cr:

highest	11.37	85.49	0.02	1.51	0.33	--	0.87	--	0.28
lowest	0.73	97.71	0.03	0.53	0.38	--	0.44	0.19	--

Sample No. JJ 2093, DB 82, 2 - 4 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	20
limonite-hematite:	75
remainder: quartz	5

Grainsize:

chromite: mostly 80 to 200 μm , up to 400 μm ✓
limonite-hematite: mostly 100 to 200 μm , up to 500 μm
quartz: mostly 50 to 100 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2096, DH 85, 0 - 2 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 10
limonite-hematite: 85
remainder: quartz 5

Grainsize:

chromite: mostly 50 to 100 μm , up to 200 μm ✓
limonite-hematite: mostly 50 to 150 μm , up to 400 μm
quartz: mostly < 100 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2097, DH 85, 2 - 4 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 5
limonite-hematite: 90
remainder: quartz 5

Grainsize:

chromite: mostly < 100 μm , up to 300 μm X
limonite-hematite: mostly 80 to 200 μm , up to 500 μm
quartz: mostly < 100 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2098, DH 85, 4 - 6 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 2
limonite-hematite: 97
remainder: quartz 1

Grainsize:

chromite: mostly 80 to 150 μm , up to 400 μm
limonite-hematite: mostly 100 to 300 μm , up to 500 μm
quartz: mostly < 100 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2087, DH 55, 0 - 2 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	5
limonite-hematite:	85
remainder: quartz	10

Grainsize:

chromite: mostly 50 to 100 μm , up to 400 μm
limonite-hematite: mostly 80 to 150 μm , up to 600 μm
quartz: < 60 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2088, DH 58, 0 - 4.5 m.

Minerals identified: chromite, quartz, limonite-hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	10
limonite-hematite:	85
remainder: quartz	5

Grainsize:

chromite: mostly 80 to 200 μm , up to 300 μm
limonite-hematite: mostly 80 to 200 μm , up to 400 μm
quartz: < 60 μm

No electron microprobe analyses were carried out.

Sample No. JJ 2089, DB 63, 0 - 6 m.

Minerals identified: chromite, quartz, limonite, laterite,
silicified laterite

Approximate percentage (number of particles per 100 particles) of
chromite and limonite-hematite:

chromite: 20
limonite-hematite: 60
remainder: quartz 20

2

Grainsize:

chromite: mostly 50 to 100 μm , up to 350 μm
limonite-laterite: mostly 50 to 150 μm , up to 300 μm
quartz: mostly < 100 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous
limonite, and chromiferous hematite as derived from electron
microprobe analyses.

Chromite (20 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	69.03	3.95	--	18.19	7.81	--	--	0.19
Range: highest	72.84	6.35	1.20	22.86	13.94	0.95	0.25	0.28
lowest	65.22	1.97	n.d.	11.20	5.75	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
highest	72.84	1.97	--	16.76	7.24	0.95	--	0.23
lowest	65.22	5.40	--	22.86	6.38	--	--	0.14

**Average composition of normal and anomalous chromite (number of
analyses in brackets):**

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
normal (7)	67.08	4.29	--	19.50	8.60	--	--	0.19
anomalous (13)	70.09	3.77	--	18.59	7.39	--	--	0.19

Fe oxides (16 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	1.66	68.22	3.95	11.24	0.40	--	3.95	0.40	--

Analyses with highest and lowest Cr:

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
highest	2.25	77.56	0.62	8.07	0.28	--	0.83	0.27	--
lowest	0.62	77.53	0.51	10.36	0.22	--	0.75	--	--

The apparently high FeO content (up to 14% in some grains) is an
artefact due to high SiO₂ content in the siliceous laterite
grains. The Fe²⁺/Fe³⁺ correction program cannot cope with this
material.

Sample No. JJ 2090, DB 71, 0 - 9 m.

Minerals identified: chromite, quartz, limonite, hematite, silicified limonite, laterite, siliceous laterite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	15	
limonite-hematite:	70	limonite >>> hematite
remainder: quartz	15	

Grainsize:

chromite: mostly 50 to 200 μm , up to 250 μm ✓
 limonite etc.: mostly 50 to 150 μm , up to 400 μm
 quartz: mostly 50 to 100 μm , up to 300 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (20 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	69.86	3.63	--	19.10	6.52	--	--	0.23
Range: highest	72.43	6.60	--	25.51	9.82	4.07	0.20	0.49
lowest	65.52	1.73	--	14.35	1.66	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	72.43	2.50	--	18.03	6.85	--	--	0.19
lowest	65.52	6.60	--	21.70	5.02	0.84	0.17	0.15

Average composition of normal and anomalous chromite (number of analyses in brackets):

normal (1)	68.94	3.00	--	18.03	9.82	--	--	0.21
anomalous (19)	69.91	3.67	--	19.16	6.34	--	--	0.27

Fe oxide (20 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	4.02	79.79	0.98	3.90	0.27	--	1.40	0.25	0.27

Analyses with highest and lowest Cr:

highest	8.15	76.96	0.54	1.91	0.34	0.19	0.92	0.59	--
lowest	1.04	81.83	2.49	1.52	0.15	--	2.60	--	0.36

Sample No. JJ 2091, DH 73, 0 - 7.5 m.

Minerals identified: chromite, quartz, limonite, hematite, laterite, siliceous laterite, magnetite, nickeloan magnetite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	30	
limonite etc.:	65	limonite >> hematite
remainder: quartz	5	

Grainsize:

chromite:	mostly 50 to 150 μm , up to 500 μm
limonite etc.:	mostly 100 to 250 μm , up to 700 μm
quartz:	mostly around 50 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (10 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	70.14	4.28	--	18.24	7.20	--	--	0.15
Range: highest	72.81	6.34	--	21.14	8.46	n.d.	0.22	0.32
lowest	68.34	3.08	--	16.57	5.42	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	72.81	3.08	--	17.71	6.85	--	--	0.17
lowest	68.34	6.34	--	16.94	8.21	--	0.17	--

Average composition of normal and anomalous chromite (number of analyses in brackets):

all chromites are anomalous, average see above

Fe oxides (28 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	2.82	82.84	0.32	5.18	0.24	0.24	1.14	0.31	--

Analyses with highest and lowest Cr:

highest	6.29	79.01	0.29	3.55	--	0.31	0.34	0.21	--
lowest	0.70	98.26	--	0.51	0.44	0.30	0.40	--	--

Several grains of nickeliferous magnetite with up to 5.68% NiO were found.

Sample No. JJ 2092, DB 82, 0 - 2 m.

Minerals identified: chromite, quartz, limonite, hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	20	
limonite-hematite:	65	limonite >> hematite
remainder: quartz	15	

Grainsize:

chromite: mostly < 100 μm , up to 300 μm
 limonite-hematite: mostly 100 to 200 μm , up to 400 μm
 quartz: mostly < 100 μm

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (12 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	70.12	3.62	--	18.85	6.21	--	--	0.17
Range: highest	72.88	6.61	--	24.59	9.18	10.29	n.d.	0.33
lowest	64.63	2.44	--	14.70	2.77	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	72.88	2.85	--	16.33	7.94	--	--	--
lowest	64.63	4.06	--	15.94	2.77	10.29	--	0.24

Average composition of normal and anomalous chromite (number of analyses in brackets):

normal (1)	64.63	4.06	1.82	15.94	2.77	10.29	--	0.24
anomalous (11)	70.62	3.58	--	19.11	6.52	--	--	0.17

Fe oxides (23 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	3.74	80.74	0.52	5.17	0.24	--	0.92	0.41	--

Analyses with highest and lowest Cr:

highest	6.66	71.82	0.47	7.77	0.21	--	1.06	0.92	0.41
lowest	1.71	95.32	0.44	0.95	0.24	0.16	0.38	0.63	--

Sample No. JJ 2084 D, DB 36, 2 - 4 m, middlings.

Minerals identified: chromite, quartz, limonite, hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite:	5	
limonite-hematite:	15	limonite > hematite
remainder: quartz	80	

Grainsize:

chromite: mostly 150 - 300 μ m
 limonite-hematite: mostly 100 - 300 μ m
 quartz: mostly < 100 μ m

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (11 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	71.20	3.49	n.d.	16.70	7.84	n.d.	n.d.	0.23
Range: highest	72.14	3.99	n.d.	20.25	9.51	3.18	n.d.	0.33
lowest	70.26	2.91	n.d.	15.18	5.14	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	72.14	3.07	n.d.	15.62	9.17	n.d.	n.d.	n.d.
lowest	70.26	3.87	--	16.58	8.38	0.67	--	0.24

Average composition of normal and anomalous chromite (number of analyses in brackets):

all chromites are anomalous, average see above

Fe oxides (35 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	5.44	81.81	0.60	3.00	0.31	0.35	1.13	0.22	0.22

Analyses with highest and lowest Cr:

highest	11.85	69.04	--	6.88	0.40	1.25	0.79	0.35	--
lowest	1.09	83.00	2.44	0.59	0.30	0.21	2.66	--	--

Sample No. JJ 2084 E 2, DB 36, 2 - 4 m, non-mag fraction.

Minerals identified: chromite, quartz, limonite, hematite

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: <1
 limonite-hematite: <1 limonite = hematite
 remainder: quartz >99

Grainsize:

chromite: mostly 50 - 100 μ m
 limonite-hematite: mostly about 100 μ m
 quartz: mostly 50 - 100 μ m

Chemical composition (in oxide wt.%) of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses.

Chromite (4 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	69.37	4.72	--	18.66	6.37	--	--	0.56
Range: highest	71.95	6.04	--	21.52	8.95	0.50	0.15	0.85
lowest	67.07	3.27	--	16.85	4.08	n.d.	n.d.	0.36

Analyses with highest and lowest Cr:

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
highest	71.95	3.27	--	16.85	6.82	0.50	--	0.51
lowest	67.07	5.35	--	17.23	8.95	--	--	0.85

Average composition of normal and anomalous chromite (number of analyses in brackets):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
normal (1)	67.07	5.35	--	17.23	8.95	0.85	--	--
anomalous (3)	70.13	4.50	--	19.14	5.51	--	--	0.47

Fe oxides (15 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	4.52	84.44	0.87	2.58	0.29	0.26	1.31	0.28	0.23

Analyses with highest and lowest Cr:

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
highest	8.33	85.63	1.51	1.78	0.31	--	1.91	0.15	0.37
lowest	1.41	82.95	--	2.09	0.30	1.05	1.60	0.17	0.51

Sample No. JJ 2086, DH 48, 0 - 2 m.

Minerals identified: chromite, zincian chromite, quartz, limonite,

Approximate percentage (number of particles per 100 particles) of chromite and limonite-hematite:

chromite: 10
 limonite-hematite: 85 limonite >>> hematite
 remainder: quartz 5

Grainsize:

chromite: mostly 100 to 200 μm , up to 350 μm
 limonite-hematite: mostly 100 to 200 μm , up to 400 μm
 quartz: mostly < 100 μm , up to 300 μm

Chemical composition of chromite, chromiferous limonite, and chromiferous hematite as derived from electron microprobe analyses. In oxide weight %.

Chromite (15 analyses):

	Cr ₂ O ₃	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	MnO	V ₂ O ₃	SiO ₂
Average:	70.17	3.72	--	19.36	5.81	--	--	0.19
Range: highest	72.38	4.95	--	24.49	8.68	9.60	0.18	0.42
lowest	66.73	2.88	--	15.50	1.42	n.d.	n.d.	n.d.

Analyses with highest and lowest Cr:

highest	72.38	3.01	--	16.62	7.83	--	--	0.16
lowest	66.73	4.01	--	17.27	1.42	9.60	--	0.16

Average composition of normal and anomalous chromite (number of analyses in brackets):

all chromites are anomalous, average see above

One grain contained approx. 4% ZnO

Fe oxides (25 analyses):

	Cr ₂ O ₃	Fe ₂ O ₃	FeO	Al ₂ O ₃	MgO	MnO	SiO ₂	TiO ₂	NiO ₂
Average:	2.79	80.23	1.58	4.42	0.36	0.62	1.37	0.35	0.35

Analyses with highest and lowest Cr:

highest	7.86	64.69	5.55	5.38	0.44	--	3.47	2.42	--
lowest	0.47	97.95	0.34	0.25	0.29	--	0.70	--	--

097

Dr R Blanks,
Metskill ,
203 The Esplanade
Mt Pleasant,,WA

18-10-88

1000 0 07 566

Preparation of 5 polished sections and
mineragrpahic examination of 5 chromite samples.

R Townend.



098

Sample 9150-10200 t/con.

Polished section

Limonite	Goethite	major
Hematite		major
Chromite		minor

The sample is dominated by iron oxides. These range from earthy limonite to crystalline martite, commonly in aggregates. There are all combinations of these two.

Chromite forms about 10% of the sample. The bulk of the chromite has limonite hematite as a margin, and veining the nucleus. Grainsizes of the least affected material ranges from 0.1-1mm. Discrete fresh chromite is a small % of the total chromite. Examples of the composite altered chromite are shown below.

Sample 9150-10500. Tails

Polished section

Limonite	goethite	dominant
Hematite		minor
Chromite		accessory

This sample is very similar to the mids with goethite probably 80-90% of the sample.

Chromite is less than 5% as sub 0.1mm remnants in coarse limonite>hematite grains.

Appendix D

Sample Attrit. then T Conc.

Polished section

Limonite	goethite	major
Hematite		major
Chromite		accessory

The sample consists of more than 90% iron oxides that are equal quantities of limonite and hematite.

The chromite is about 5%. Much of it is discrete as small 0.1-0.2mm grains. Chromite included in limonite hematite is rare.

Sample T Conc. Att.

Polished section

Limonite	Goethite	major
Hematite		major
Chromite		minor

The sample has a dominant iron oxide content with roughly equal proportions of the limonite and hematite. The latter has the martite texture. Commonly the pair are together.

The chromite content is estimated at about 10%. Grains vary from fresh almost discrete to small remnants within the iron oxides, where particles may be less than 0.1mm. There are all stages in between.

Appendix D

Sample 9150-10200 Mids

Polished section

Limonite	Goethite	dominant
Hematite		minor
Chromite		accessory

This sample is dominated by Limonite goethite, with hematite only a minor component of some limonite grains.

Chromite is probably less than 5%. It occurs as rare 0.5mm grains slightly veined, and as remnants in dominant limonite.

PHOTO 1 7 CONC. CHROMITE FRAGMENTS IN LIMONITE. NIC UNCL.
FIELD WIDTH 0.55MM

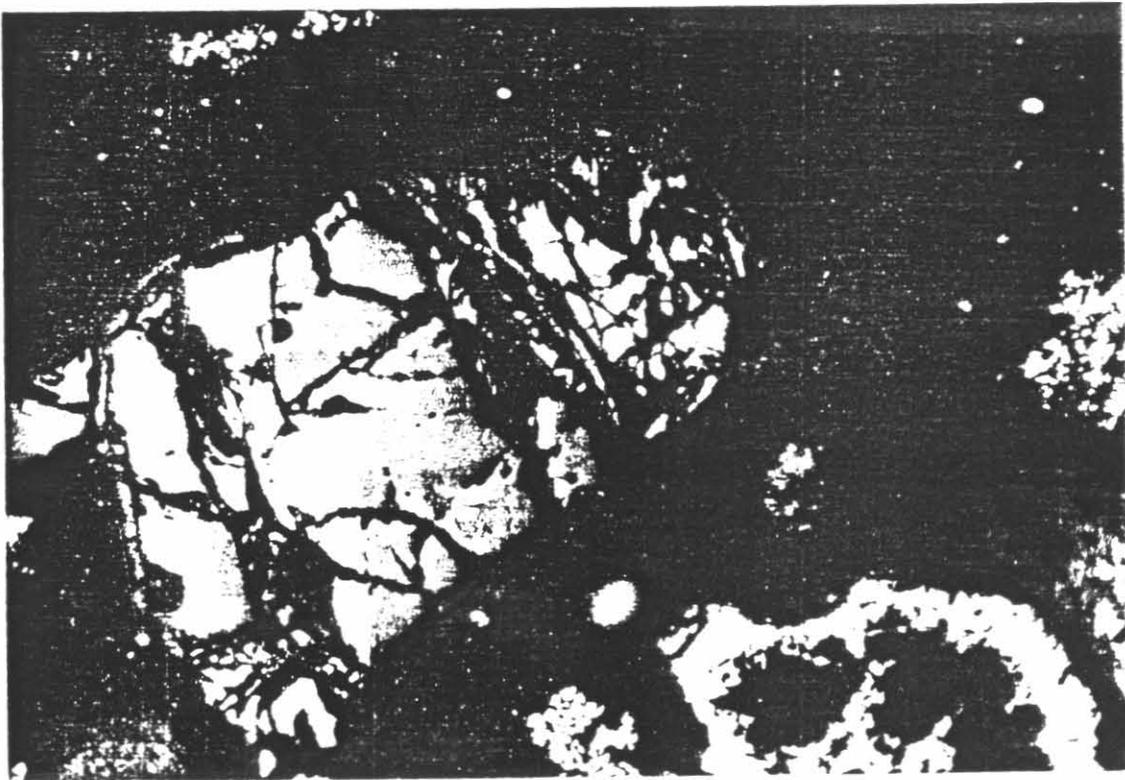
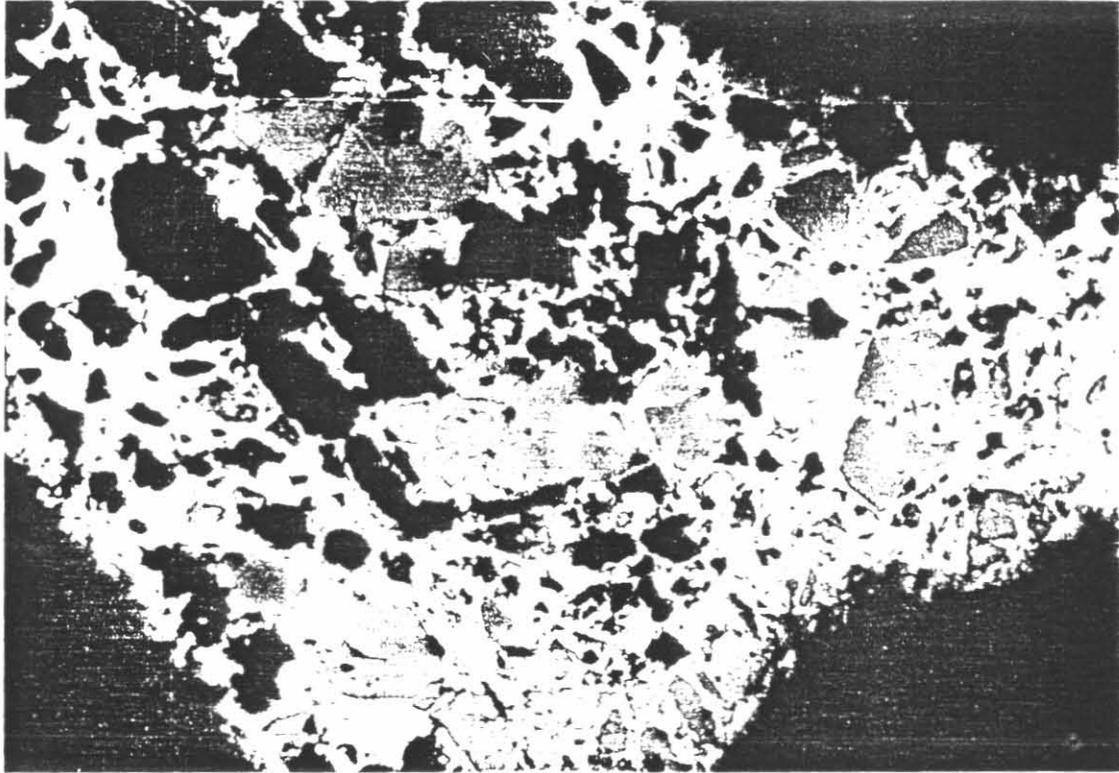


PHOTO 2 7 CONC. CHROMITE LINED AND VEINED BY LIMONITE. NIC UNCL.
FIELD WIDTH 0.54MM

964103

PHOTO 3 MIDS. CHROMITE WITH MARGIN OF IRON OXIDES, ALSO NARROW VEINS. NIC UNC. F. WIDTH 0.54MM

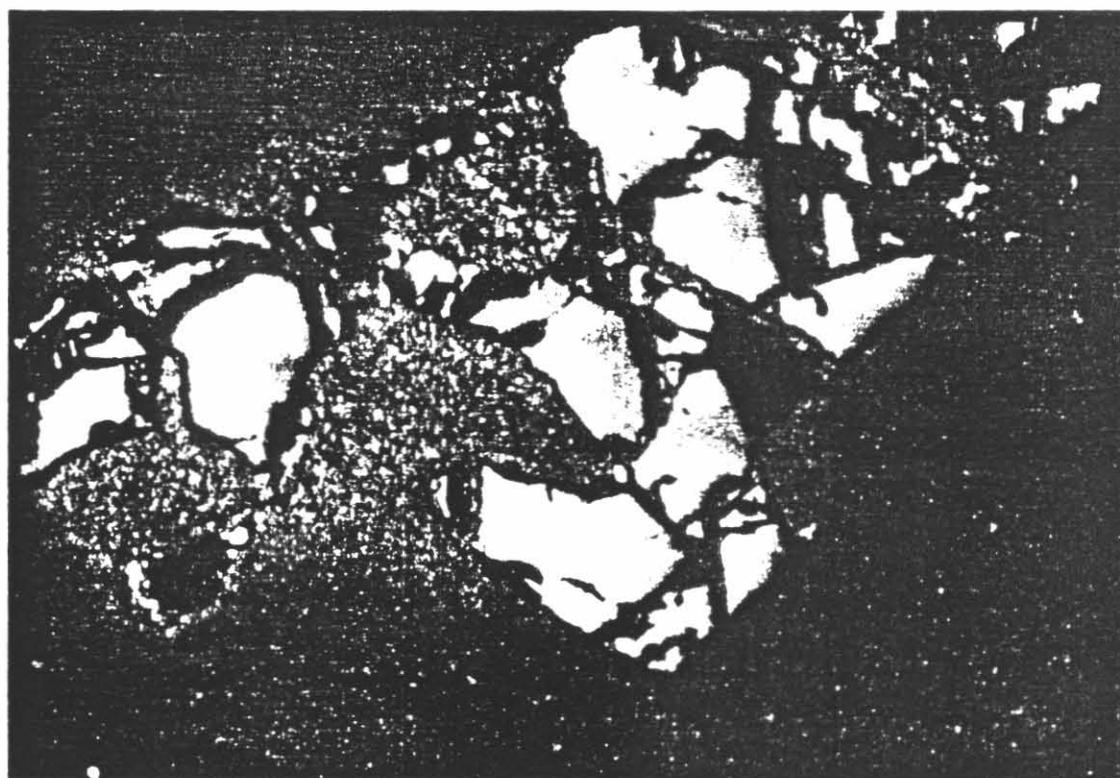
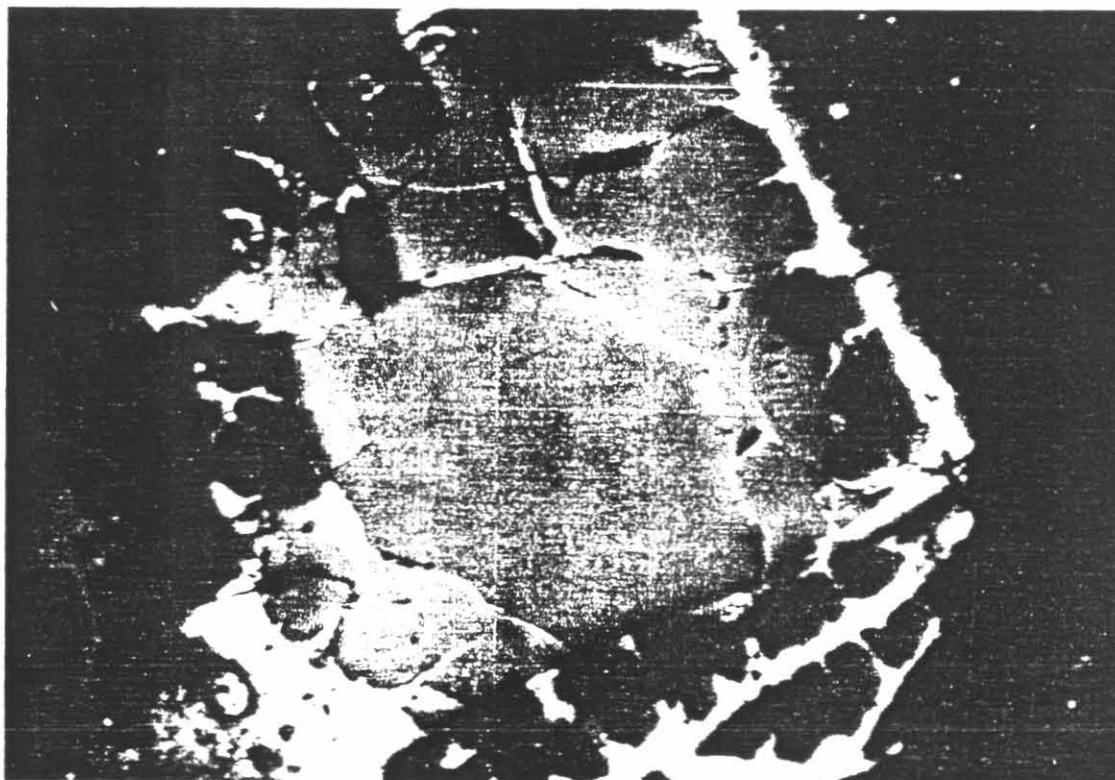


PHOTO 4 MIDS RELIC CHROMITE IN LIMONITE. NIC UNC. FIELD WIDTH 0.54MM

564104

PHOTO 5 T CONCL. ATT. FINE RELIC CHROMITE IN LIMONITE GOETHITE.
NIC UNC. FIELD WIDTH 0.54MM

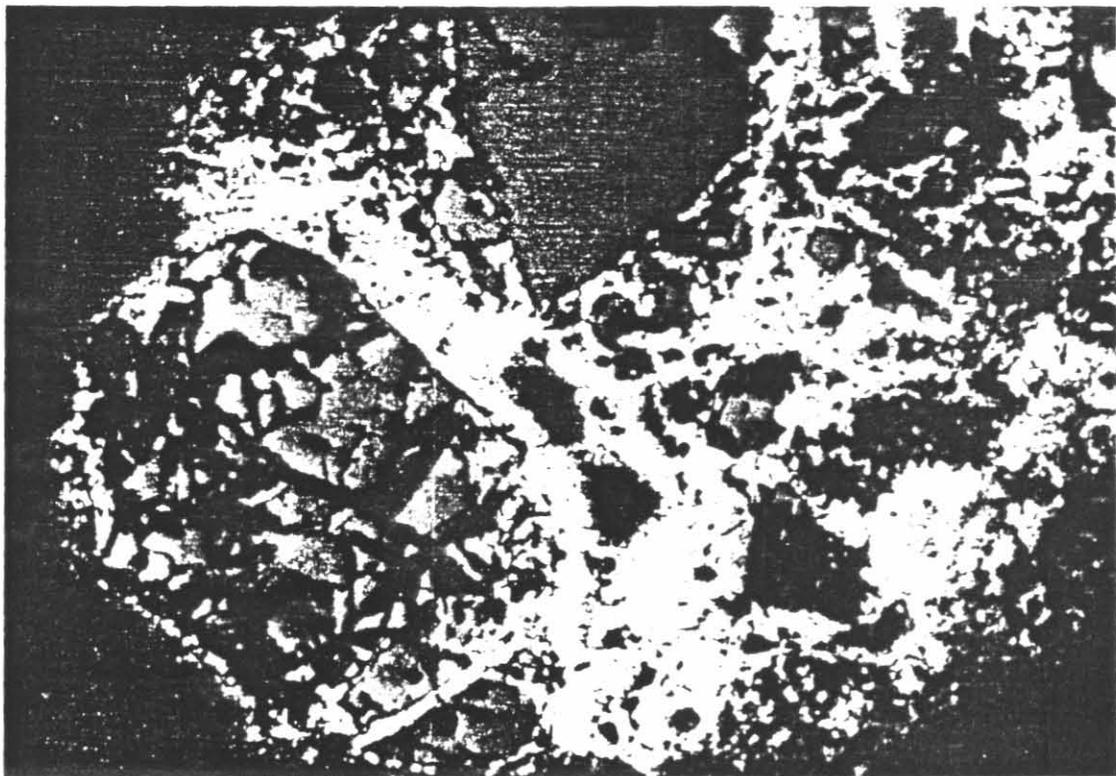
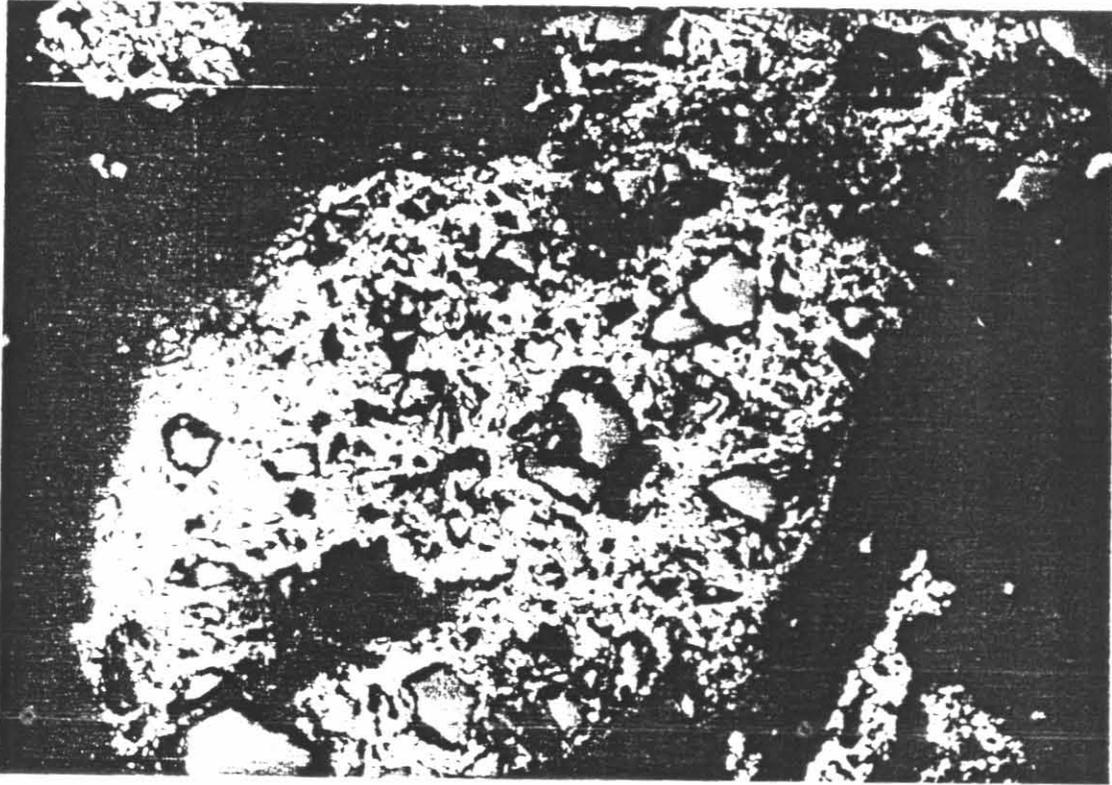


PHOTO 6 T CONCL. ATT. CHROMITE IN GOETHITE NIC UNC.
FIELD WIDTH 0.54MM

PHOTO 7 ATTRITIONED T. CONCL. DISCRETE CHROMITE AND IRON OXIDES.
NIC UNC. FIELD WIDTH 0.54MM

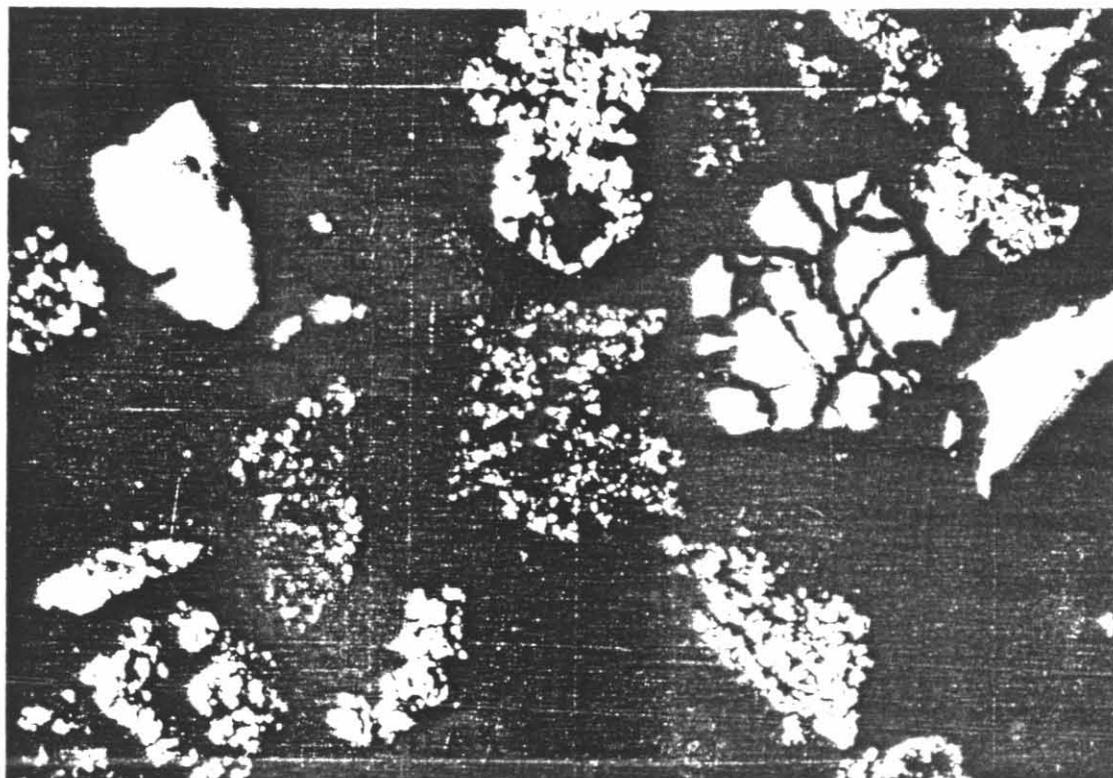


PHOTO 8 ATTRITIONED T. CONCL. CHROMITE IN HEMATITE AND LIMONITE
NIC UNC. F. WIDTH 0.54MM

105

564106

Dr R Blanks,

20-10-88

Metskill

203 The Esplanade,

Mt Pleasant,

WA

1000 0 07 581

Preparation of six polished sections
and mineragraphic examination of
six chromite samples.

R Townend



Appendix E

Sample Table conc. 1

Tributary Creek Sample

Polished section

Chromite dominant
 Magnetite accessory
 Leucoxene accessory

This is a chromite concentrate. The chromite content probably exceeds 90% with grains essentially liberated. They appear fresh and although variable in colour/composition from grain to grain, within grains zoning is negligible. A very few show some porosity.

The other constituent are fresh discrete magnetite, leucoxene, and non opaques.

Appendix E

Sample Table conc. 2

Hole 22 Hatched I Concentrate

Polished section

Chromite	dominant
Magnetite	minor
Martite	accessory
Leucoxene	trace

This is a chromite concentrate. The nature of the chromite seems identical to sample 1, ie, fresh and liberated. It is estimated to form 85-90% by volume.

The other minerals are mainly magnetite, rarely part martite, plus a few complete martites, and trace of leucoxene.

107

564108

Sample Table conc. 3

Area C, 9420N - 9900E

Polished section

Chromite dominant
 Magnetite minor
 Limonite accessory

This is a chromite concentrate. The bulk of the chromite is present as discrete fresh grains. The size range seems wider than samples 1 and 2, with many at 0.1mm or less. A few have limonite rims, and rarely they are remnants in limonite. The chromite volume is estimated at 70%.

The main gangue is liberated fresh magnetite. Limonite goethite is also significant.

Appendix E

Sample table conc. 4 Area C 9350N, 10100E

Polished section

Magnetite	dominant
Chromite	major
Hematite	minor
Limonite	accessory
Mn oxides	accessory

This sample has magnetite > chromite. The chromite occurs mainly as discrete fresh grains, although commonly they can have a narrow rim of hematite. A few are more veined by magnetite hematite. The chromite volume is estimated at 40%.

The magnetite commonly has a martite rim. Limonite is a separate grains, but there is also earthy or clayey limonite around particles.

108

Area C

Sample table conc. 5

9150N 10500E

Polished section

Chromite	major
Martite	major
Magnetite	major
Limonite	minor
Mn oxides	trace

The sample is a mixed chromite iron oxide concentrate. The chromite is present mostly as grains with narrow rims of iron oxide and commonly veins. The iron oxide is either hematite or limonite as rims. The latter is probably part clayey. The chromite content is estimated at 30-40%.

Magnetite part altered to martite is the most abundant gangue. The Mn oxide is probably pyrolusite.

Appendix E

Sample Table Conc. 6

Area C 9150N, 10300E

Polished section

Chromite	major
Magnetite	major
Hematite	major
Limonite	minor
Mn oxides	accessory

This samples is a mixed chromite iron oxide concentrate. The chromite is largely present as discrete angular grains. A few have rims of hematite limonite, rarely they are veining the chromite. Rare chromite is within a limonite host. Free chromites are between 0.1 and 0.5mm. The chromite content is estimated as 40-50%.

Magnetite part altered to martite is the main gangue. Limonite is also significant.

564110

PHOTO 1 T1 CHROMITE VARIATION. NIO UNCL. F. WIDTH 0.54MM

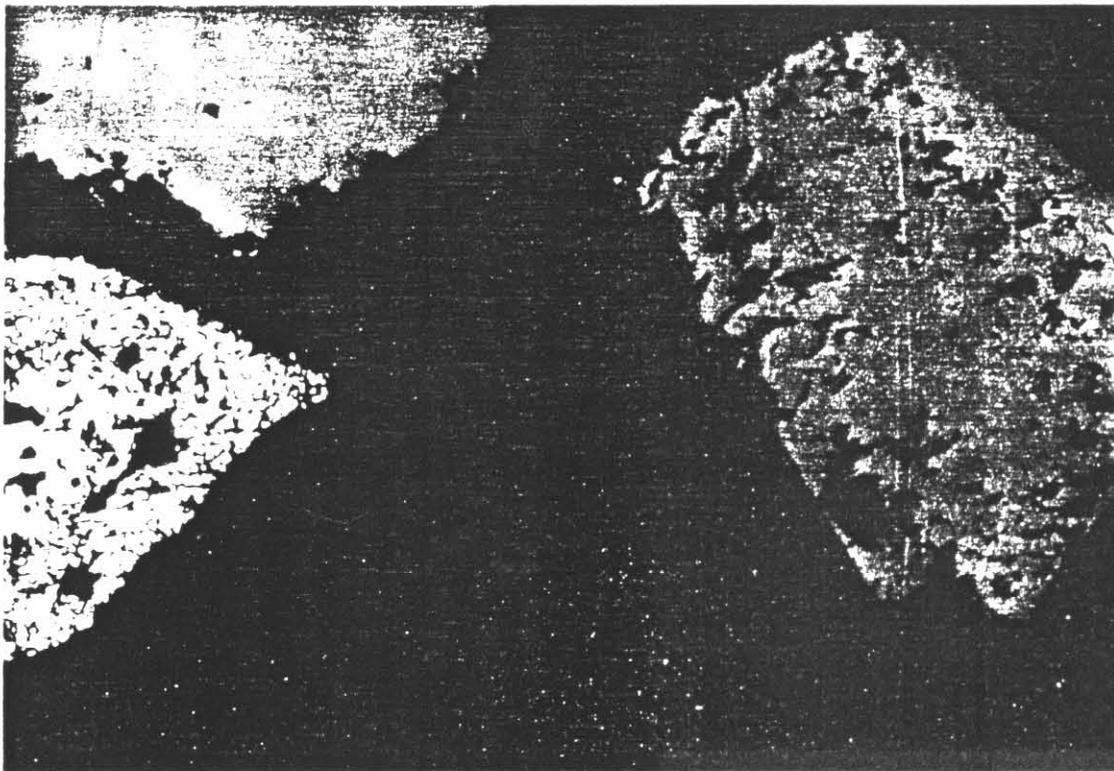
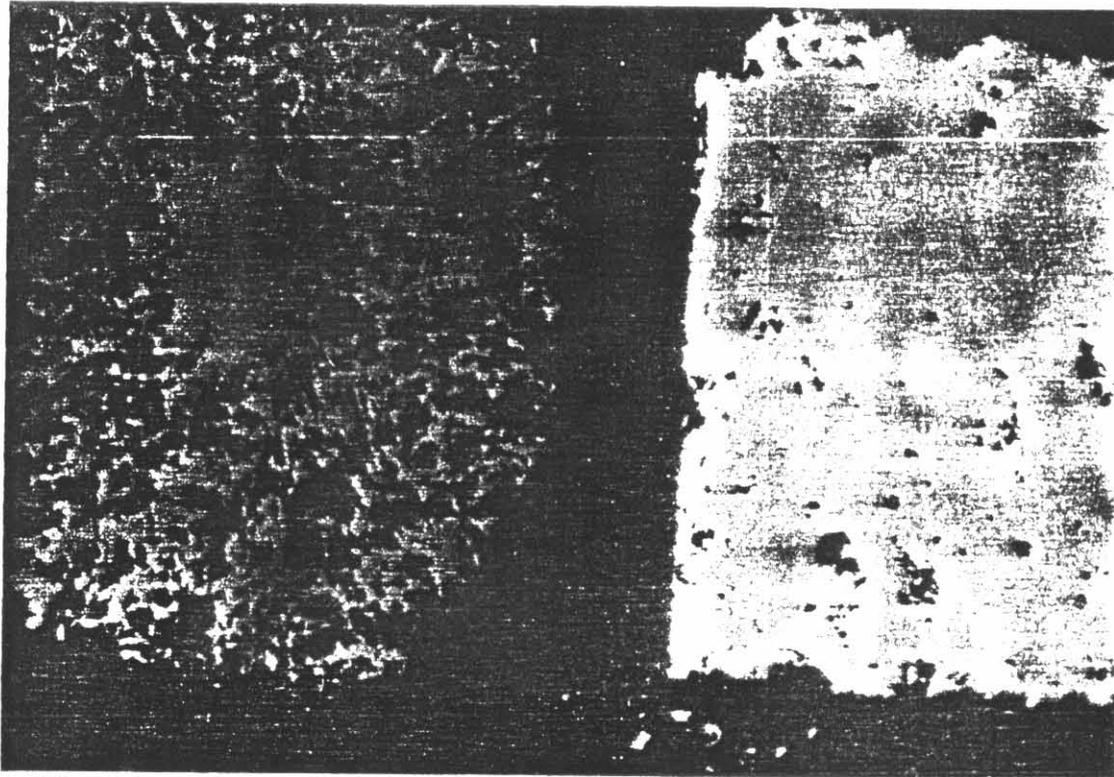
PHOTO 2 T1 CHROMITES PLUS MAGNETITE ALTERING TO MARTITE.
NIO UNCL. FIELD WIDTH 0.54MM

PHOTO 3 13 CHROMITES WITH LIMONITE RIM, MAGNETITE. NIC UNCL.
FIELD WIDTH 0.54MM

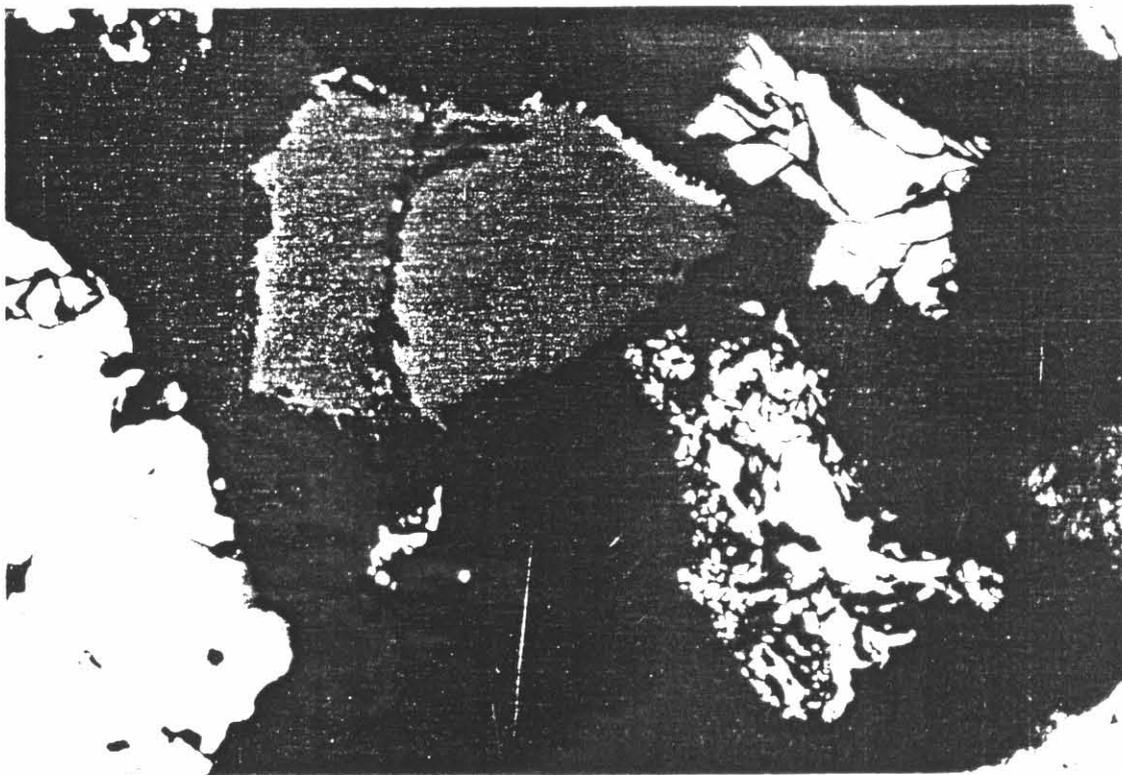
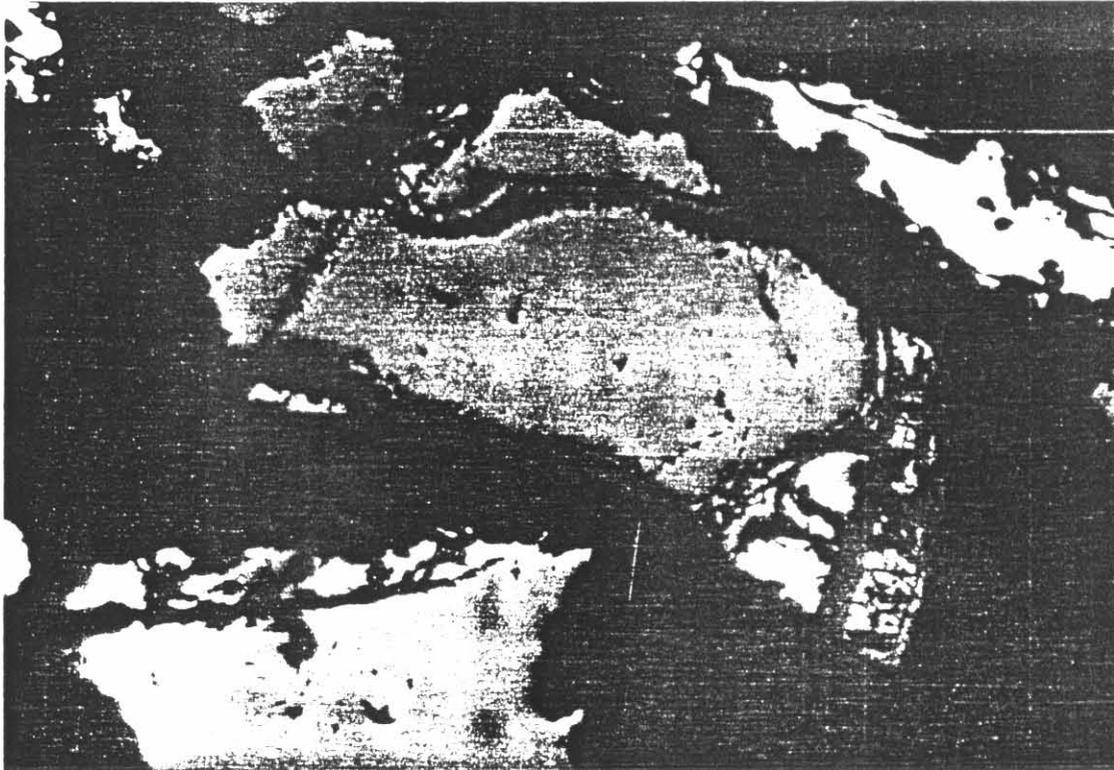


PHOTO 4 14 CHROMITE SUBORDINATE TO MAGNETITE.
NIC UNCL. FIELD WIDTH 0.54MM

564412

PHOTO 5. 15. CHROMITE WITH RIM OF HEMATITE. , SEPARATE MARTITE.
NIC UNCL. F. WIDTH 0.54MM

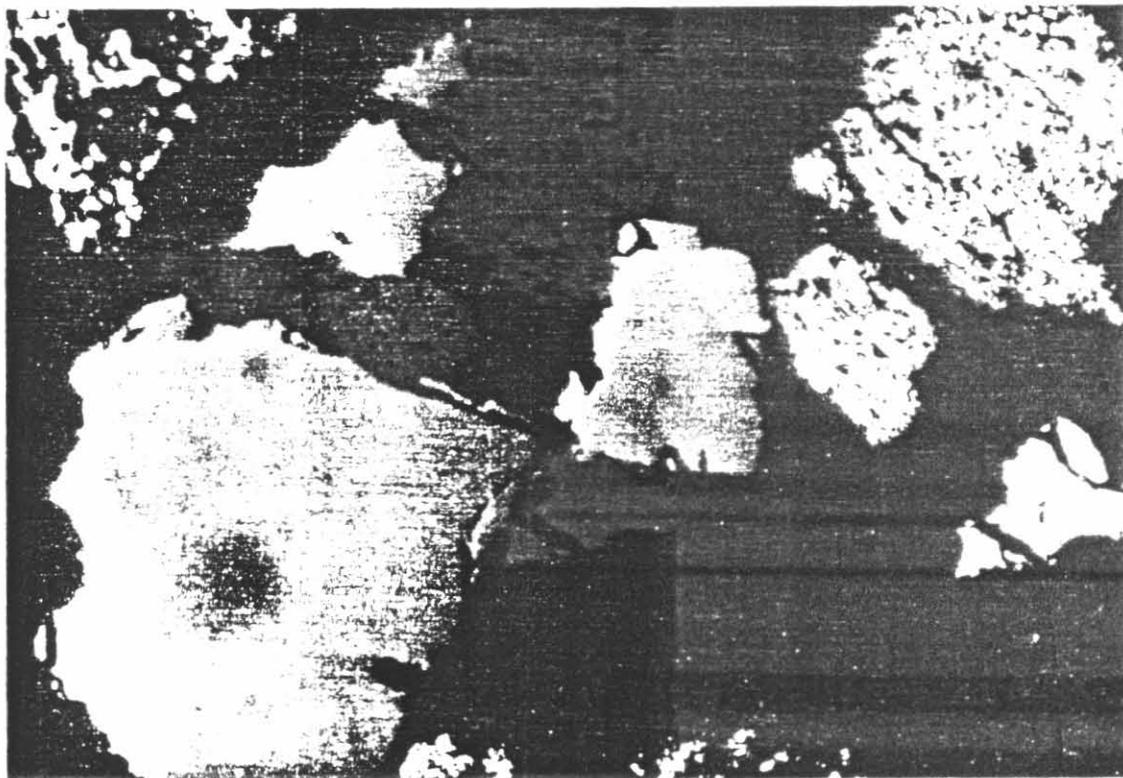
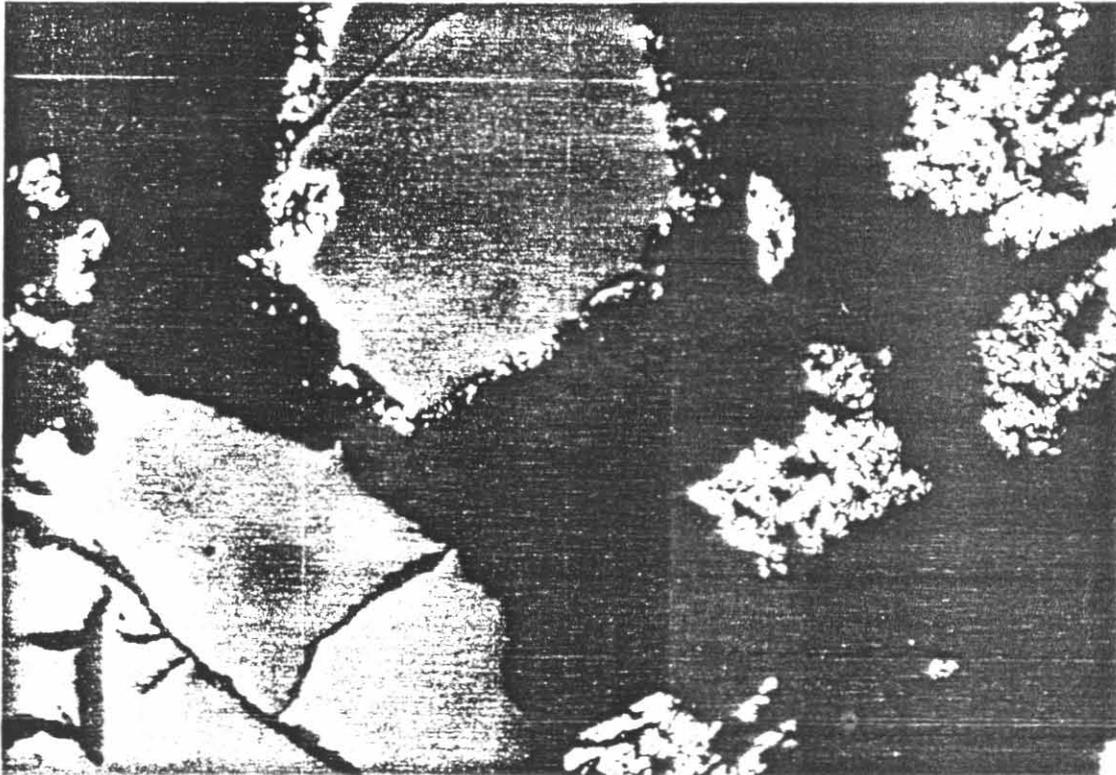
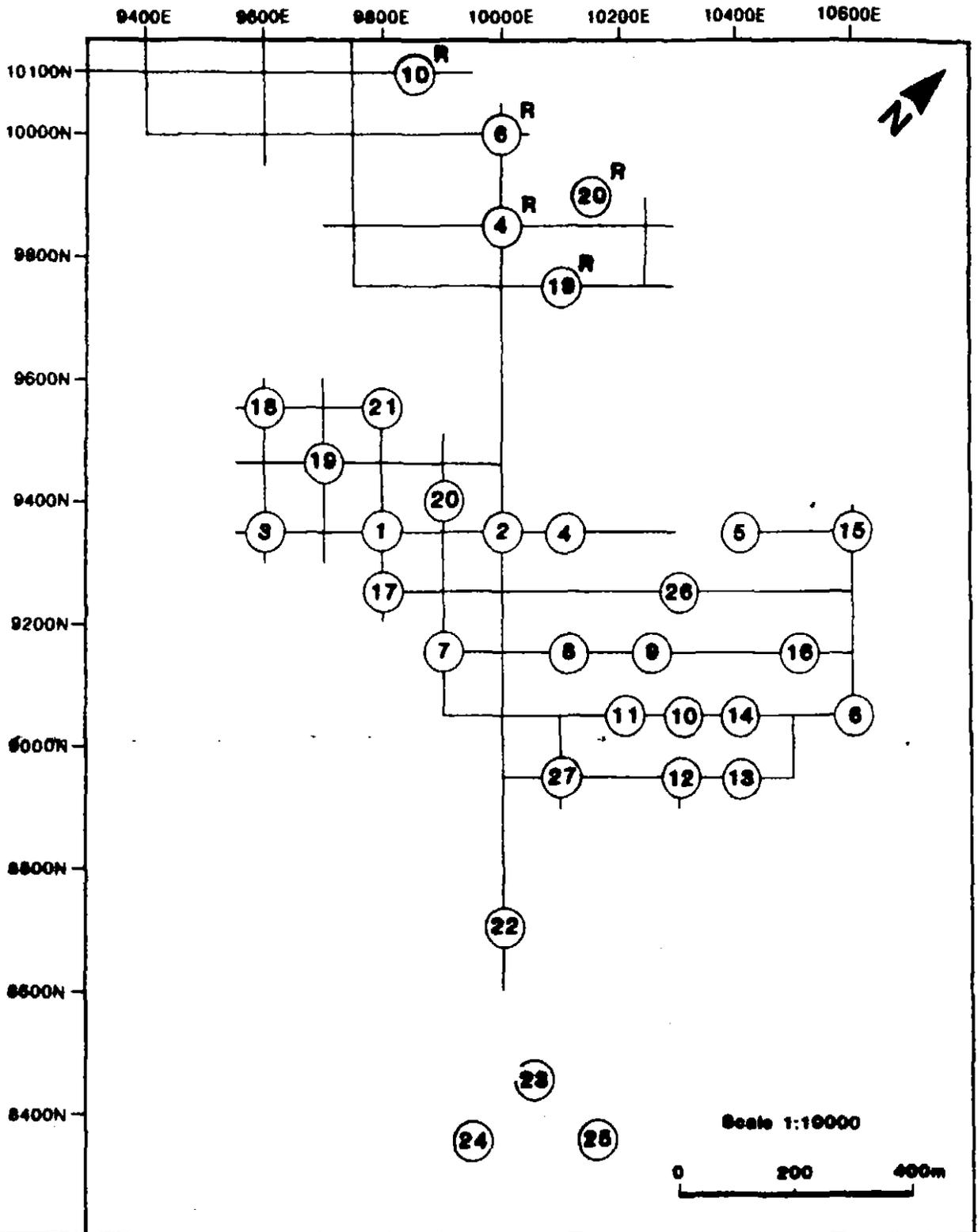


PHOTO 6. 16. DISCRETE FRESH CHROMITE, SEPARATE MARTITE/MAGNETITE.
NIC UNCL. FIELD WIDTH 0.54MM



**CLEARED GRIDLINES SHOWING
BULK SAMPLE SITES 1988**

Figure 2b

GENALYSIS LABORATORY SERVICES PTY. LTD.**LABORATORY REPORT**

17 DAVISON ST. MADDINGTON, W.A. 6109. P.O. BOX 144 GOSNELLS W.A. 6110
TELEPHONE (09) 459 9011, 459 2272. TELEX: GLS 96166.
FAX: (09) 459 5343.

KALGOORLIE SAMPLE PREPARATION DIVISION 12 KEOGH WAY KALGOORLIE W.A. 6430
P.O. BOX 388 KALGOORLIE W.A. 6430 TELEPHONE (090) 21 2881.
FAX: (090) 21 3476.

JOB INFORMATION

JOB CODE : 470.0/890313
NO. SAMPLES : 26
ELEMENTS : 6
CLIENT O/N : 604
DATE RECEIVED : 02/02/89
DATE COMPLETED : 01/03/89

LEGEND

'X' = LESS THAN DETECTION LIMIT
'N/L' = SAMPLE NOT RECEIVED
'*' = RESULTS CHECKED
'()' = RESULTS STILL TO COME
'I/S' = INSUFFICIENT SAMPLE FOR ANALYSIS
'E6' = RESULT x 1,000,000

COMMENTS : ATTENTION : R BLANKS....
COMMENTS : ATTENTION : R BLANKS....

PLEASE NOTE:

COARSE REJECTS AND PULPS WILL BE STORED FOR 60 DAYS WITHOUT CHARGE. AFTER THIS TIME ALL COARSE REJECTS AND PULPS WILL BE STORED AT A RATE OF \$1.20/cubic metre/day UNTIL YOUR WRITTEN ADVICE REGARDING COLLECTION OR DISPOSAL IS RECEIVED. EXPENSES RELATED TO THE RETURN OR DISPOSAL OF SAMPLES WILL BE CHARGED TO YOU AT COST.

SAMPLE PREPARATION DETAILS

SAMPLE STATE(S) & SAMPLE PREPARATION(S)

DR,FP,QTZ
WC-BOWL

Abbreviations used for Preparation codes :

CP : Course Pulverise	CR : Crush	DR : Dry
CUT : Diamond Saw Cut	FP : fine Pulverise	HM : Harner Mill
SSHG : Single Stage Mix & Grind	MS : Mix & Split	O : Other
MR : Not Required	QTZ : Quartz Clean Between	COMPS : Composite
ZX : Two Splits		

Abbreviations used for Sample States :

CONC : Concentrates	COST : Costeans	CRJCT : Coarse Rejects
D/CHIP: Drill Chip	D/CORE: Drill Core	D/CUT : Drill Cuttings
HRC : Heavy Mineral Concentrates	PERC : Percussion Chip	PISLIT: Pisolite
RC : Reverse Circulation	R/CHIP: Rock Chip	SOLN : Solutions
SOLM : Solutions	STRSED: Stream Sediments	UNSPEC: Unspecified
V/CHIP: Vacuum Chip	V/DRIL: Vacuum Drill	XCRJCT: Ex Coarse Rejects

Wilson River - Nonmetalloid Products

Appendix F

Page 2
OF FAX.

470.0/885630

ELEMENTS UNITS DETECTION METHOD	Sample Location	Concn per m ³	Re	Ch	Part 1	Page 1	Ir	Pt	Re
			Ru	Rh	Pd	Os	Ir	Pt	Re
			ppb	ppb	ppb	ppb	ppb	ppb	ppb
			MIS/M	MIS/M	MIS/M	MIS/M	MIS/M	MIS/M	MIS/M
SAMPLE NUMBERS	Pit	g/m ³							
1 1501	15	35.9	170	10	10	70	720	50	X
2 1502	6	18.8	22500	700	10	60000	78000	3200	X
3 1503	20	20.4	9200	270	15	44000	61000	2300	X
4 1504	2	20.1	180	10	15	500	620	20	X
5 1505	17	73.7	1900	120	15	4300	7200	720	X
6 1506	1	25.3	1040	45	10	2900	3600	200	X
7 1507	5	17.3	370000	19500	90	2.12E6	2.02E6	240000	X
8 1508	A19R	7.4	6000	350	180	21500	25000	2800	X
9 1509	8	15.1	70000	2350	30	280000	340000	17500	X
10 1510	7	10.2	2300	80	10	4700	8400	330	X
11 1511	A6R	14.7	13500	540	10	44000	54000	4900	X
12 1512	10	9.6	900	45	10	1650	3900	180	X
13 1513	A4R	5.1	5600	100	30	17000	30000	1800	X
14 1514	A20R	17.5	3500	60	5	8000	12000	600	X
15 1515	21	8.6	73000	4200	15	140000	250000	65000	X
16 1516	27	5.7	23500	760	20	66000	91000	7500	X
17 1517	3	54.6	1160	70	10	2600	5400	780	X
18 1518	13	4.3	2700	80	5	7800	9000	480	X
19 1519	11	12.3	12500	450	5	25000	33000	1800	X
20 1520	19	5.2	15500	490	35	33000	53000	2400	X
21 1521	12	26.8	7300	240	15	29000	28500	1200	X
22 1522	16	37.8	490	30	15	740	2600	220	X
23 1523	14	81.0	1500	55	10	9000	10000	190	X
24 1524	18	71.0	3700	240	10	6800	16500	2700	X
25 1525	4	6.9	450	30	10	1450	2100	200	X
26 1526	9	24.4	3000	120	15	12000	14500	1200	X
Ch. 0001 (1501)			160	10	10	80	800	40	X
Ch. 0026 (1526)			2700	110	10	9800	14000	1100	X
STD: SARM7			490	250	1550	70	100	3700	
STD: SARM7									

END OF REPORT

CONTINUED FROM PAGE 1

SAMPLE WEIGHTS VARY BUT IF YOU ARE INTERESTED I WILL SEND THE COMPLETE SUITE VIA ANSERTY AIR FREIGHT.

ADVISE IF INTERESTED

REGARDS

RON BLANKS

Mr. Ron Blanks, c/- Metskill Ltd.

23rd January, 1989.

The Wilson River Project (on EL. 24/85)

Assessment of this prospect is difficult because its nature and origins have not been well understood. I have noted that the Callina staff are cautious in their use of the term laterite and usually refer to the deposits (A,B,C, & D) as detrital, implying some degree of lateral transportation before the onset of chemical weathering which has superimposed features similar to incipient lateritisation.

The residual mantle profile, as inferred from meagre descriptions, lacks many essential features of typical in situ laterite developed on peridotite. Namely:- (i) lack of chemical zoning of Fe, Ni, Co, MgO, SiO₂ (it is assumed that no such zoning exists as it is not mentioned in the reports).

(ii) No secondary silica, magnesia, or nickel magnesian silicates (again, not mentioned in reports). It is assumed that these products of weathering (incipient lateritisation) have been flushed out by laterally moving ground-water.

(iii) The presence of sand and clay layers within the profile. There is reference to a green clay at the base of the profile.

(iv) The presence of platinoid metals and gold. These do not occur in significant amounts in undisturbed residual laterite profiles. It is assumed that some concentration process has preceded the residual geothitic weathering. This is consistent with the concept of transported ultramafic detritus.

(v) The absence of similar weathering mantles over the greater part of Serpentine Ridge.

These factors negate any suggestion that the areas being tested are erosional remnants of a formerly more extensive residual laterite profile and are consistent with Callina's accepted view of them as transported ultramafic detritus on which chemical weathering has been superimposed. The distribution of "hard-cap", pisolites and ferruginous clay probably relates to variable permeability and water table levels within the deposits. It is presumed that "hard-cap" and pisolites form where the profile is not continually water saturated (i.e. not below long term water table level). The presence of hard-cap and pisolites does not affect the chromite or P.G.M. content but makes recovery difficult and the products would probably be contaminated by geothite coatings. In assessing chromite contents in bulk "ore" and in concentrates, allowance will have to be made for non-chromite Cr in geothite and some clays which often can be considerable.

The Serpentine Ridge area was examined stereoscopically on the colour air-photos for clues to the possible nature and origin of the Wilson River areas of chromite-bearing detritus. There is a rough arcuate conformity of physiographic elements at the southern end of Serpentine Ridge including the detritus deposits (A,B,C, & D) being tested. In order to follow my somewhat reckless reconstruction of these elements you should refer to the annotated overlays of air-photo number 020 of Run 37 and 019 of Run 34W which cover the south and north extremities, respectively, of the Serpentine Ridge. The red chinagraph

Mr. Ron Blanks, c/- Metskill Ltd.

23rd January, 1989.

boundaries on the southern air-photo (020/37) delimit three related physiographic provinces developed on or immediately adjacent to the linear ultramafic body which comprises Serpentine Ridge. These elements have been labelled (in red chinagraph pencil) from north west to south-east, "eroded", "coarse detritus" and "fine detritus" which I think is a valid differentiation. Within the coarse detritus zone possible conformable arcuate subzones are indicated by blue chinagraph notations. The primary zonation suggests to me remnants of a terminal glacial moraine deposited at the nose of a glacier which had gouged a path down the 10km length of the ultramafic outcrop when an extensive ice sheet was retreating towards higher ground to the north west (the Meredith Granite terrain). The nominated subzones of the "coarse detritus" unit could be indicative of successive depositional phases around the front of a glacier retreating to the north-west, or they could be to gravity slumping of the unstable rubble pile.

It is suggested that the button-grass "plain" south of the coarse detritus zone represents an outwash fan of fine, mainly ultramafic, detritus which was flushed out of the adjacent coarse, highly permeable, moraine and deposited under relatively low energy conditions, possibly within a lake.

Some support for the concept of a glacial path down the length of the Serpentine Ridge outcrop is afforded by remnant cirque-like features (denoted in red chinagraph on the air-photo overlay 019/34W) within and around the north-western end of the ultramafic outcrop belt and hanging valleys in the higher Meredith Granite terrain adjacent to the north-west.

This concept envisages a south-easterly flowing glacier occupying a gouged out valley along the +10km length of the ultramafic outcrop which now forms Serpentine Ridge. Initially, the glacier probably selectively became entrenched on a serpentinised zone within the ultramafic belt taking advantage of relative softness and lack of resistance to abrasion. With the cessation of glaciation and the onset of Quaternary uplift for whatever reasons, a new regime of erosion and weathering prevailed resulting in deeply incised consequent drainage patterns. Under this new regime the more massive, impermeable, ultramafic rocks were less susceptible to erosion than the surrounding sedimentary rocks which contained a network of weakness zones on bedding planes, fractures and faults into which the newer, currently persisting, drainages incised. Continued erosion under the newer drainage regime has resulted in a topographic inversion so that the former glacial valley floor over the ultramafic belt has now become the Serpentine Ridge with evidence of its glacial origin preserved only at the higher, north-western, and lower, south-eastern extremities.

Probing the origins of the detrital deposits being tested is not entirely an esoteric or academic exercise but may help understand some of the seemingly random and abrupt changes in texture and mineral content within the deposits. Deep weathering (ferruginisation) of the detritus deposits in contrast to the lack of weathering of the massive ultramafic outcrops to the north-west is probably attributable to high permeability of the original blocky moraine deposit. The sandy and clayey zones encountered during the testing could represent narrow melt-water channels rilling over or through the coarser blocky material. The blocky parts

Mr. Ron Blanks, c/- Metskill Ltd.

23rd January, 1989.

of the deposit could be expected to have a chromite content similar to that of the original ultramafic rock, slightly residually enriched by weathering (say in the 1-3 vol. % range). Whereas resistate minerals would be concentrated in the finer sediments occupying drainage channels within the coarse detritus and chromite/magnetite in the 5-10% range with some enhancement of P.G.M. content, might be expected.

The glacial moraine concept implies that the button grass plain south of the deposits currently being tested overlies fine ultramafic detritus washed out of the adjacent coarser deposits. The detritus could be expected to contain more total chromite than the coarser moraine deposits but that chromite would be mainly as fine shards because of fracturing of larger euhedra during the additional reworking and transportation. Magnetite being more durable would not be reduced in grain size to the same degree and thus the ratio of recoverable magnetite to recoverable chromite might be higher in the button-grass plains area than in the coarser detritus in areas A, B, C, and D.

Total ferruginisation and limited exposure will probably have masked the original texture of the postulated moraine deposits but supporting evidence may be present in the form of exotic boulders of non-ultramafic rocks or the presence of heavy minerals (zircon, apatite, cassiterite or gold) not normally associated with ultramafic rocks.

The suggestion that the button-grass plain is composed dominantly of fine ultramafic detritus possibly with an enhanced, but finer grained chromite content, warrants reconnaissance sampling. This will be difficult because of the high water-table and the probable unconsolidated nature of the sediments below the water-table. It is also likely that, because of the action of humic acids either from entrapped former lacustrine vegetation or from the latter-day superficial peat mat, all trace of limonite will have been converted to soluble ferrous complexes which would either be flushed out of the system above the water-table or contribute to the growth of authigenic pyrite on insoluble nuclei (e.g. chromite shards) in the lower zones of stagnating ground water. Leaching of limonite from weathered boulders and coarse fragments of peridotite and their replacement by secondary silica by supergene processes not well understood would lead to a residual concentration of siliceous gravels in the uppermost part of the regolith in this environment. Black, grey and green clays could be expected below the button-grass plain in strong contrast to the brick-red clays of areas A, B, C, & D from which it is presumed the button-grass plains detritus was derived.

One possibly positive outcome of the photogeological study of the Wilson River deposits is the recognition of one large and several small additional areas of coarse detritus which should be similar in composition to areas A, C, and D. The larger area, immediately west of area A is shown on the air-photo overlay (020/37). The central, plateau part of this area may be so-called "hard-cap" but the softer part of the weathering profile should be exposed around the flanks. This and other adjacent smaller fans of detritus are heavily timbered unlike areas A, C, and D possibly because they lie outside the zone of ultramafic sub-crop.

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