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SML 557

BLINMAN – WIRREALPA AREA

PROGRESS REPORTS TO LICENCE EXPIRY/RENEWAL FOR THE PERIOD 25/3/1971 TO 24/3/1972

Submitted by
North Flinders Mines Ltd
1972

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Government of South Australia
Primary Industries and Resources SA

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TENEMENT HOLDER: North Flinders Mines Ltd.

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PLANS (Continued)

0 03

GEOLOGICAL REPORT ON THE

PATAWARTA DIAPIR

PART S.M.L. 557 (formerly S.M.L. 292)

MARCH, 1971

R. READ
Geologist

NORTH FLINDERS MINES LIMITED

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ACCOMPANYING PLANS

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I INTRODUCTION

The Patawarta Diapir is a structure about 400 (5 miles.) chains long and up to 100 chains wide. Associated with it are numerous copper occurrences with minor gold, cobalt and possibly bismuth.

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II GEOLOGY OF THE RIM ROCKS

A. STRATIGRAPHY

1. Flaggy Siltstones

2. ABC Sandstone

Massive boldly outcropping well bedded sandstone with cross-bedding and ripple-marks.

3. Wonoka and Bunyeroo Formations

These begin with flaggy siltstones passing up into red and green shales with thin dolomite beds, one of which carries faint copper stainings ($1\frac{1}{2}$' wide). Above these are very calcareous siltstones with interbedded blue and purple silty limestones. These pass into red siltstones with sandy bands which become more common towards the top.

4. Pound Sandstone

The Wonoka silts pass into the Pound Sandstone which is the typical massive sandstone forming a prominent range.

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B. STRUCTURE

The area lies on one limb of a large synclinal structure. The regional dip is north-easterly. Locally, folding has produced a small basin and an adjoining dome (since engulfed by the diapir).

A large hinge fault has produced a horizontal displacement in the Pound Sandstone of about 4 miles at the surface. The diapir has intruded the small dome and along this fault.

Another diapir has intruded further east along the same fault, coming within 10 chains of the Patawarta Diapir. It is remarkable that whereas the Patawarta Diapir contains numerous small copper occurrences and gave rise to a number of stream sediment anomalies, the other diapir appears to have no mines and no anomalous stream sediment values.

Two other faults were observed, a small E-W fault on the West side of the diapir, apparently later than the diapir and a fault cutting the ABC Sandstone near the Western limit of the diapir.

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III GEOLOGY OF THE DIAPIR

A. ROCK TYPES

1. Laminated Quartzites

These make up a large proportion of the rafts within the diapir including the largest. They are laminated interbedded siltstones and quartzites with heavy mineral bands, ripple marks and halite casts. They are distinctly different to any rocks out-cropping in the vicinity of the diapir, indicating that the diapir is intrusive.

Some small copper occurrences appear to be associated with this rock type, Cu 2, Cu 3, to Cu 10.

2. Quartzite, Siltstones, calc-silts and dolo-silts

The above rock types are abundant in the diapir and could come from any part of the Proterozoic sequence.

The silts and dolo-silts adjacent to the Lady Lehman Lode carry disseminated sulphides of low-grade. (Shackleton).

3. Melaphyres

Only one melaphrye was recognised in this diapir - a dark blue to dark green rock with calcite-filled amygdales. In view of the association of melaphryes with mineralization in the Blinman Dome (Coates), chip samples were taken.

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4. Dolerites

Numerous plugs of dark green basic igneous rock occur in the diapir. In some cases contact metamophosed breccia can be observed, indicating that they are post-diapiric.

According to Coates, mineralization is commonly associated with dolerites of the Blinman Diapir. Only three instances were noted in the Patawarta Diapir.

a) An old pit in the contact zone of a small plug has exposed a small calcite vein bearing haematite, pyrite and chalcopyrite in metamorphosed breccia. This could be more coincidence as both dolerites and sulphide-bearing calcite veins are common.

b) Another old pit has exposed copper-stained metamorphosed breccia.

c) Small pseudomorphs after pyrite were noted in the contact zone of the large plug in the S.E. end of the diapir (Sample 810).

5. Breccia

This makes up a large part of the diapir. It consists of fragments of various rock types of all sizes up to the large rafts, in a carbonate matrix. Blocks in the breccia are often very contorted, as are the large rafts, especially near their margins.

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6. Rim Dolomite

This is a prominently outcroppig carbonate rock which occurs on the S.W. and East margins of the diapir. It contains pebbles and flakes of chert and has a bedded aspect, which appears sedimentary on casual inspection. However, it is not part of the sequence outside the diapir as it runs along the fault line across the bedding.

Its length makes it improbable that it is a raft in the diapir.

The chert pebbles appear to result from the breaking up of silica bands which occur in places.

In places the rim dolomite can be observed to grade into the breccia. Small barite veins occur within it. Similar though less extensive dolomites occur on the margin of the Blinman Diapir (Coate's p.8). Coates ascribes these dolomites to 'Metamorphic differentiation of dolomitic material from carbonate breccia'. He interprets the bedding as a flow structure. The writer agrees that the 'bedding' is due to movement of the diapir, but is uncertain about the mode of formation.

B. MINERALIZATION

The area contains many small calcite veins, some of which carry all or some of the minerals siderite, micaceous

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haematite, pyrite and chalcopyrite in varying proportions. All known veins and workings occur within the Patawarta Diapir. However, the zinc stream sediment anomalies in the southern part of the area have their sources in the Bunyeroo siltstones to the south of the Diapir. This is probably the most interesting mineralization in the area. These are being investigated by soil sampling.

Lady Lehman Mine

This has been described by Shackleton & Dickenson. It is a calcite vein up to 5' wide bearing pyrite, chalcopyrite and micaceous haematite. The vein occurs on the contact of a raft of siltstone with diapiric breccia, this contact being parallel to the bedding of the siltstone.

At both the eastern and western ends the vein disappears where the raft has broken across the bedding of the siltstone. At the eastern end there are a number of pits on small veins, both in the breccia and in the siltstone. Disseminated very low grade mineralization occurs in the siltstone and the breccia.

Midnight Mine

This is a group of workings occuring in small fractures in siltstone raft. Thin calcite-siderite veins carry varying amounts of pyrite and chalcopyrite, some quite rich. As is the case with most prospects in the area, little or no secondary enrichment has occured, as copper is immobile in calcite and also because the calcite has tightly enclosed the sulphides, preventing oxidation. Hence chalcopyrite can be observed at the surface in places.

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Haematite Workings

North of the Lady Lehman mine a number of narrow micaceous haematite veins carrying chalcopyrite have been worked by shallow open-cuts and one stope about 30' long and perhaps 39' deep.

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Numerous small pits, shafts and trenches have been dug on small calcite veins, or less commonly shears. None of these workings can have had any significant production. In addition a number of copper-bearing calcite veins were observed at the surface.

Small alluvial gold workings occur on the flat to the West of Patawarta Gap.

Austin (1863) mentions bismuth at the 'Mt. Rugged Mine' - presumably one of the small workings south of the road through Patawarta Gap. No bismuth has been observed in the area but some samples have been submitted for spectrographic analysis.

R. Read for RB/rhw

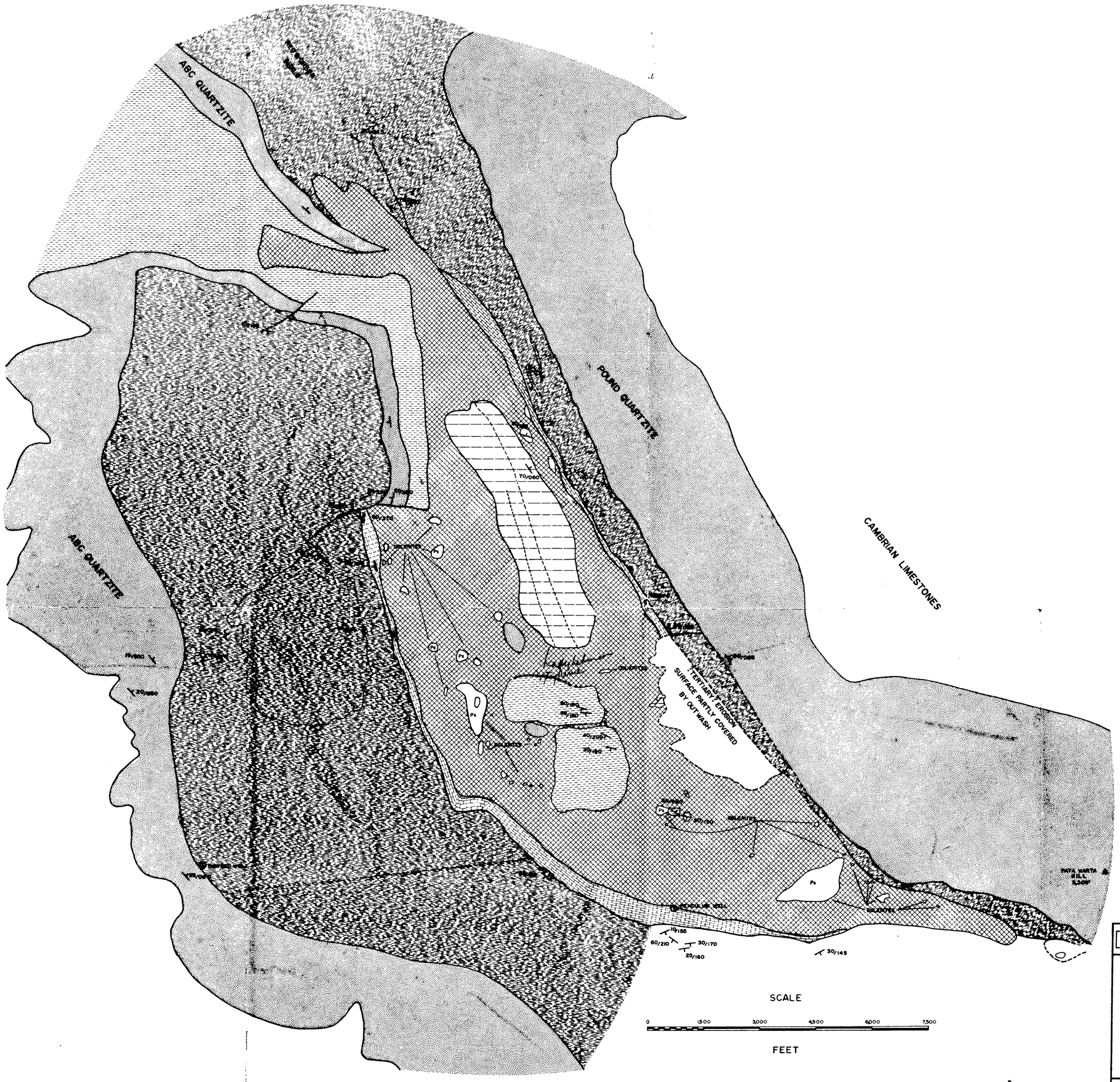
R. READ.
Geologist

NORTH FLINDERS MINES LIMITED.

APPENDIX I

References

Austin 1863	The Mines of South Australia
Coates	Geology of the Blinman Dome Diapir
Dickinson S.B.	S.A. Dept. of Mines Bulletin No. 21
Grasso R.	Cadnia 1 mile Geological Sheet, publ. S.A. Department of Mines.
Shackleton	Report by Minoil for Admin Exploration on Lady Lehman drilling.



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REFERENCE

- SANDSTONE QUARTZITE: FOUND @ ABC QUARTZITE AND RAFTS IN DIAPIR
- WONOKA & BUNYEROO EQUIVALENTS: RED SANDY SILTS PASSING DOWN INTO CALC SILTS WITH BLUE SILTY LIMESTONE INTERBEDS & RED & GREEN SHALES WITH THIN DOLOMITES.
- SILTSTONES: UNDER ABC @ IN DIAPIR.
- FLAGGY INTERBEDDED QUARTZITES & SILTSTONES: WITH RIPPLE MARK & HALITE CASTS AS RAFTS IN DIAPIR.
- RIM DOLOMITE: PRODOMINENTLY OUTCROPPING "DOLOMITE" WITH CHERT PEBBLES SHOWING ORIENTATION PARALLEL TO THE EDGE OF THE DIAPIR.
- BRECCIA: CARBONATE MATRIX BEARING FRAGMENTS OF VARIOUS ROCK TYPES - CHIEFLY SILTS & QUARTZITES IN RANDOM ORIENTATION COMMONLY PEBBLE SIZE RANGING UPTO LARGE RAFTS.
- Ps — DOLERITES: DARK GREEN BASIC IGNEOUS ROCKS PROBABLY INTRUDED AFTER DIAPIRISM.
- MELAPHYRE: RAFT IN DIAPIR WITH CALCITE - FILLED AMYGDALES.
- LADY LEHMAN LODE: CALCITE BEARING PYRITE & CHALCOPYRITE.
- TREND LINES.
- 60/040 — DIP & DIP DIRECTION OF BEDDING.
- 60/040 — DIP & DIP DIRECTION OF "PSEUDO-BEDDING" IN "RIM DOLOMITE".

NFM North Flinders Mines N.L.

LADY LEHMAN MINE
S.M.L. 292

GEOLOGICAL MAP

GEOLOGY BY B.READ

DRN:- M.J.T.	DATE:- 29/3/71.	SCALE:- 1" reps. 1500'.

DWG 292-8

ENV 1638(I) - 3

1638(I) - 3

N

801-40,140,60 X 802-35,90,40.

806-11000,480,90,Bi-20 X 805-230,000,680,130,Bi-<20 X 807-Bi.20 X 808-Bi.<20

804-35,90,80 X 803-50,90,70 X 809-290,80,70

X 810-120,40,160

PENDULUM WELL

PATA WARTA HILL 3,300'

ASSAYS
IN P.P.M.

801-40,140,60
ASSAY No.-Cu, Ni, Co

SCALE

0 1500 3000 4500 6000 7500

FEET

NFM North Flinders Mines N.L.

LADY LEHMAN MINE
S.M.L. 292
SAMPLE LOCATION MAP WITH ASSAYS-P.P.M.

OVERLAY TO LADY LEHMAN GEOLOGY MAP 292-8

DRN:- M.J.T.	DATE:- 29/3/71.	SCALE:- 1"=ops. 1500'.

DWG. 292-9

ENV 1638(I) - 2

I-2

FOLLOW UP OF STREAM SEDIMENT GEOCHEMICAL ANOMALIES

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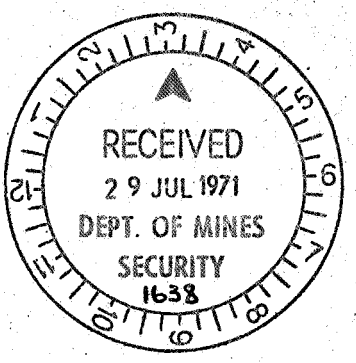
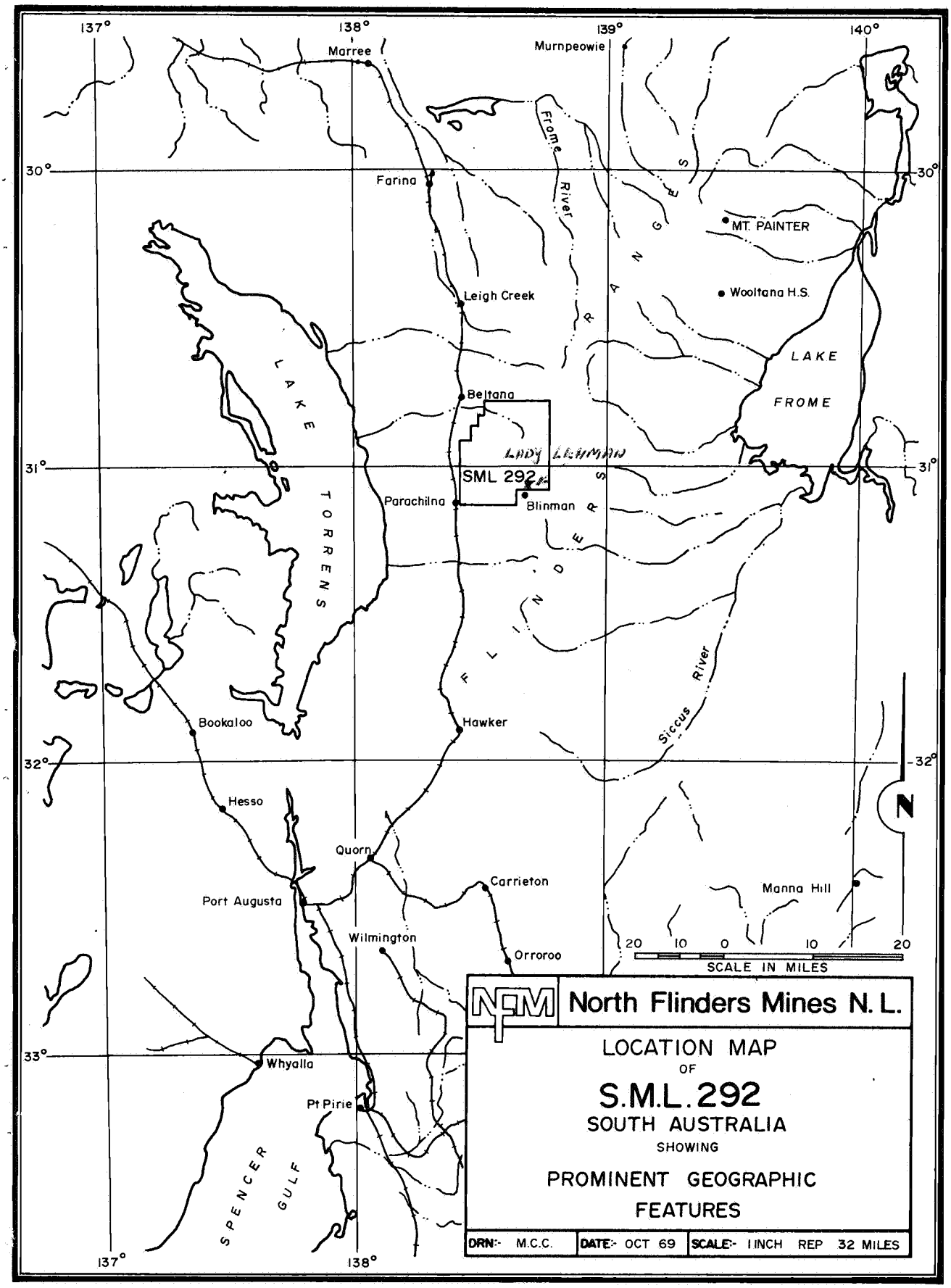
PART S.M.L. 557 (formerly SML 292)

MARCH, 1971

S.J. CARTHEW
Student Geologist
NORTH FLINDERS MINES LIMITED

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Marree
Murnpeowie
Farina
Leigh Creek
Beltana
Parachilna
Blinman
SML 292
LADY LAWLEY
Frome River
RANGES
MT. PAINTER
Wooltana H.S.
LAKE FROME
LAKE TORRENS
FLINDERS RANGES
Siccus River
Bookaloo
Hawker
Hesso
Quorn
Carrieton
Port Augusta
Wilmington
Orroroo
Manna Hill
Whyalla
Pt Pirie
SPENCER GULF
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SCALE IN MILES
NFM
North Flinders Mines N.L.
LOCATION MAP
OF
S.M.L. 292
SOUTH AUSTRALIA
SHOWING
PROMINENT GEOGRAPHIC FEATURES
DRN:- M.C.C.
DATE:- OCT 69
SCALE:- 1 INCH REP 32 MILES

DWG:292-1

CONTENTS:

0 16

ACCOMPANYING PLANS

Regional Map Lady Lehman Mine Area
Showing copper occurences, scale 1" rep. 1500' Dwg. 292-1

The Lady Lehman Mine is situated eight miles north-by northeast of Mooloolo homestead. A geochemical stream sampling survey defined an anomalous copper and zinc zone of about ten square miles about this mine. Within this anomalous zone four mines have been recorded, Mosely's (record of the Mines of South Australia, p.97), Lady Lehman (Mining Review 6, p.19) Lady Lennon also named Homeward Rule and Midnight Mine (Mining Review 8, p.20, Mining Review 107 and Geology Survey Bulletin 21, p.63) and the Mount Rugged Mine also named Patawarta Mine (Record of the Mines of South Australia, p.95)Elements of economic interest recorded in these Mines are copper, gold, bismuth, cobalt, silver.

The streams within the outlined anomalous area have been re-followed up with stream sediment samples every one hundred feet. In the field at the time of examination, geologist-geochemist Roger Fidler was following up geochemical anomalies. Geologist Robert Read was mapping the Lady Lehman diapir where the source of the anomalies are centred and my assignment was to study the mineralization in the old workings.

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I AREA 'A' - MOSLEY'S COPPER MINE

This mine is situated 1 mile north-northeast of the Lady Lehman copper mine. A number of shallow shafts (up to forty feet deep), prospect pits and five trenches expose the lode formation. The lode formations strike in a general north-south direction for approximately one mile. Copper mineralization is exposed in 'veins' of ferruginous calcite and siderite that vary in width up to four feet. Micaceous hematite and malachite forms a stockwork of veins that can be traced along the trench walls for distances up to thirty feet. The western limit of the mineralization is a bed of sandstone.

Recording from north to south, a geological description of each digging with copper found exposed is as follows:-

Stream with copper anomalies Cu 60, 130, 70, 80 60 and 70.

Cu 9

A shallow digging in the creek bank, exposes brecciated slates with thin veins of quartz and calcite veins in which are isolated splashes of malachite. Two prospect pits upstream from this digging expose the same formation.

Cu 10

In a pit three feet wide, 6 feet deep and ten feet long, grey shales outcrop with malachite in micaceous hematite and also in brecciated siltstones.

Cu 8

Malachite occurs in the joints of kunkar limestone crust and a half inch vein of chalcopyrite is exposed in the pit.

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Inclined Shaft - Copper Anomaly 90

An inclined shaft whose surface dimensions are three feet by twelve feet and stoped to a depth of forty feet deep exhibits malachite diffused in yellow - brown shales, ferruginous calcite and micaceous hematite veins.

Stream with copper anomalies - 110, 150, 170, 170, 140, 80, 100, 70, 50.

Trench

Situated at the head of the creek a trench has the dimensions of two feet wide, fifteen feet long and up to twelve feet deep. Malachite is associated with hematite in breccia and yellow slates. The mineralization occurs along 'joints' and in an abundant stockwork of veins which vary up to one feet wide. These veins can be traced along the trench for about thirty feet. One grab sample from the micaceous hematite vein assayed 6.2% copper.

Cu 2 - Cu 3 - Cu 4

Below a bold sandstone and quartzite outcrop, two shallow pits expose a one feet wide vein of breccia and ferruginous calcite which has veinlets of malachite and chalcopyrite and malachite has diffused into the shales. The lode strikes ESE - WNW for about 1000 feet and dips at 80°.

Cu 5

On a spur with sandstone quartzite boldly outcropping two shallow diggings fifty feet apart expose a high grade six inch wide vein with copper minerals, malachite and chalcopyrite with hematite. The sandstone outcrop, striking north-south, dips at 80°, and is four feet wide. One hundred yards south west of these diggings, malachite has diffused into grey shales.

K 9

Malachite and chalcopyrite in ferruginous calcite and gossan (?) in grey slates is exposed in a collapsed tunnel, in the bank of the creek. The lode exposed is eight feet wide,

...../4

strikes in a general north and south direction and dips at 75°. Rock chip samples across the mineralized face assays 3.7% copper and 360 p.p.m. zinc.

Cu 7 - Cu 6

A number of shallow workings have been sunk along a general north and south line for about three hundred and up to forty feet apart on what appears to be no defined lode. Malachite and chalcopyrite are in veins of quartz and ferruginous calcite. Malachite also occurs in splashes and veinlets through the diapiric raft and has diffused into minor lenses of grey siltstones.

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II LADY LEHMAN MINE AREA

The Lady Lehman Mine has been described by Dickinson S.B. (1944) and Shackleton(1968).

At the surface, the mineralization follows approximately the northern boundary of a 'raft' of calcareous siltstones and diapiric breccia. Shallow workings along this boundary of the raft indicate the lode to continue for over 5,000 feet. The lode consists of pyrite and chalcopyrite in ferruginous calcite and has diffused into the overlying siltstones. As Dickinson reports the lode is not continuous.

Cu 13

On the edge of the plain, near the head of a creek, the stream sediment sample taken assays 200 p.p.m. Cu, 390 p.p.m. Zinc and 180 p.p.m. Pb. The source of these high anomalies is from two pits at the head of the creek. In the pits, malachite is associated with scapolite and micaceous siltstone. Across a five feet intersection the rock chips assayed 3.6% copper, 630 p.p.m. lead and 0.18% Zinc.

K5, K6 & K7

Six inch veins of malachite and chalcopyrite and malachite diffused in shales is exposed in the pits. At pits sample K6 and K7 assayed 2.3% copper and 1.0% copper respectively.

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III LADY LENNON MINE AREA

This mine has also been named the Midnight Mine and the Homeward Rule. The copper mineralization in this area is associated with ferruginous calcite veins and has generally diffused into the shale with these veins. The mineralization strikes a general north west and south east direction through a raft of calcareous siltstones.

From this mine ninety tons of ore have been produced.

Cu 19

Malachite is associated with scapolite is a small pit on the west bank of the creek. It is situated four hundred yards north west of the Lady Lennon Mine.

Cu 16

Malachite and chalcopyrite veins in ferruginous calcite and grey slates.

Cu 17

Open Cut and Drive

On the east face of the open cut recording from the entrance:

(i) 0 feet to fifteen feet,
three inch width of malachite diffused into the joints of yellow shales.

(ii) Fifteen feet to 27 feet.
The ferruginous calcite and gossan with copper mineralization (malachite, azurite and chalcopyrite) averages two feet wide.

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Sampling over an eight foot intersection between these beds, the rock chips assayed 3.6% copper, and 360 p.p.m. zinc.

The adits have been driven into the north face of the open cut. In these workings the copper lode widens.

In the workings the beds dip at 5^{o} and striking in a north and south direction.

Cu 18

Parallel to the copper lode at Cu 17 and two hundred feet to the east of it a one to three feet wide lode of ferruginous calcite with malachite and chalcopyrite occurs in grey shales. The copper mineralization has diffused into the interbedded grey shales.

This lode can be traced for about one thousand feet by the numerous workings along the line of lode. Some of these workings have been stoped to depth of about forty feet.

Two hundred yards west of these workings, another calcite vein has minor copper association.

K 10

Malachite and Azurite has diffused through red and grey shales over a ten to twelve feet intersection in an open cut. Rock chip sampling across this intersection assay 3.8% copper.

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IV MOUNT RUGGED MINE AREA

Numerous lodes of ferruginous calcite and diapiric blocks have splashes and veins of malachite, chalcocite and chalcopyrite. In this area, igneous 'bodies' have metamorphosed the surround rocks. (The zones of contact metamorphism are very narrow, 10' at the most. The igneous bodies do not appear to have caused brecciation - R.E. Read). In this surrounding zone minor copper mineralization has been recorded at the localities, A1, A2, A4, Z1, Z2 and outside this area at K3. I have not been able to record copper mineralization in all the brecciated zones around the igneous blocks.

A6

A three feet wide calcite lode carries malachite and chalcopyrite. The lode, which can be traced along the surface for one hundred feet, strikes in a north east and south west direction, dipping at 30^{o}. From a cross-section of the lode samples collected assayed 1.1% copper.

My observation of the other copper occurrences with ferruginous calcite are of only minor importance.

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APPENDIX 'A'

K3

Fifteen feet above the creek bed on a horseshoe bend, a pit eight feet long, six feet wide and six feet deep exposes copper mineralization associated with diapiric rocks and thin calcite veins. Chip samples across a six feet wide face assayed 0.35% copper, 900 p.p.m. lead and 0.25% zinc. This copper occurrence may be southward extension of the Lady Lehman lode?

APPENDIX 'B'

One occurrence was noted where copper mineralization is associated within an igneous block. This occurrence is situated at the head of a creek with the copper anomalies 35, 40, 85 and 100.

In this same area copper was noted in ferruginous calcite and quartz veins. At Y2, a 3" vein of malachite and chalcopyrite in siderite and gossan material in soft siltstones at the fork of a creek assayed 20% copper and 160 p.p.m. zinc.

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V CONCLUSIONS

The widespread mineralization in the Lady Lehman diapir appears to be discontinuous, and irregularly defined at the surface. Copper mineralization is to be found primarily in the numerous ferruginous calcite veins and sometimes in the associated siltstones. Within the rim of the diapir, igneous bodies have been mapped by R. Read. On the periphery of some of these igneous outcrops, copper mineralization is to be found in the breccia. One mile E.N.E. of Blinman Hut Well, is the only locality where copper mineralization has been recorded in the igneous bodies.

The area may be regarded as low grade in bulk for copper but may also be of interest for gold, bismuth and cobalt.

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APPENDIX I

Sample	Description.	Cu p.p.m.	Pb p.p.m.	Zn p.p.m.
9912	K3	3,500	900	2,500
3	A6	11,000	35	20
4	K10	38,000	75	180
5	X2	200,000	50	160
6	trench	62,000	20	30
7	Cu 13	36,000	630	1,800
8	K9	37,000	80	360
9	Cu 17 Open cut	36,000	80	360
9220	K7	23,000	50	20
21	K6	10,000	80	20

S. J. CARTHEW
(Student Geologist)
NORTH FLINDERS MINES LIMITED

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REFERENCE

- RIM OF DIAPIR
- IGNEOUS INTRUSIONS
- ⊕ COPPER OCCURRENCES
- × COPPER WORKINGS
- PP PROSPECT PIT NO COPPER MINERALISATION NOTED
- Tr TRENCH

SCALE

0 1500 3000 4500 6000 7500

FEET

NFM North Flinders Mines N. L.

LADY LEHMAN MINE
S.M.L. 292
REGIONAL MAP
SHOWING
CU. OCCURRENCES
BY S.J.CARTHEW

DRN:- M.J.T. | DATE:- 29/3/71. | SCALE:- 1" reps. 1500'.

DWG 292-10

ENV 1638(I) - 4

1638 -(I) 4

NORTH FLINDERS MINES LIMITED

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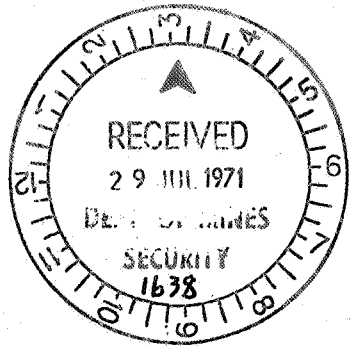
QUARTERLY REPORT

S.M.L. 557

SOUTH AUSTRALIA

PERIOD ENDED JUNE, 1971



R.B. WILSON
Chief Geologist

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APPENDICES

ACCOMPANYING MAPS

Dwg. 557-2 — Location Map

Progress maps, Narina Area, S.M.L. 557, Stream Sediment Reconnaissance Survey.

1 - Sample Location Map

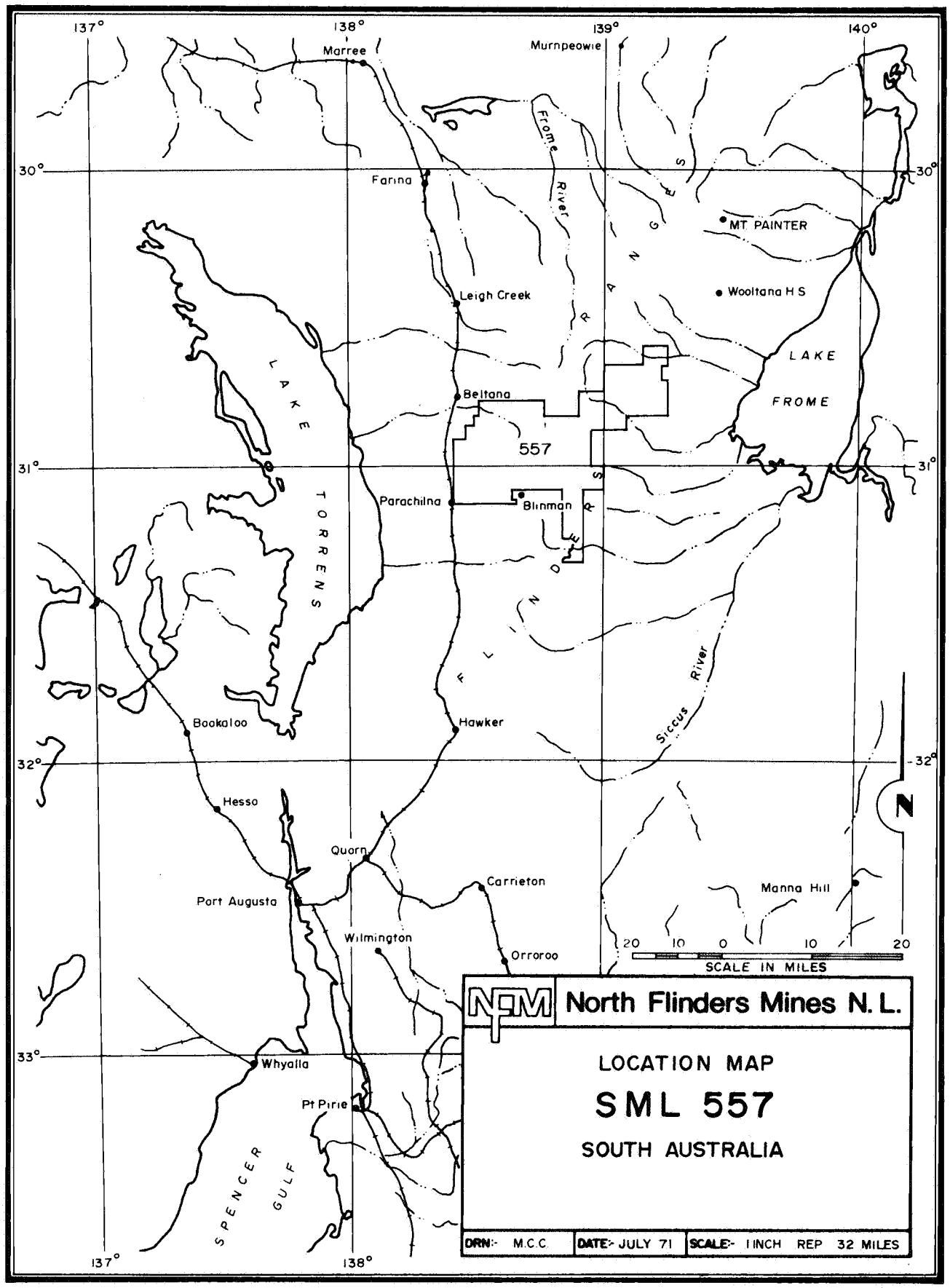
2 - Copper Results

3 - Lead Results

4 - Zinc Results

Dwg. 557-1 — Wilkawillina Gorge, S.M.L. 557, Geological map with Rock-chip sample Traverses (Zn, ppm) Scale 1 in = 800 ft. (approx.)

Dwg. 290-24 — Third Plain Prospect S.M.L. 290 Geological map Scale 1 in = 400 ft. (Approx.)


137°
138°
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30°
31°
32°
33°
Marree
Murnpeowie
Farina
Frome River
RANGES
MT PAINTER
Wooltana H S
Leigh Creek
LAKE FROME
LAKE TORRENS
Beltana
557
Parachilna
Blinman
FLINDERS RANGES
Siccus River
Bookaloo
Hawker
Hesso
Quorn
Carrieton
Manna Hill
Port Augusta
Wilmington
Orroroo
Whyalla
Pt Pirie
SPENCER GULF
N
20 10 0 10 20
SCALE IN MILES
NFM
North Flinders Mines N. L.
LOCATION MAP
SML 557
SOUTH AUSTRALIA
DRN:- M.C.C.
DATE:- JULY 71
SCALE:- 1 INCH REP 32 MILES

DWG 557-2

I. INTRODUCTION

Special Mining Lease 557, covering an area of approximately 1000 square miles in the Central Flinders Ranges of South Australia, was granted for a period of 2 years. The area formerly comprised Special Mining Leases 290, 292 and 293.

II PERSONNEL

A graduate-geologist, Mr. R.E. Read (B.Sc., Adelaide) has been stationed at Blinman since late February, 1971, to carry out recommended follow-up work and detailed geological investigations of previously-known and newly-discovered mineralized areas. Mr. S. Carthew (Student-geologist) acted as geological assistant during investigation of the Lady Lehman-Patawarta area.

A three-man geochemical crew under the direction of Technical Supervisor Mr. W. Doe, has been stationed in the Point Well - Narina - Irish Well region since April, to complete reconnaissance stream-sediment sampling and for detailed follow-up investigations of previously-delineated anomalous areas.

A road-crew with bulldozer and truck, was used in the area for a 2-week period, in an attempt to upgrade the Moro Springs - Point Well road, which had been severely affected by floodwaters earlier in the year.

Support for the exploration programme of this area is provided by the Head Office (Adelaide) and the Field Camp (Arkaroola Homestead).

...../2

III SUMMARY OF OPERATIONS

A. GEOCHEMICAL-CREW

1. Reconnaissance Stream-sediment sampling

A total of 1169 stream samples were taken from an area of approximately 145 square miles in the Point Well - Narina - Bullock Head Gap region, sieved to 80 mesh and analysed for Cu, Pb, Zn. (McPhar Geophysics Pty. Ltd). Several anomalous areas as well as several one-sample anomalies are apparent from this work. Sampling is continuing and expected to be completed by about mid-August 1971. Reconnaissance sampling of the western and southern portions of Special Mining Lease 557 (former S.M.L. 292 and 290 respectively) had been completed previously.

2. Follow-up Geochemical Work

In the search for further possible willemite outcrops within the Wilkawillina Limestone, certain anomalous areas, from Wilkawillina Gorge in the south to Erina Waters and extending to the Point-Well - Narina region, have been resampled in more detail. Heavy mineral fractions from such sampling have been microscopically examined for the presence of willemite with, to date, disappointing results. Zinc anomalies have been related to:-

(a) Massive manganese-iron oxide cappings - some of which appear conformable with the host-rocks (Wilkawillina Limestone), while others are related to faults and/or joints.

OR:

(b) Mangariferous rock-phosphate outcrops - of a similar nature to those previously investigated by North Flinders Mines at Erina Waters. A further example of the relationship between zinc anomalies and phosphate-rich rocks was noted in an area some 2 miles east of Point Well Outstation. Here, phosphate-rich rocks appear related to erosional features (? ancient karst-topography) again in a stratigraphic position near the Wilkawillina - Parara boundary.

A sample of this material assayed 17.0 % P_2O_5 and 1700. p.p.m. Zn.

A further highly anomalous zone (Cu, Pb, Zn) was check-sampled in the Bullock Head Gap area and confirmed. No obvious mineralization is evident in the shales below the A.B.C. Quartzite although a reconnaissance soil-profile has indicated zinc values up to 2000 p.p.m. Zn . Details of this follow-up work are not yet available.

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B. GEOLOGICAL FOLLOW-UP AND MAPPING INVESTIGATIONS

1. Lady Lehman - Patawarta Diapir Area

An anomalous area in the general Lady Lehman Mine region was delineated by earlier reconnaissance and more detailed follow-up stream sediment surveys (see previous North Flinders Mines reports, former S.M.L. 292). Follow-up of these copper anomalies by S. Carthew resulted in the re-discovery of numerous old workings, as well as several new copper occurrences, covering an area of some 4 square miles to the immediate northwest of Patawarta Hill. Subsequent regional geological mapping (1 in = 1800 feet approx.) and detailed investigations has shown fairly persistent copper mineralization (pyrite-chalcopyrite) to be associated with numerous thin calcite-siderite veins, the most extensive of which was found to occur at the Lady Lehman Mine itself. Previous drilling of this latter prospect, although not conclusive due to drilling problems, gave generally low to moderate copper values over relatively narrow widths. Some minor copper mineralization was also noted to be associated with narrow veins of micaceous hematite and also with the margins of several small post-diapir doleritic plugs. Tentative conclusions reached are that these occurrences, although widespread, would not offer sufficient tonnage-potential to be of interest to the Company.

A zone of zinc anomalies to the immediate south of the Patawarta Diapir has recently been investigated by R. Read. Reconnaissance soil-sample traverses have delineated narrow zones of zinc-rich gossan, possibly of stratiform character, within red-green shale-siltstone of the Wonoka Formation. Full assay data and geochemical profiles are not yet available, although further detailed investigation over a strike length of 3,000 to 4,000 feet, appears warranted at this stage. Preliminary petrological work on speciments of this gossan (Appendix III - A.W.G. Whittle), has indicated the presence of pyrite and sphalerite boxworks, and also small quantities of smithsonite.

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2. Area North of Wilkawillina Gorge

A zone of anomalous stream-sediment samples (Zn), some $\frac{3}{4}$ mile north of Wilkawillina Gorge, was investigated in more detail by R. Read (see appended map Dwg. 557-1). No willemite could be detected in the heavy mineral fractions of these anomalous samples.

Detailed rock-chip traverses across limestone-dolomite beds of the Wonoka Formation, stratigraphically immediately below the Pound Sandstone, shows the presence of low zinc values in some thin carbonate horizons. No specific minerals were identified and it is assumed that zinc exists in solid-solution with the dolomite or limestone.

Careful examination of the Wilkawillina Limestone, even in the vicinity of the major northeast-trending fault, failed to reveal any zones of 'red dolomitization' which typically occur as a halo surrounding known willemite bodies.

No further work is contemplated for this area.

3. Third Plain Area

Semi-detailed (1 in = 400 ft.) geological mapping of the area surrounding the Third Plain Willemite Prospect, was carried out by R. Read with the object hopefully of establishing some broader structural or stratigraphic control for the mineralization, which could be of assistance in the prospecting for further willemite bodies. No such controls are obvious from this work, although the 'halo' of red-dolomitization surrounding the willemite body seems universal in the known South Australian localities for this type of zinc-mineralization. Percussion drilling of this prospect previously had suggested the presence of complex thrust-faults in the immediate vicinity of the willemite-body, not apparent from this latest geological mapping (Dwg. 290-24).

...../6

4. Additional Work

Soil-sampling, chip-sampling and detailed mapping has been carried-out by R. Read on several areas confirmed as anomalous as a result of previous follow-up work carried-out by R. Fiddler (See previous reports, former S.M.L. 292).

These include:-

Wepowie Lead Mine	-	Gridding, soil-rock sampling, mapping.
Mt. Mary Copper Mine	-	Gridding, soil-rock sampling, mapping.
Occurrence 'D'	-	Soil and rock-chip sampling.

No details of this work are yet available.

In addition, several other old mines, which were 're-discovered' as a result of reconnaissance and follow-up geochemical surveys, were inspected to determine the possible worth of further detailed work. Many of these, such as the old Warioota Copper mine (northeast of Nuccaleena Mine), occur as small, narrow, discontinuous, but often rich, pods of copper-carbonate mineralization, associated with minor faults or shears. These do not appear to offer any worthwhile tonnage-potential and further investigation was not considered to be warranted.

...../7

IV FUTURE PROGRAMMES

The following future programmes are contemplated:-

1) Completion of reconnaissance stream-sediment sampling (mid-August).
2) Continuation of detailed follow-up work, including heavy mineral investigations, on anomalous areas.
3) Continued geological mapping, sampling, costeaning in Patawarta zinc-area, possibly eventual preliminary percussion-drilling.
4) More detailed geological and geochemical investigation of the Bullock Head Gap anomalous zone.
5) Geological mapping and further sampling of the Moro Gorge dolomite area with weak lead values, previously investigated by M. Garman.
6) Continued re-examination of known old mines or mineralized areas, offering some possible tonnage-potential.

BALCANOONA

CADNIA

ARROWIE - 1 MILE GEOLOGICAL SHEETS

NOS. 1002/001 - 1169

North Flinders Mines N. L.

NARINA AREA
S.M.L-557

STREAM SEDIMENT RECONNAISSANCE SURVEY.

SAMPLE LOCATION MAP

DRN:- I S	DATE:- 16-12-70	SCALE:- 60 chains = 1 inch

RECEIVED

BALCANOONA

CADNIA

ARROWIE – 1 MILE GEOLOGICAL SHEETS

(ALREADY SAMPLED)

TRAGOONA HILL

Pound Well

Nantawarrinna Spring

Nantawarrinna Bore

Angus Hut Well

Bald Hill Bore

Donkey Water Creek

Donkey Water Spring

Orange Tree Dam

One Tree Bore

Irish Well

Double Gum Bore

Top Well Bore

Dam

Roebuck Bore

MT URO

PEAK

MT ROEBUCK

RIVERS BLUFF

STIRRUP IRON RANGE

COCKSCOMB

MT ANDRE

MT McFARLANE

BULLOCK HEAD GAP

BEN LOMOND

NARINA

JUBILEE RANGE

MT BROOKE

ANN HILL

Round Range

Woodendinna

30°40'

30°43'

30°45'

30°50'

30°53'

138°45'

138°54'

139°05'

139°09'

139°10'

139°15'

NFM	North Flinders Mines N. L.
NARINA AREA	
S.M.L-557	
STREAM SEDIMENT RECONNAISSANCE SURVEY.	
COPPER RESULTS p.p.m.	
DRN:- I S	DATE:- 16-12-70
SCALE:- 60 chains = 1 inch.	

RECEIVED

BALCANOONA

CADNIA

ARROWIE - 1 MILE GEOLOGICAL SHEETS

(ALREADY SAMPLED)

Nantawarrinna Spring

Nantawarrinna Bore

Angus Hut (W.)

Bald Hill Bore

Donkey Water Spring

Orange Tree Dam

Orange Tree Bore

Irish Well

Double Gap Bore

Top Well Bore

Dam

Rowbuck Bore (W.)

Pound (W.)

MT URO

PEAK

MT ROEBUCK

RIVERS BLUFF

FRAGGONA HILL

COCKSCOMB

MT ANDRE

MT McFARLANE

BEN LOMOND

ANN HILL

NARINA

MT BROOKE

BULLOCK HEAD GAP

Pound Ridge

Woodendinna

Jubilee Range

Stirling Range

Stirrup Iron Range

30°38'

30°40'

30°43'

30°45'

30°50'

30°53'

139°45'

139°54'

139°46'

139°55'

North Flinders Mines N. L.

NARINA AREA

S.M.L.-557

STREAM SEDIMENT RECONNAISSANCE SURVEY.

LEAD RESULTS p.p.m.

DRN:- I.S. | DATE:- 16-12-70 | SCALE:- 60 chains = 1 inch.

RECEIVED
29 JUL 1971

BALCANOONA

CADNIA

ARROWIE - 1 MILE GEOLOGICAL SHEETS

North Flinders Mines N. L.

NARINA AREA

S.M.L-557

STREAM SEDIMENT RECONNAISSANCE SURVEY.

ZINC RESULTS p.p.m.

DRN:- I.S	DATE:- 16.12.70	SCALE:- 60 chains = 1 inch.

RECEIVED
29 JUL 1971
DEPT. OF MINES

ROCK CHIP-SAMPLE TRAVERSES

TRAVERSE "G"
S th 0° East

20	
15	
25	
25	SILTY BLUE - GREY & BUFF - COLOURED
25	
40	LIMESTONES WITH PURPLE BANDS &
25	
30	INTRAFORMATIONAL BANDS
30	
30	
50	
40	
30	

TRAVERSE "H"
S th 80° East

20	
20	
25	
25	
20	
20	
30	
20	BLUE - GREY SILTY LIMESTONE
20	
50	
30	
20	
30	
15	

TRAVERSE "E"
S m 50° East

240	RED & GREY DOLOMITES
84	BUFF COLOURED
95	CARBONATES
110	

TRAVERSE "D
S m 60° East

1700	END OF OUTCROP
1900	LIMESTONE
1000	
820	DARK LIMESTONE
4600	LIMESTONE
13060	IRON STAINED LIMESTONE
2000	SMALL GOSSANOUS OUTCROP
3400	

TRAVERSE C
DENSE BLUE SILTY LIMESTONES

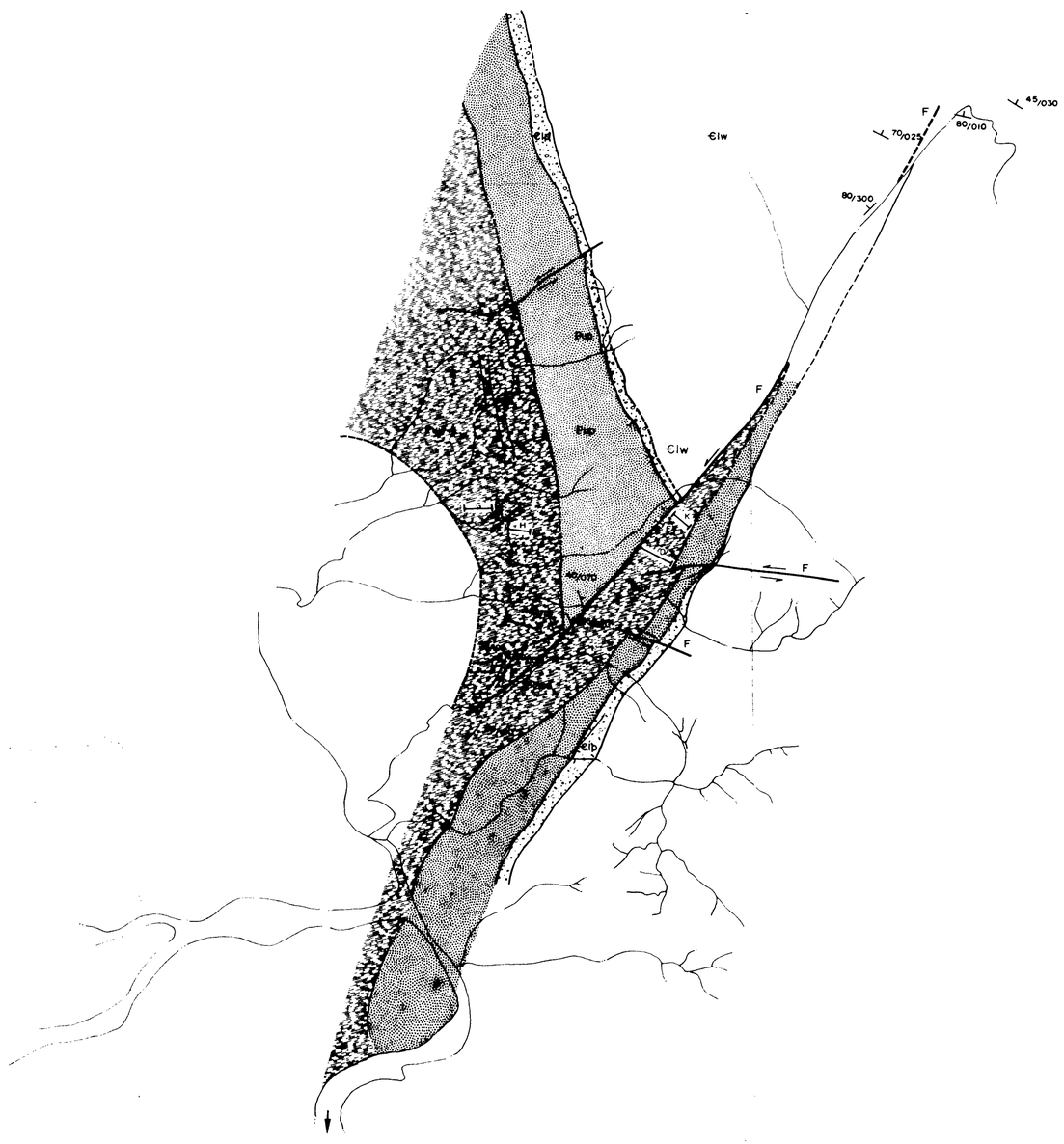
290	
98	
170	
15	
10	QUARTZITIC SILTS
15	
95	
150	
70	
25	
20	CALC - SILTS & LIMESTONES
20	
25	
40	
50	

TRAVERSE "K"
S th 50° East

2000	
9500	
1000	BLUE LIMESTONE
2700	
2400	BROWN ? DOLOMITE & BLUE - GREY SILTY LIMESTONE
340	DARK BROWN ? DOLOMITE & LIMESTONE ROCK & HAEMATITE
640	SILTY LIMESTONE &
490	DARK BROWN ? DOLOMITE
30	QUARTZITIC BAND
30	NO OUTCROP
400	BLUE GREY SILTY
210	LIMESTONE
	BLUE - GREY SILTY LIMESTONE & NUMEROUS
200	CALCITE - FILLED TENSION GASHES
35	BLE - GREY SILTY
40	LIMESTONE

NOTE ALL DISTANCES PACED, ONLY APPROX

SCALE 1" reps 100'



REFERENCE

- €Iw — WILKAWILLINA LIMESTONE
- PARACHILNA FORMATION : SOFT GREEN POORLY OUTCROPPING SANDSTONES & SHALES
- POUND QUARTZITE
- WONOKA FORMATION : CALCAREOUS SILTSTONES (SANDSTONE MEMBERS) & BLUE-GREY LIMESTONES & OCCASIONAL PURPLE LIMESTONES. NUMEROUS INTRAFORMATIONAL CONGLOMERATE BANDS
- 30/170 — DIP & DIRECTION OF STRIKE
- F — FAULTS
- D — CHIP SAMPLE TRAVERSE

North Flinders Mines N. L.

WILKAWILLINA GORGE

SML 557

GEOLOGICAL MAP

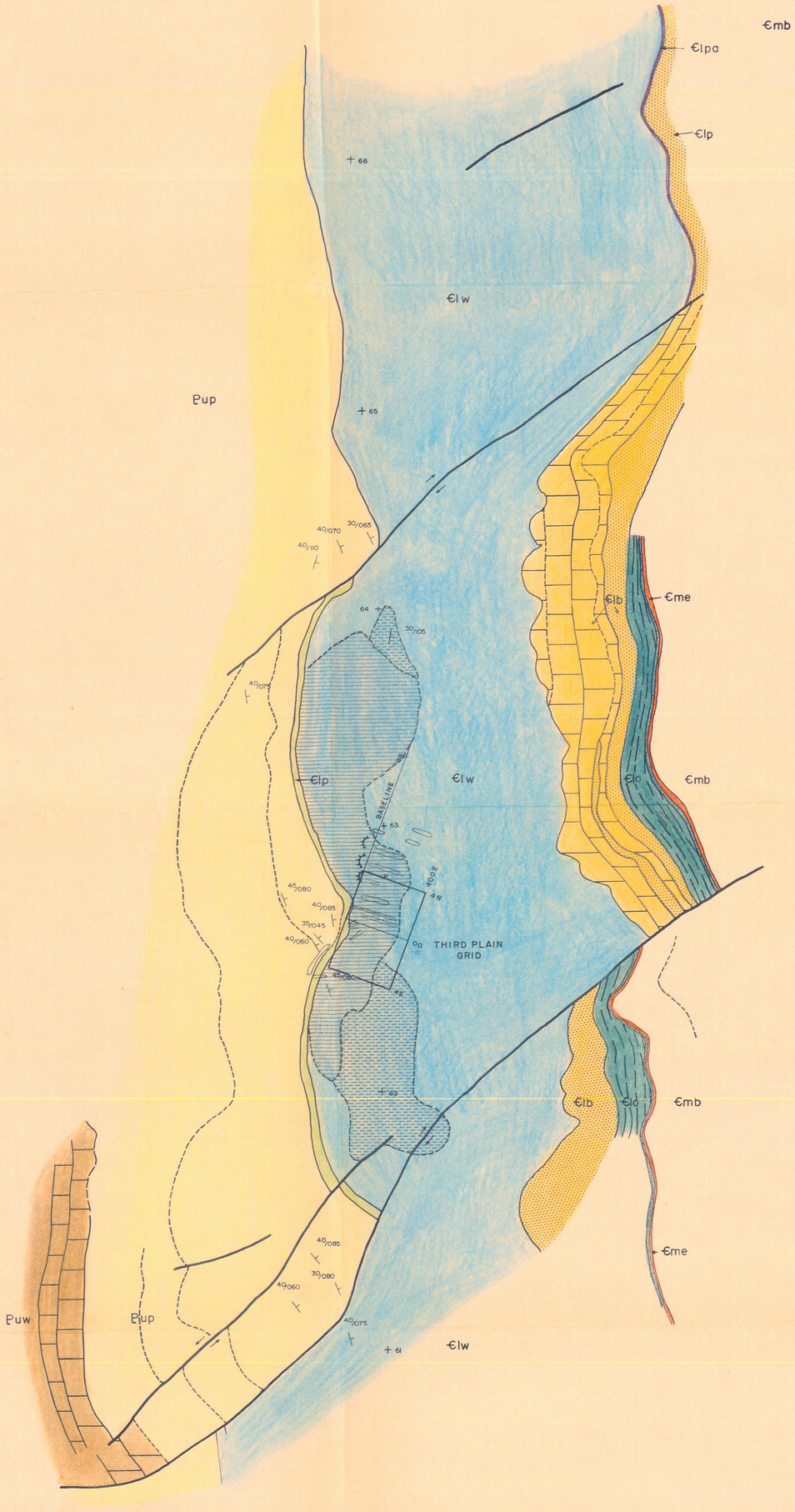
WITH

ROCK CHIP SAMPLE TRAVERSES (Zn. P.P.M.)

DRN:- M.J.T	DATE:- 9/6/71	SCALE:- 1" reps 800' (approx)

DWG 557-1

N



€mb — BILLY CREEK FORMATION: RED & GREEN SHALES, CALCEREOUS AT THE BASE IN PART

€me — EDEOWIE LIMESTONE MEMBER

€lo — ORAPARRINA SHALE: GREEN SHALY SILTSTONES, THIN SANDSTONE MEMBER AT TOP

€lb — BUNKERS SANDSTONE: MEDIUM SANDSTONE WITH INTERBEDDED CLEAN TO SANDY LIMESTONES SHOWING MARKED HORIZONTAL FACIES CHANGE

€lpa — PARARA LIMESTONE: DARK FLAGGY LIMESTONE

€lw — WILKAWILLINA LIMESTONE: MASSIVE CLEAN LIMESTONE ALTERED TO PINK DOLOMITE IN VICINITY OF ZINC MINERALIZATION

€lp — PARACHILNA FORMATION: SOFT GREEN SANDSTONES WITH INTERBEDDED SHALES VERY POORLY OUTCROPPING

Pup — POUND QUARTZITE: SANDSTONE WITH INTERBEDDED RED SILTSTONES

Puw — WONOKA FORMATION: CALCEREOUS SILTSTONES & LIMESTONES

ZONES OF PINK DOLOMITE: WITHIN THE WILKAWILLINA LIMESTONE

ZONES OF FAINTLY PINK: OR MOTTLED PINK & GREY DOLOMITE.

FAULTS: WITH DIRECTIONS OF MOVEMENT

BULLDOZED COSTEAN & SPOIL HEAPS

70/140 — STRIKE & DIP OF BEDDING

+61 — CENTRE OF AERIAL PHOTOGRAPH

SCALE

0 400 800 1200 1600 2000

FEET

PRELIMINARY ONLY.

RECEIVED 29 JUL 1971 DEPT. OF MINES SECURITY 1638

North Flinders Mines N. L.

THIRD PLAIN PROSPECT

SML 290

GEOLOGICAL MAP

DRN:- MJT	DATE:- 20/5/71	SCALE:- 1" reps 400' (approx)

Dwg 290-24

ENV 1638(I) - 10

McPHAR GEOPHYSICS PTY. LTD.

50-52 MARY STREET, UNLEY, SOUTH AUSTRALIA
POSTAL ADDRESS: P.O. BOX 42, UNLEY, SOUTH AUSTRALIA 5061

TELEPHONE 72 2133

CABLE
"PHARGEO" ADELAIDE
TELEX
"PHARGEO" AA82623

0 38

19th July, 1971

MINERALOGICAL REPORT NO. 630

by Dr.A.W.G.Whittle

TO: Mr. B. Wilson,
North Flinders Mining Co.,
25 Greenhill Road,
WAYVILLE.S.A. 5034

YOUR REFERENCE: Your order no. 3051

MATERIAL: Gossan

IDENTIFICATION: Patawarta Gossan

WORK REQUESTED: Detailed mineralogical investigation

SAMPLES AND SECTIONS: To be returned to you

McPHAR GEOPHYSICS PTY. LTD.

D. H. McColl

.....

for. A.W.G. Whittle
Consultant for
McPhar Geophysics Pty. Ltd.

The specimen is a highly cellular quartz-rich rock with minimal limonite staining, and with a ragged brecciated appearance.

This appears in thin section as a stressed and brecciated aggregate of subhedral quartz in which a distinct lineation is visible. Among the quartz there are irregular patches of microcrystalline limonite; leached cavities which are lined by thin layers of colloform limonite, with or without microcrystalline jarosite, and smithsonite; and randomly-sited patches of microcrystalline jarosite, and of smithsonite, each of which has no direct relationship to indigenous boxwork limonite. These randomly-sited jarosite and smithsonite aggregates are 0.1-0.2 mm. in size, generally located amongst the quartz, and are indicative of limited movement of oxysalts within the gossan.

Positive evidence of the presence of pyrite and sphalerite was established in the polished section. Protected, unoxidised relics of these two minerals, exist as grains of 0.01-0.1 mm. size within quartz throughout most of the gossan. The zinc mineral is pure sphalerite with little or no solid solution FeS, hence the minimal limonite in the gossan.

In certain areas there are closely associated rhombic goethite boxworks, 1-2 mm. in size, from calcite; and elongate wavy sub-parallel walled goethite boxworks with acute angled partitions and copious microspherulitic "pin-point" goethite, 0.75 x 0.25 - 1.25 x 1.00 mm. in size, from sphalerite.

In nearby areas there are elongate clusters of leached open isometric pyrite cells which are associated with euhedral quartz, and with protected relics of pyrite.

The sample is therefore a true gossan which represents a stressed, brecciated and oxidised quartz-calcite-pyrite-sphalerite lode formation.

APPENDIX V

0 40

GEOLOGICAL REPORT ON

WEPOWIE MINE

S.M.L. 557

JULY, 1971

R.E. READ

Geologist

NORTH FLINDERS MINES LIMITED

C O N T E N T S :

ACCOMPANYING PLANS

Wepowie Mine Geological Map. Scale 1 in = 40 ft.
Drawing No. 557-3

Wepowie Mine Sample Location Map, Scale 1 in = 40 ft.
Drawing No. 557-4

Wepowie Mine Overlay showing Zinc Values, Scale 1 in = 40 ft.
Drawing No. 557-5

Wepowie Mine Overlay showing Copper Values, Scale 1 in = 40 ft.
Drawing No. 557-6

Wepowie Mine Overlay showing Lead Values, Scale 1 in = 40 ft.
Drawing No. 557-7

I INTRODUCTION

The Wepowie Mine is a group of small lead deposits with minor amounts of silver, occuring sporadically along a fault near the Oratunga Diapir. All known occurrences of lead lie in the fault and appear to be small.

The chances of finding large tonnages of lead appear to be slim.

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II LOCATION

The Wepowie Mine, known locally as the Niltibury is on Mooloolloo station, near the Oratunga boundary. Access is by means of an old track running north from the Blinman-Mooloolloo road just west of the Glass Gorge.

III References

The Wepowie Mine is described on p.191 of the Record of Mines of S.A. 1908. No production figures are given. It has been briefly described by R. Fidler, in his follow-up on old S.M.L. 292.

IV Geology

The rocks in the mine area belong to the Etina Formation of the Umberatana Group. They are green shaly siltstones, limestones and arkosic limestones grading to calcareous arkoses with a uniform gentle northward dip. The workings lie in a north-south fault not shown on the Blinman 1 mile Geological Map. The fault has produced a brecciated zone which in places has been infilled with siderite. At the surface it is marked by outcrops of silicified breccia and silicified country rock.

From the northern end, where it meets the Oratunga Diapir, the fault can be traced south for about 4000' till it dies out.

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The Oratunga Diapir is a typical Flinders Range diapir, consisting of an intruded mass of shales and other rocks, contorted, strongly weathered and with associated small bodies of basic igneous rock.

V WORKINGS

There are 5 groups of workings, designated 'A' to 'F' from north to south in this report. All except 'A' workings lie on the fault. Only 'C' and 'D' workings are of any importance.

i. 'A' Workings

These consist of a trench and an adit, estimated from its dump to be 80' to 100' long. The adit appears to have been driven on account of some copper-stainings occurring in a shear in the dolomite ridge above. Examination of the dump shows that the adit has reached the dolomite which shows calcite veining. No economic mineralization is visible on the dump and from these samples assayed for Cu, Pb, and Zn only one high result was obtained, - 0.4% Pb in calcite hand-picked as it appeared to contain minute crystals of galena.

No mineralization was visible in the trench and a grab-sample of the spoil-heap did not contain appreciable Cu, Pb or Zn.

...../4

To the N.W. of these workings a single pit has been sunk on copper-stainings in a dolerite in the diapir. Of three samples the highest Cu was 0.6% and as the occurrence is very limited it is of no importance.

ii. 'B' Workings

These are a number of pits in breccia on the edge of the diapir. They are sunk on a number of small scattered veins of galena. Results from chip-sampling across the walls of a pit showed that grades are too low to be economic.(Average about 3% Pb over 6 feet). Soil sampling showed that the occurrence does not extend south, but may extend north.

iii. 'C' Workings

This is the most extensive group of workings. There are two lodes, about 100' apart. The fault appears to have split (see geological map) into two relatively large faults with lead mineralization in each. In addition there are a number of small fractures striking approximately north-south, filled with calcite, siderite and sometimes limonite. There is also evidence

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of later East-West faulting. A siderite vein east of the workings appears to have been displaced, and the fault passing through the east-shaft may have been faulted just north of that shaft. Each lode has been tested by a shaft and trenches. The ore in the oxidized zone is chiefly polysphaerite. Galena has been obtained at depths. The reference in the Record of Mines, samples taken recently, and a statement by A. Winckle all indicate that the silver content of the ore from these workings is low.

Samples of the ore-dumps gave over 30% Pb, but the vein widths appear to be narrow, 9" for W shaft, 2' for E shaft. Furthermore, the strike lengths are limited, no mineralization of economic grades being exposed outside the shafts. (See Plan).

iv. 'D' Workings

This is a single shaft of considerable depth, from which stoping appears to have been carried out. The dump has a volume of about 70 cu.yds, indicating a large amount of underground work.

The ore is a mixture of polysphaerite and galena. Hand-picked ore gave 34% Pb and 34 p.p.m. (or $2\frac{1}{2}$ oz, ton) silver.

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In the vicinity of the shaft the fault is marked by a conspicuous outcrop of silicified breccia about 20 feet wide. Chip samples of this capping yielded from 900 p.p.m. Pb near the shaft to 100 p.p.m. 80 feet to the south.

South-East of this shaft is another siliceous outcrop similar to the capping over the main fault and apparently covering a splinter fault. A chip sample of this outcrop yielded 3700 p.p.m. Pb, high in comparison with values obtained from the capping near the shaft. This splinter fault has a possible strike length of about 200'. Further chip-samples have been taken to test it.

v. 'E' Workings

This is a single pit sunk in siderite carrying a little galena and some copper-stainings. The mineralization exposed is too poor to be economic.

vi. 'F' Workings

Near the southern end of the fault a pit has been dug in a small pocket of galena. The ore on the dump of the pit is of reasonable grade, but sampling the end wall shows that the occurrence is very limited.

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VI GEOCHEMICAL SAMPLING

A trial line of auger holes was put in at 'C' Workings on line 00N, from 100E to 300W. Holes were spaced at 25 feet and samples were taken of the 'B' horizon at 6", the deepest 'B' horizon and the deepest 'C' horizon. To the east the 'B' horizon was sampled at a depth at 6" from 100E to 400E, again at 25 foot spacings.

Going east from the lodes the lead-content steadily decreases, as would be expected.

To the West the pattern is similar except that there are two anomalous peaks, at 300W and from 200W to 100W.

That at 300W is restricted to the 'C' horizon sample and only Pb is high. The other anomaly is broader and is reflected in the 'B' horizon samples. It is accompanied by two high Zn. values and one high Cu value in the 'C' horizon.

...../8

VII CONCLUSIONS

None of the old workings in the main fault appear to have yielded much lead in the past. The strike lengths of individual shoots of ore are small.

It is probable that any other shoots of ore which may exist in the fault would be too small to justify the expense of finding them. Prospecting for further shoots could be cheaply carried out by systematic chip-sampling of the fault-capping.

The splinter fault near 'D' shaft may be of interest depending on the assay results from chip sampling.

More work is being done to find the extent of the geochemical anomalies west of 'C' workings.

VIII RECOMMENDATIONS

No further work is recommended unless favourable results are obtained from the two prospects mentioned above.

R. E. Read B.Sc.

R.E. READ B.Sc.

Geologist

NORTH FLINDERS MINES LIMITED

APPENDIX I

Results from chip-sampling of the splinter-fault near 'D' shaft are now available. These show that the high value obtained earlier resulted from inadvertently including in the sample a considerable proportion of a small pocket of plumbiferous material, and that the lead values in the fault-capping are not particularly high. This prospect is, therefore, of no further interest.

R. E. Read

R.E. Read. B.Sc.

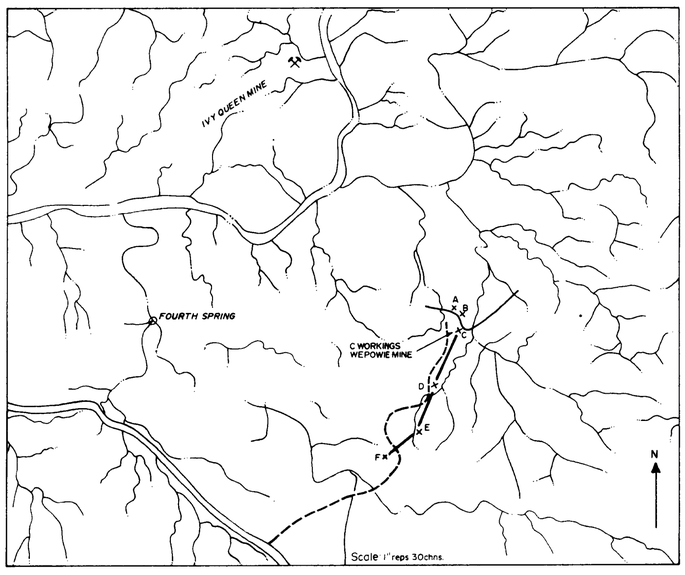
300W 200W 100W 00 100E 200E 300E 400E

300N 200N 100N 00 100S 200S 300S

T.N. M.N. 7.5° G.N.

30° 45° 33° 25° 45° 20° 15° 10°

LOCALITY MAP



SCALE

50 0 50 100 150 200 250

IN FEET

REFERENCE

- YELLOW WEATHERING GREEN SHALE & SILTSTONES
- LIMESTONES, PEBBLLY ARKOSIC LIMESTONE LIMESTONES & CALCAREOUS ARKOSE
- SILICIFIED FAULT CAPPING
- BRECCIA – CARBONATE MATRIX
- VEIN OF CALCITE WITH VARYING AMOUNTS OF SIDERITE & LIMONITE
- FAULT, OBSERVED
- FAULT, INFERRED
- GEOLOGICAL BOUNDARY, OBSERVED
- " " , INFERRED
- MINE SHAFT WITH DUMP
- STRIKE & DIP OF BEDDING
- SURVEY PEG
- MINE
- Pb OCCURENCE
- CREEK
- ROAD
- TRACK
- DIAPIR BOUNDARY (APPROXIMATE)

NFM North Flinders Mines N. L.

"C- WORKINGS" WEPOWIE MINE

SML 557

GEOLOGICAL MAP

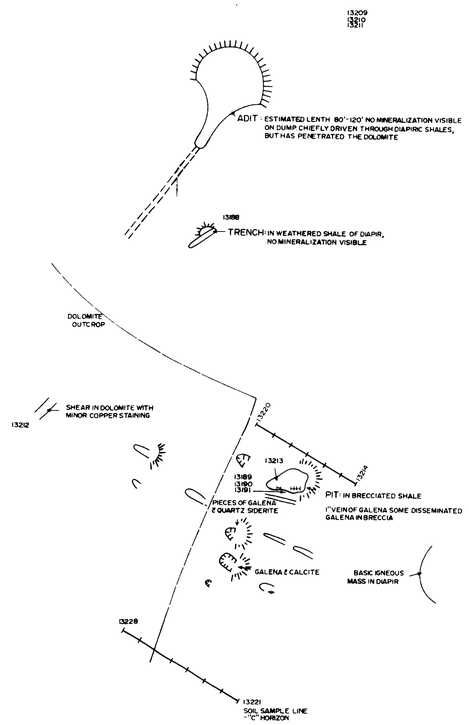
GEOLOGY BY R.E. READ

DRN:- M.T.	DATE:- SEPT. '71	SCALE:- 1" reps 40'

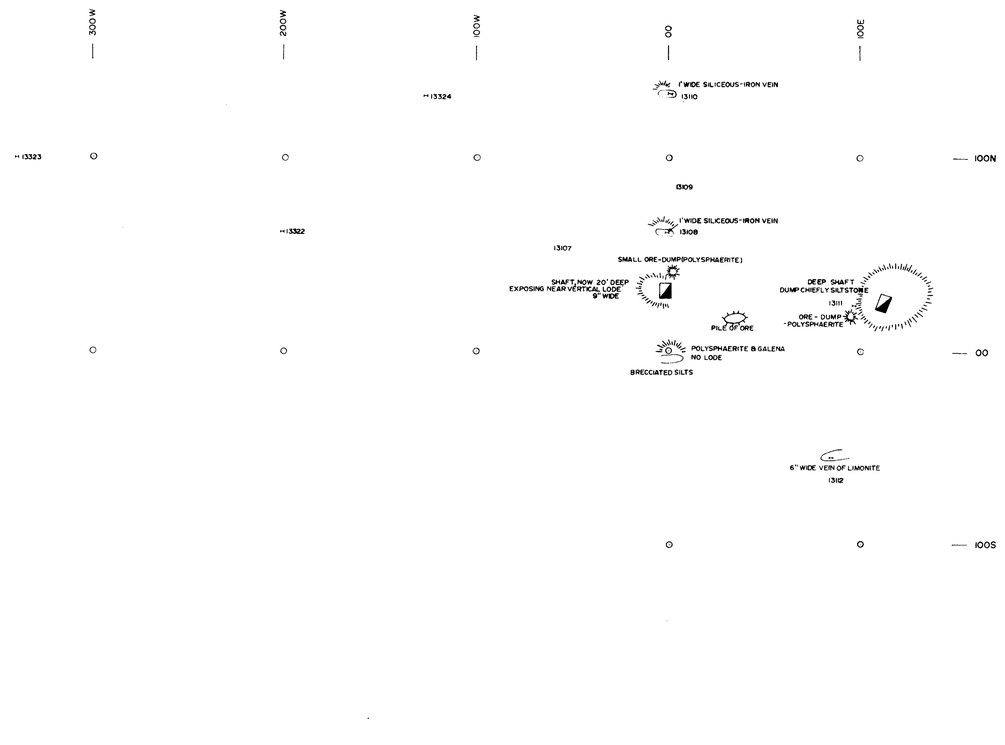
DWG 557-3

ENV 1638(III)-10

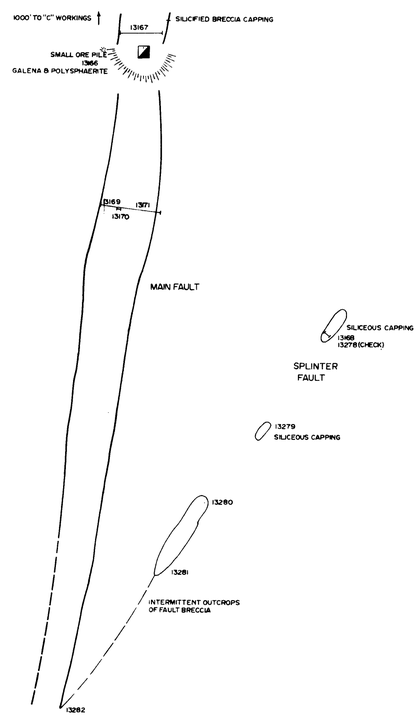
III -10



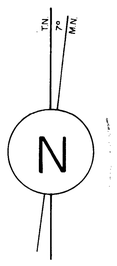
PLAN OF "A & B" WORKINGS WEPOWIE MINE

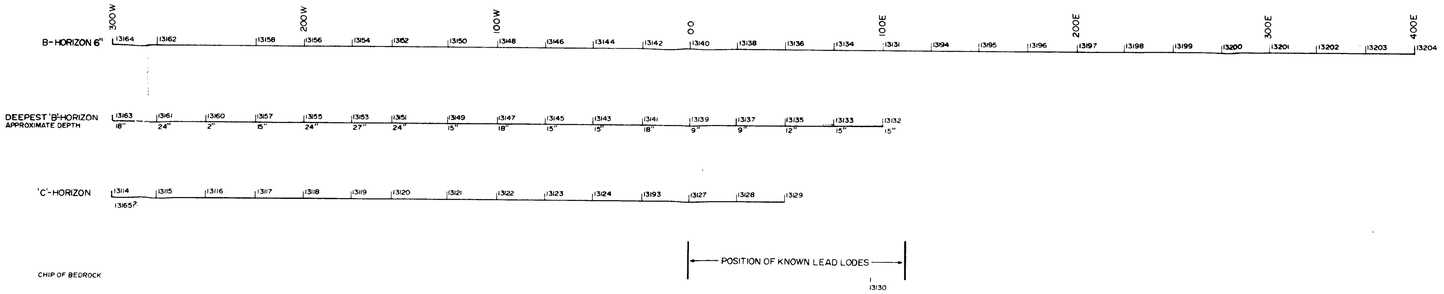


PLAN OF "C" WORKINGS WEPOWIE MINE (OVERLAY TO GEOLOGICAL MAP)



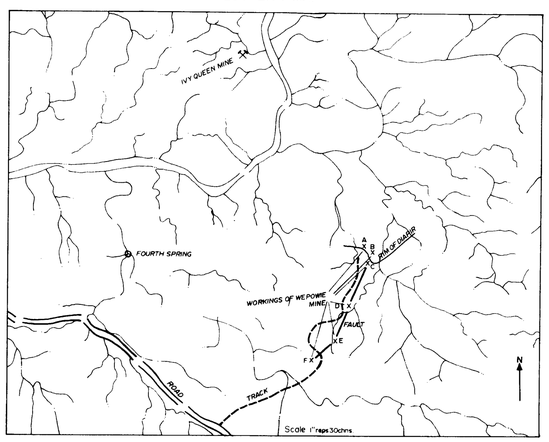
PLAN OF "D" WORKINGS WEPOWIE MINE SHOWING MAIN FAULT & SPLINTER FAULT





GEOCHEMICAL SAMPLES ON LINE 00N "C" WORKINGS WEPOWIE MINE

LOCALITY MAP



SCALE

50 0 50 100 150 200 250

IN FEET

North Flinders Mines N. L.

WEPOWIE MINE

SML 557

MINE WORKINGS

WITH

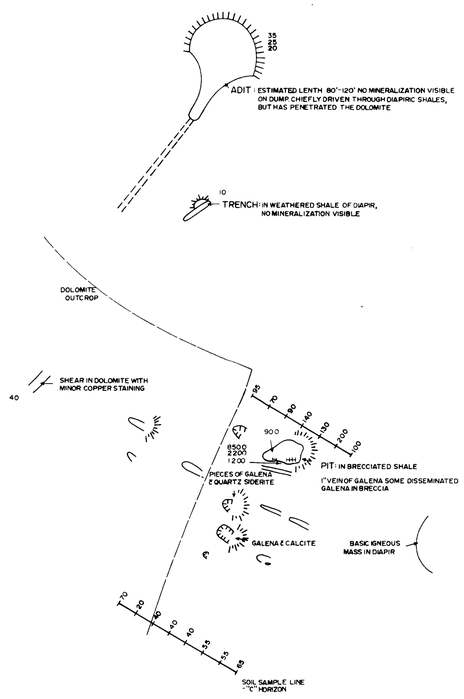
GEOCHEMICAL SAMPLE LOCATIONS

DRN:- M.T	DATE:- SEPT. 71'	SCALE:- 1"reps 40'

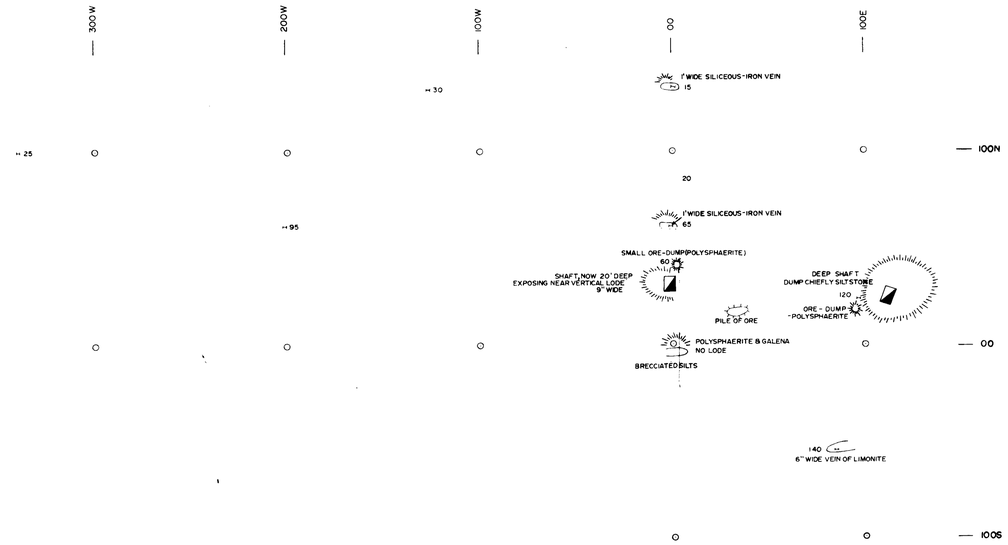
DWG 557-4

ENV 1638(III)-14

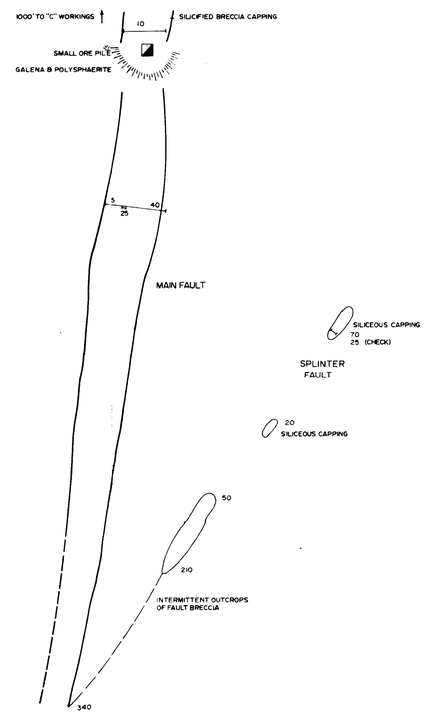
III-14



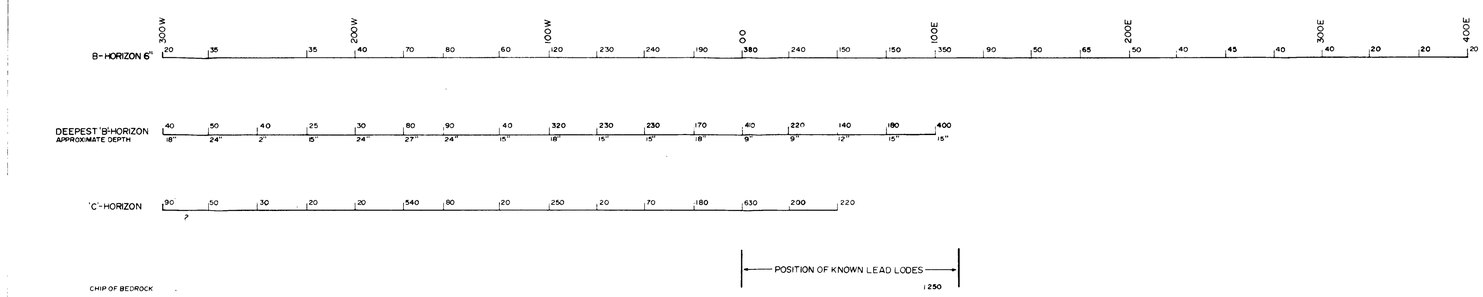
PLAN OF "A & B" WORKINGS WEPOWIE MINE



PLAN OF "C" WORKINGS WEPOWIE MINE (OVERLAY TO GEOLOGICAL MAP)

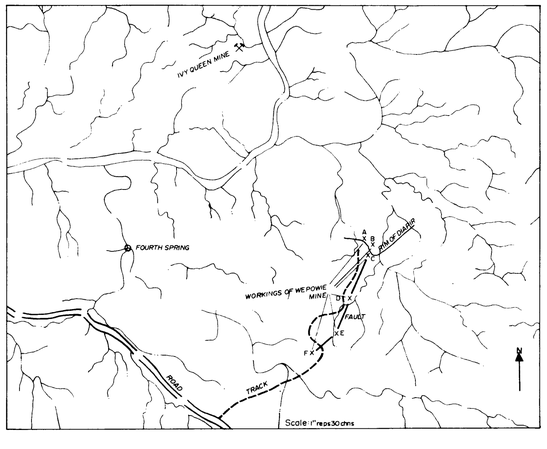


PLAN OF "D" WORKINGS WEPOWIE MINE SHOWING MAIN FAULT & SPLINTER FAULT



GEOCHEMICAL SAMPLES ON LINE 00N "C" WORKINGS WEPOWIE MINE

LOCALITY MAP



SCALE

50 0 50 100 150 200 250

IN FEET

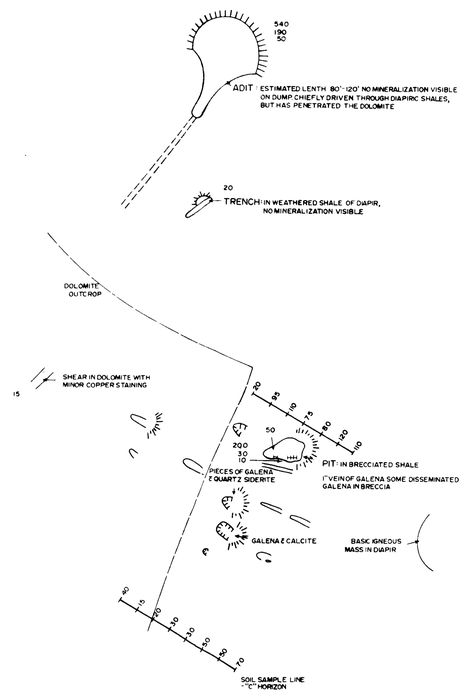
North Flinders Mines N. L.		
WEPOWIE MINE SML 557 MINE WORKINGS WITH GEOCHEMICAL ASSAYS Zn P.P.M.		
DRN:- M.T.	DATE:- SEPT 71'	SCALE:- 1"reps 40'

RECEIVED 1 NOV 1971 DEPT. OF MINES SECURITY 1638-3

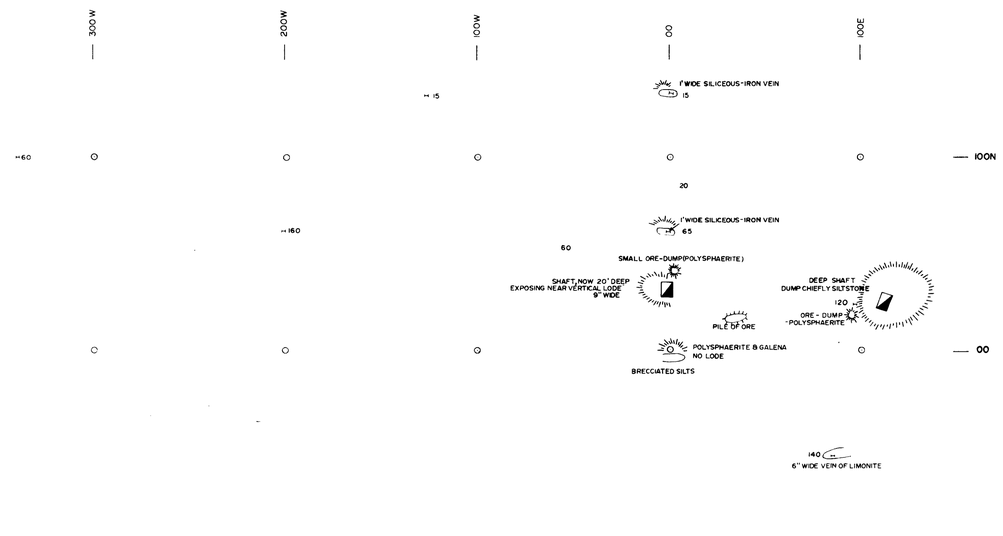
DWG 557-5

ENV 1638 (III) - 13

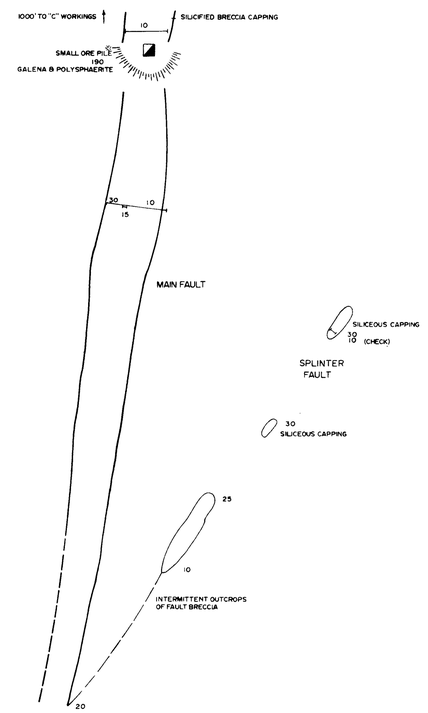
III - 13



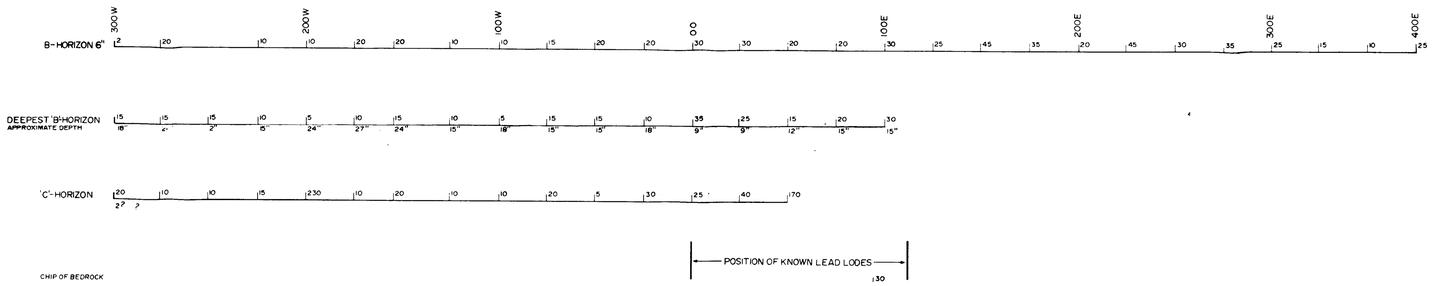
PLAN OF "A & B" WORKINGS WEPOWIE MINE



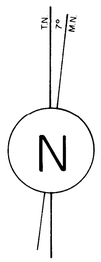
PLAN OF "c" WORKINGS WEPOWIE MINE (OVERLAY TO GEOLOGICAL MAP)



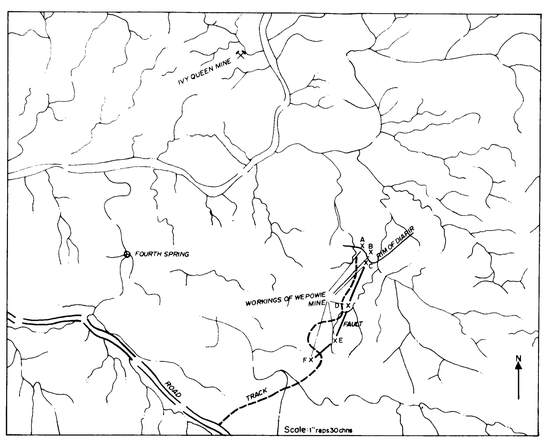
PLAN OF "D" WORKINGS WEPOWIE MINE SHOWING MAIN FAULT & SPLINTER FAULT



GEOCHEMICAL SAMPLES ON LINE 00N "C" WORKINGS WEPOWIE MINE



LOCALITY MAP



SCALE

50 0 50 100 150 200 250

IN FEET

North Flinders Mines N. L.

WEPOWIE MINE

SML 557

MINE WORKINGS

WITH

GEOCHEMICAL ASSAYS

Cu P.P.M.

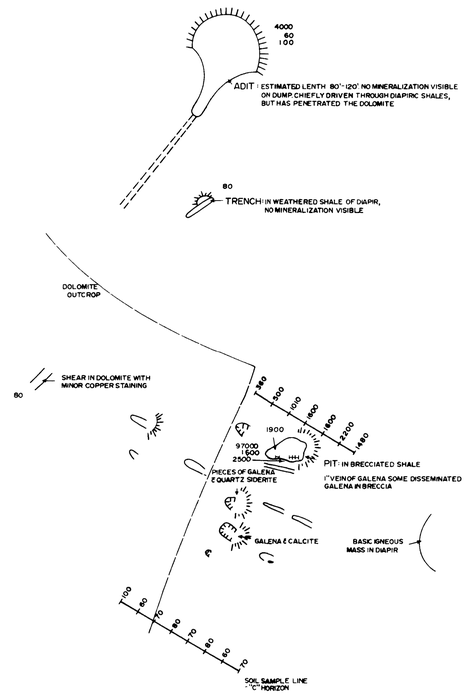
RECEIVED
1 NOV 1971
DEPT. OF MINES
SECURITY
1638-3

DRN:- M.T.	DATE:- SEPT 71'	SCALE:- 1" reps 40'

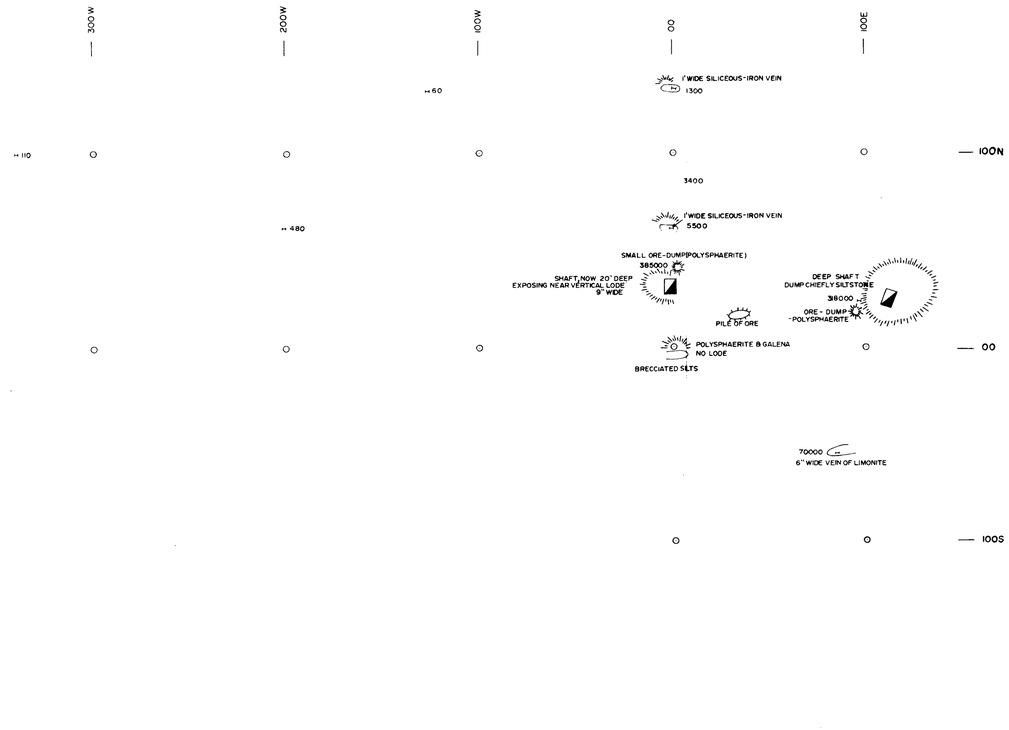
DWG 557-6

ENV 1638(III)-12

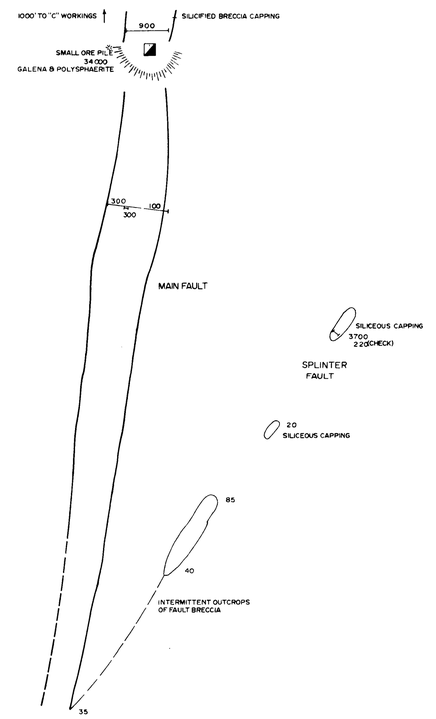
III - 12



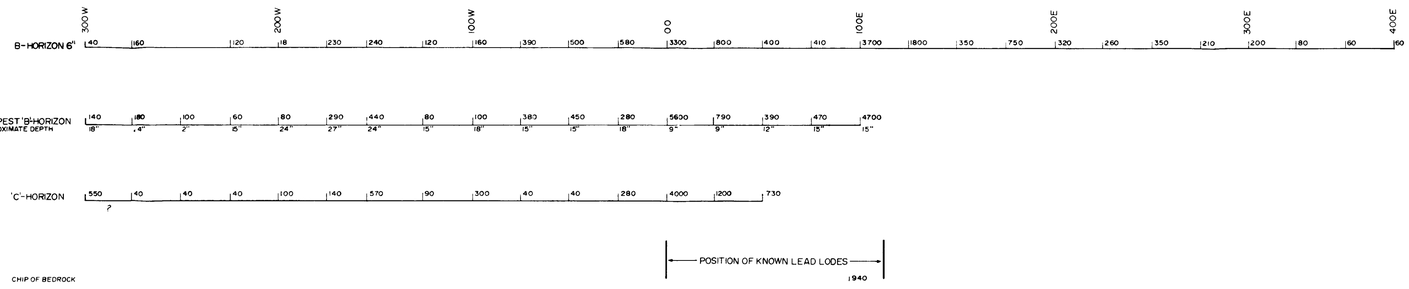
PLAN OF "A & B" WORKINGS WEPOWIE MINE



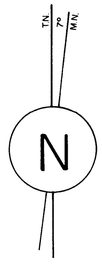
PLAN OF "C" WORKINGS WEPOWIE MINE (OVERLAY TO GEOLOGICAL MAP)



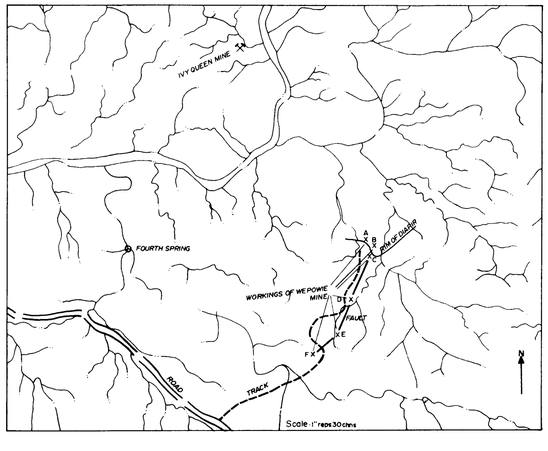
PLAN OF "D" WORKINGS WEPOWIE MINE SHOWING MAIN FAULT & SPLINTER FAULT



GEOCHEMICAL SAMPLES ON LINE 00N "C" WORKINGS WEPOWIE MINE



LOCALITY MAP



SCALE

50 0 50 100 150 200 250

IN FEET

North Flinders Mines N. L.

WEPOWIE MINE

SML 557

MINE WORKINGS WITH GEOCHEMICAL ASSAYS Pb P.P.M.

RECEIVED 1 NOV 1971 DEPT. OF MINES SECURITY 1638-3

DRN:- M.T.	DATE:- SEPT 71'	SCALE:- 1"reps40'

DWG557-7

ENV 1638(III) - 11

III - 11

APPENDIX VII

REPORT ON MT. MARY MINE

0 52

S.M.L. 557

AUGUST, 1971

R.E. READ.

Geologist

NORTH FLINDERS MINES LIMITED

C O N T E N T S :

ACCOMPANYING PLANS

Geological Map of Mine Area, Scale 1 in = 100 ft.
drawing no. 557-12

Plan of Workings, Scale 1 in = 100 ft.
drawing no. 557-13.

No plans with report.

1.11.71

I INTRODUCTION

The Mt. Mary Mine was examined as part of the programme of examining certain old mines on S.M.L. 557. The mine workings and geology were mapped at 100 ft. to 1 in. using a tape and compass grid. Further stations were surveyed in by compass-bearings as needed.

II LOCATION

The mine is on Alpana Station, about half a mile from Angorichina Hostel. Access is by means of a rough track running north-east from the Blinman-Parachilna road, immediately west of the grid on the Alpana-Angorinchina boundary.

The topography is moderately rugged, relief being of the order of a few-hundred feet, with steep slopes at up to 45^{o}.

III REFERENCES

The mine is mentioned in the S.A. Record of Mines, and in Coates 'Geology of the Blinman Dome Diapir', p.34. Coates suggests that 'the mineralization has derived from the diapir and channelled along the fault'.

...../2

IV GEOLOGY

The mine lies in Precambrian rocks of the Umberatana Group on the western side of the Blinman Diapir. The mine is near a large East-West fault, shown on the Blinman 1-mile map to emanate from the Blinman Diapir. This fault is cut by a later North-South fault, not shown on the 1-mile map. The geology has been complicated by extensive faulting at various times. The structural-setting at the mine is not clear from the present mapping, and mapping over a broader area would be required to clarify it.

The stratigraphy is described in the legend to the accompanying map.

...../3

V WORKINGS

There are three groups of workings, the more important two being situated in the large East-West fault.

a) NORTH WORKINGS

These consist of a number of trenches, pits, a shallow-shaft and adit. All the workings have followed quartz-siderite veins, some of which carry a little copper, both as malachite and sulphides. The copper-bearing veins generally have some associated gossanous material. These veins appear to occupy fractures.

Production from these old workings does not appear extensive.

b) EAST WORKINGS

Again the mineralization is in a quart-siderite vein. The vein appears to be in a small fault which has displaced the large shear-zone. The deposit has been opened up by means of a shaft, adit and shallow open-cut. The shaft is now only about 30 ft. deep, but the length of the old horse-run (about 100 ft.) indicates that the workings may extend much deeper.

...../4

The ore on the dumps is chiefly malachite with limonite, quartz, siderite and lesser amounts of calcite. Some chalcopyrite is present.

The ore-grade is low, samples ranging from 8% Cu. down to 0.25%. The assays of ore (30% Cu.) quoted in the Record of Mines and by Coates, obviously refer to hand-picked ore. The grade is probably between 1% and 5% Cu. According to the Record of Mines the ore carried about 4 dwts gold to the ton. Silver contents are low (see Appendix).

c) WEST WORKINGS

This is a small open-cut on top of a hill and an adit about 100 ft. below the open cut. The vein worked in the open-cut lies within, and roughly parallel to, the large shear.

A narrow gossanous vein carrying 1% Cu. is visible in the western end of the open-cut.

...../5

VI CONCLUSIONS

Copper mineralization is restricted to the faults, mainly associated with small quartz-siderite veins carrying some copper. Grades are low and vein-widths narrow. Any further investigation would have to be directed toward the primary ore of East and possibly West workings. This would require geophysics and drilling. Bearing in mind the low grade of the primary ore, and probable small dimensions of ore-shoots, the expense does not seem warranted.

VII RECOMMENDATIONS

No further work is recommended.

R. E. Read B. Sc.

R.E. READ.

Geologist

APPENDIX I

0 59

ASSAY RESULTS

EAST WORKINGS.

Sample No.	Cu. p.p.m.	Co. p.p.m.	Ag p.p.m.	Description
13270	80,000	300	5	grab sample of picked ore on the dump of East Workings.
13271	42,000	580	4	grab of ore dump at Shaft.
13272	70,000	150	4	Heap of fine ore on adit dump.

WEST WORKINGS

Sample No.	Cu. p.p.m.	Pb. p.p.m.	Zn.p.p.m.	Description
13256	830	60	110	Chip sample of quartz limonite vein, west face of open-cut.
13257	360	20	30	Chip of breccia, west face open-cut.
13258	210	20	30	Chip of breccia, west face open-cut.
13259	12,000	20	130	Chip over 9" of breccia and vein of gossan, east face open-cut.
13260	760	60	50	Grab sample of rejected ore.
13261	44,000	130	50	Grab sample of ore-dump.

557–12
Geological Map of Mine of Area

557–13
Plan of Workings
ARE MISSING

Quarterly Report

–

September 1971

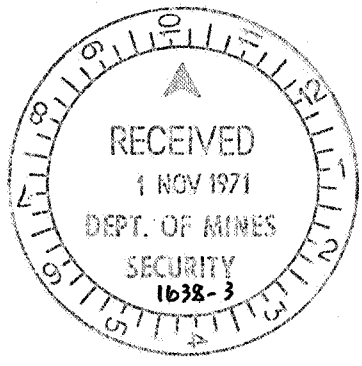
Appendix 8

IS MISSING

APPENDIX VI

REPORT ON OCCURRENCES 'D' AND 'L'

S.M.L. 557



R.E. READ.

Geologist

NORTH FLINDERS MINES LIMITED

August, 1971

C O N T E N T S :

ACCOMPANYING PLANS

Geological Plan, Occurrence 'L'
drawing number 557-8

Sampling Plan - Occurrence 'L'
drawing number 557-9

Geological Plan, Occurrence 'D'
drawing number 557-10

Sampling Plan, Occurrence 'D'
drawing number 557-11

No Plans rcd.

'11-7'

I INTRODUCTION

These two occurrences were among prospects on which further work was recommended by Mr. R.W. Fidler in his follow-up work on S.M.L. 292 (now part of S.M.L. 557). Both are in the Blinman Diapir.

The locations are shown in the accompanying map.

...../2

II OCCURRENCE 'D'

At occurrence 'D' a raft of siltstones and inter-bedded dolomite carries low-grade copper along its south-western margin.

A number of small pits have been sunk exposing a dolomite bed about $1\frac{1}{2}$ feet thick carrying copper, together with siltstone bearing copper over a width of at least 6 ft.

The cupriferous dolomite appears to the 'mine-type' dolomite of the Blinman Mine. It can be traced for at least 300 ft. The copper mineralization is very close to the contact of the raft with the breccia.

To the west copper-stained dolomite and dolomitic siltstone, carrying only a few hundred p.p.m. Cu, outcrop in a creek-bed.

However, the creek flows roughly parallel to the strike and there is still some chance of concealed ore-grade dolomite extending westwards.

...../3

Conclusions on Occurrence 'D'

Grades in the mineralized zone appear to be fair, 1% Cu or better. At the eastern end the ore grade rock has a width of at least 6 ft, but less than 20 ft. Minimum width at the western trench is 4 ft. The observable strike is slightly over 300 ft. The eastern end is limited by the end of the raft.

The western limit has not yet been determined.

The south wall of the copper mineralization appears to be the edge of the raft. Therefore, if the edge of the raft were to dip vertically or to the south the thickness of mineralization might increase markedly. Similarly there is a chance of increased strike-length at depth, especially eastwards.

...../4

III OCCURRENCE 'L'

This consists of a dolomite plug in the diapir surrounded by metamorphosed and pyritized breccia. Copper occurs in the margins of the plug and in the zone of metamorphism in small haematite veins carrying chalcopyrite, oxidized to malachite at the surface.

The best grades obtained were about 1% Cu. from the small veins. The plug and metabreccia carry very little copper.

As the haematite veins are between 1 and 6 inches thick and are separated by large amounts of barren rock the overall grade is very low.

...../5

IV RECOMMENDATIONS

Auger sampling should be continued at the western end of occurrence 'D' to find the possible strike length.

At least one costean should be bull-dozed to expose the full width and to ascertain whether the raft-breccia contact is in fact the southern edge of the copper mineralization. This would be relatively cheap as soil cover is about 1 to 2 feet thick.

Further investigation would require drilling or geophysics to test the extension in depth. Dolomite lying on the dump at one of the shallow pits shows chalcopyrite with no evidence of pyrite. Therefore, the body should be suitable for investigation by induced polarization.

No further work is recommended on occurrence 'L'.

R.E. Read

Geologist

557–8

Geological Plan
Occurrence ‘L’

557–9

Sample Plan
Occurrence ‘L’

557-10

Geological Plan
Occurrence ‘D’

557-11

Sample Plan
Occurrence ‘D’

ARE MISSING

APPENDIX IV

0 67

REPORT ON COMPLETION

OF FOLLOW UP

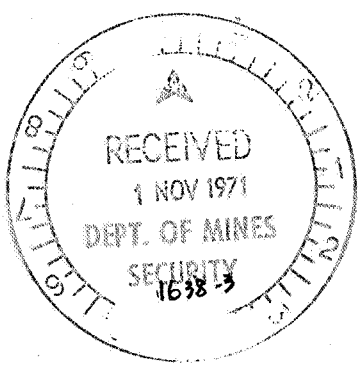
S.M.L. 292

(Now Part of S.M.L. 557)

R.E. READ.

Geologist

NORTH FLINDERS MINES LIMITED



September, 1971

C O N T E N T S:

ACCOMPANYING PLANS

Nilpena Area showing mine and occurrence locations, scale 1 in. = 60 chains. drawing number: GC 4138A.

PART I - EXAMINATION OF ANOMALOUS DRAINAGES

I INTRODUCTION

The two drainages examined were found to be anomalous for copper in the reconnaissance survey of S.M.L. 292 and confirmed in the follow-up. They were not examined by Mr. R. Fidler during his examination of other anomalies on S.M.L. 292 due to wet conditions.

...../2

II INVESTIGATION

No mineralization could be seen in drainage 20, which produced only two anomalous values in the follow-up, the highest being 70 p.p.m. Cu.

Only diapiric breccia could be seen outcropping and it is inferred that the copper is coming from a small unexposed basic igneous mass as in drainage 8.

Drainage 8 was found to be draining a basic igneous body, on the margin of which were a number of small pits. A chip sample from one of the pits contained only 370 p.p.m. Cu. However, two short lines of soil samples showed copper values of up to 600 p.p.m. near the pit and 320 p.p.m. 100 ft. west. Small adjacent drainages, not sampled in the reconnaissance survey were sampled. Both have anomalous copper values in the creek to the east rising to 200 p.p.m. and having a different source of copper to that in drainage 8.

The Ango Mine was examined at the same time. The mineralization is similar to that in drainage 8, again being associated with a basic igneous body. Random sampling of the dump of the main shaft yielded over 1% copper.

Despite Mr. M.Garman's conclusions on the Ango Mine it appears that the contact zone around the margins of basic igneous rocks in this area is favourable for the occurrence of copper (as in the Blinman Diapir). There is a considerable extent of basic igneous rock both around drainage 8 and the Ango Mine.

...../3

III CONCLUSIONS AND RECOMMENDATIONS

The mineralization in drainage 8 is at least worth a small soil-survey. It is suggested that this be extended to include the Ango Mine.

R.E. READ.

Geologist

PART II.

Brief Note on Small Mines in S.M.L. 292 (Now part of S.M.L.557)

INTRODUCTION

The following two prospects were missed in earlier investigations and are described for the sake of completeness.

DESCRIPTION.

A small mine was located within two hundred feet of the rim of the Blinman Diapir near Oratunga Homestead. The mineralization investigated was a calcite vein carrying chalcopyrite which fills a small fault radial to the diapir, striking at 165°. An underlay shaft has followed the vein down for 28 feet. Width at the shaft is about $2\frac{1}{2}$ feet. To the south of the shaft the vein appears to have been stoped. The vein could not be seen in a pit 15 feet north of the shaft, and has apparently disappeared. Although the grade of ore is quite good the strike length of 50 to 60 feet makes it too small to be of economic interest. Suprisingly the mine escaped detection in the stream-sampling programmes of both North Flinders and Noranda.

Another small copper occurrence was noted in the Parachilna Gorge. Two small pits have exposed copper mineralization in a shear. The occurrence is directly above a large creek and thus escaped detection in the stream-sediment survey. It is too small to be of interest.

R.E. Read.

McPHAR GEOPHYSICS PTY. LTD.

NUCCALEENA JOINT VENTURE AREA

BELTANA CADNIA

1 MILE SHEETS

PARACHILNA

31°00' COPLEY 4 MILE SHEETS PARACHILNA

NILPENA R.S.

WARIOOTA MINE

Dunbar Well

Ned Well

Warriowl

Waters Well

MOOLOOLOO H.S.

BLINMAN

AEPUWIE MINE

ORATUNGA H.S.

PATAWARTA HILL

LADY ... HMAN Cu MINE

QUEEN MINE

wheal Butler Cu

ANGU MINE Cu

WT ELKINGTON

Mt Mary Mine Cu

138°24' 138°30' 138°36' 138°42' 138°48'

30°47' 30°50' 30°52' 30°55' 31°00' 31°05' 31°08'

North Flinders Mines N. L.

NILPENA AREA

S.M.L.–292

MINE AND OCCURRENCE LOCATIONS

RECEIVED 1 NOV 1971 DEPT. OF MINES SECURITY 1638-II

1638 (II) – 2

DRN:- R.D.M. | DATE:- 29-3-71 | SCALE:- 60 chains = 1 inch

ENV 1638II – 2

DWG: G C 4138A

0 73

NORTH FLINDERS MINES LTD.

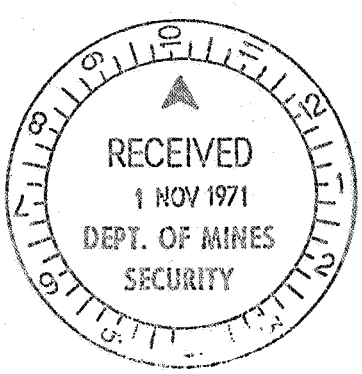
QUARTERLY REPORT

S.M.L. 557

SOUTH AUSTRALIA

PERIOD ENDED SEPTEMBER, 1971.

R.B. Wilson.



C O N T E N T S

0 74

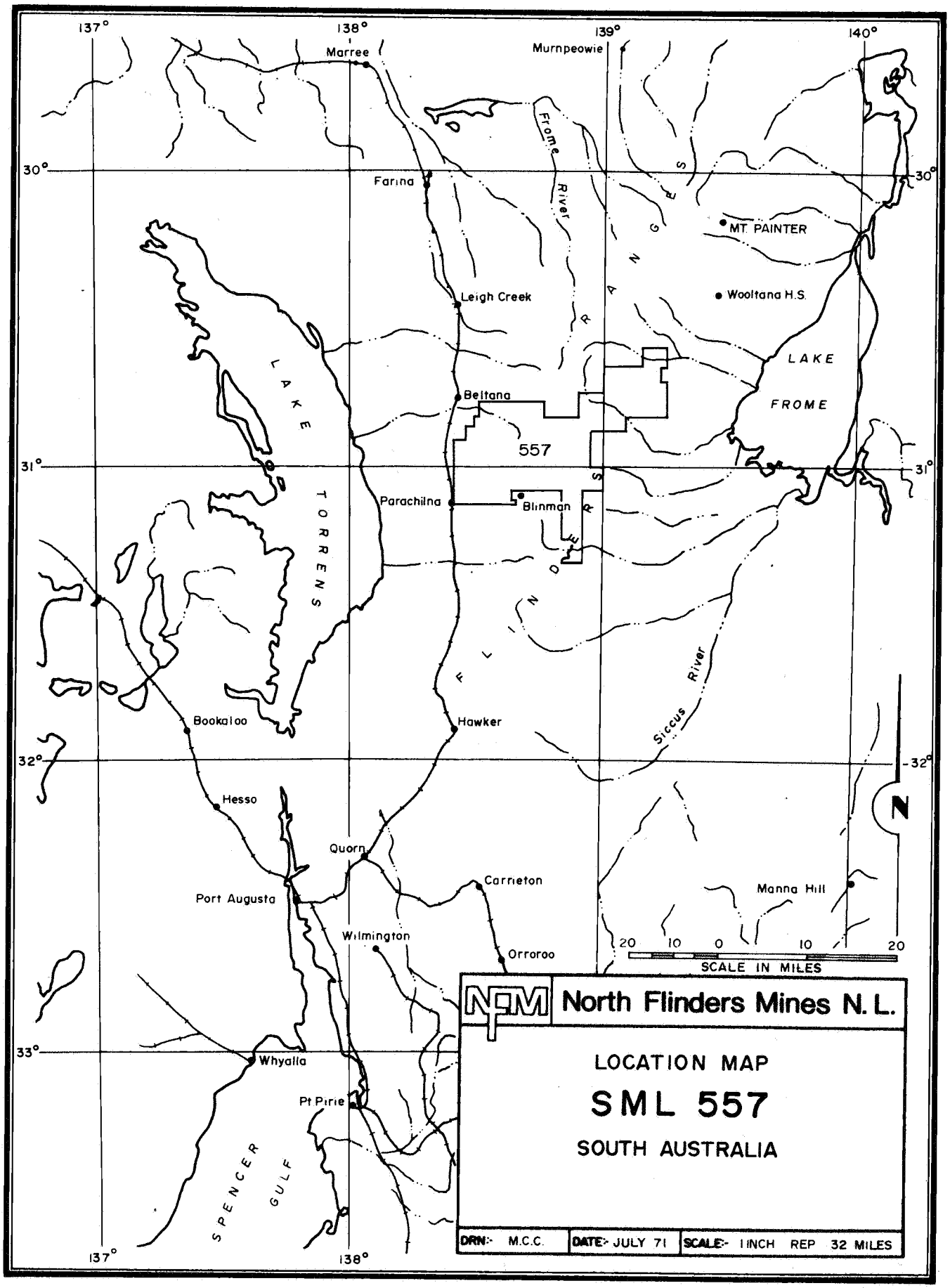
APPENDICES

APPENDIX VIII "REVIEW OF I.P. SURVEYS IN BLINMAN AREA"
Rep. No. by R.J. SMITH, McPHAR GEOPHYSICS PTY. LTD.
17.7.11

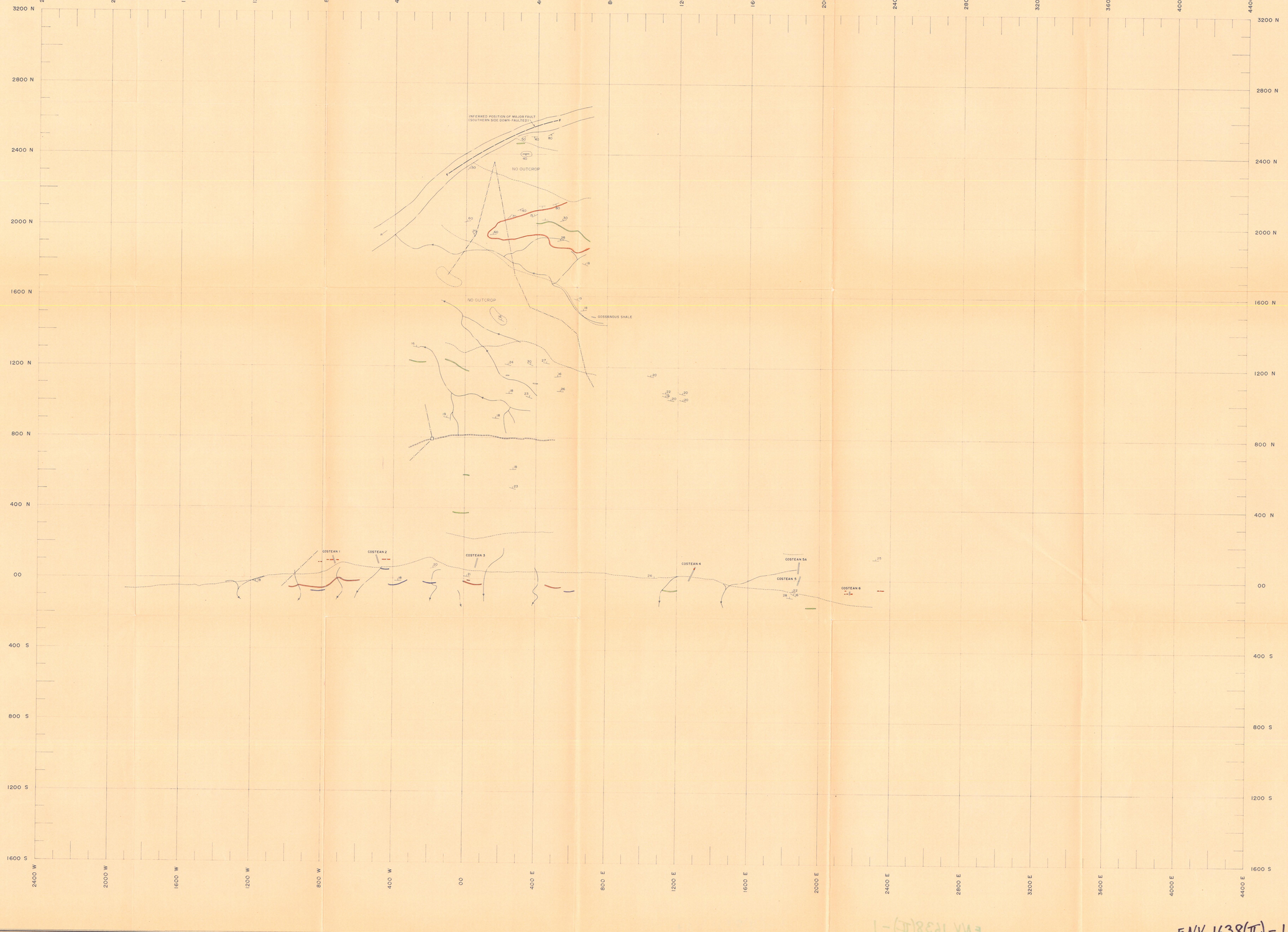
ACCOMPANYING MAPS

	DWG. 557-2	Location Map
	DWG. 557- 14	Geol. Map, Patawarta Zinc Prospect 1" = 200 ft. scale by R.E.Read.
*	DWG. 557-15	Geochemical Soil Survey, Patawarta Zinc Prospect. 1" = 200 ft. scale.

* Note Maps not yet drafted - Will be forwarded at later date.


137°
138°
139°
140°
30°
31°
32°
33°
Marree
Murnpeowie
Farina
Leigh Creek
Beltana
Parachilna
Blinman
Hawker
Bookaloo
Hesso
Quorn
Port Augusta
Wilmington
Carrieton
Orroroo
Manna Hill
Whyalla
Pt Pirie
MT. PAINTER
Wooltana H.S.
LAKE FROME
LAKE TORRENS
SPENCER GULF
Frome River
FLINDERS RANGES
Siccus River
557
N
20 10 0 10 20
SCALE IN MILES
North Flinders Mines N.L.
LOCATION MAP
SML 557
SOUTH AUSTRALIA
DRN:- M.C.C.
DATE:- JULY 71
SCALE:- 1 INCH REP 32 MILES

DWG 557-2



N
M.N.

REFERENCE

- MASSIVE CHERTY SILTSTONE
- DENSE BLUE-SILTY DOLOMITE
- GREYWACKE: LITHIC GREYWACKE WITH PEBBLES UP TO 10mm ACROSS
- GOSSAN, OUTCROP-FLOAT
- APPROXIMATE BOUNDARY OF AREAS OF NO OUTCROP
- FAULT
- CREEK
- FENCE
- STRIKE & DIP OF BEDDING (NOTE: DIPS >25° TO NEAREST 5°; <25° TO NEAREST 1°)

SCALE

200 100 0 200 400 600 800 1000

FEET

North Flinders Mines N.L.

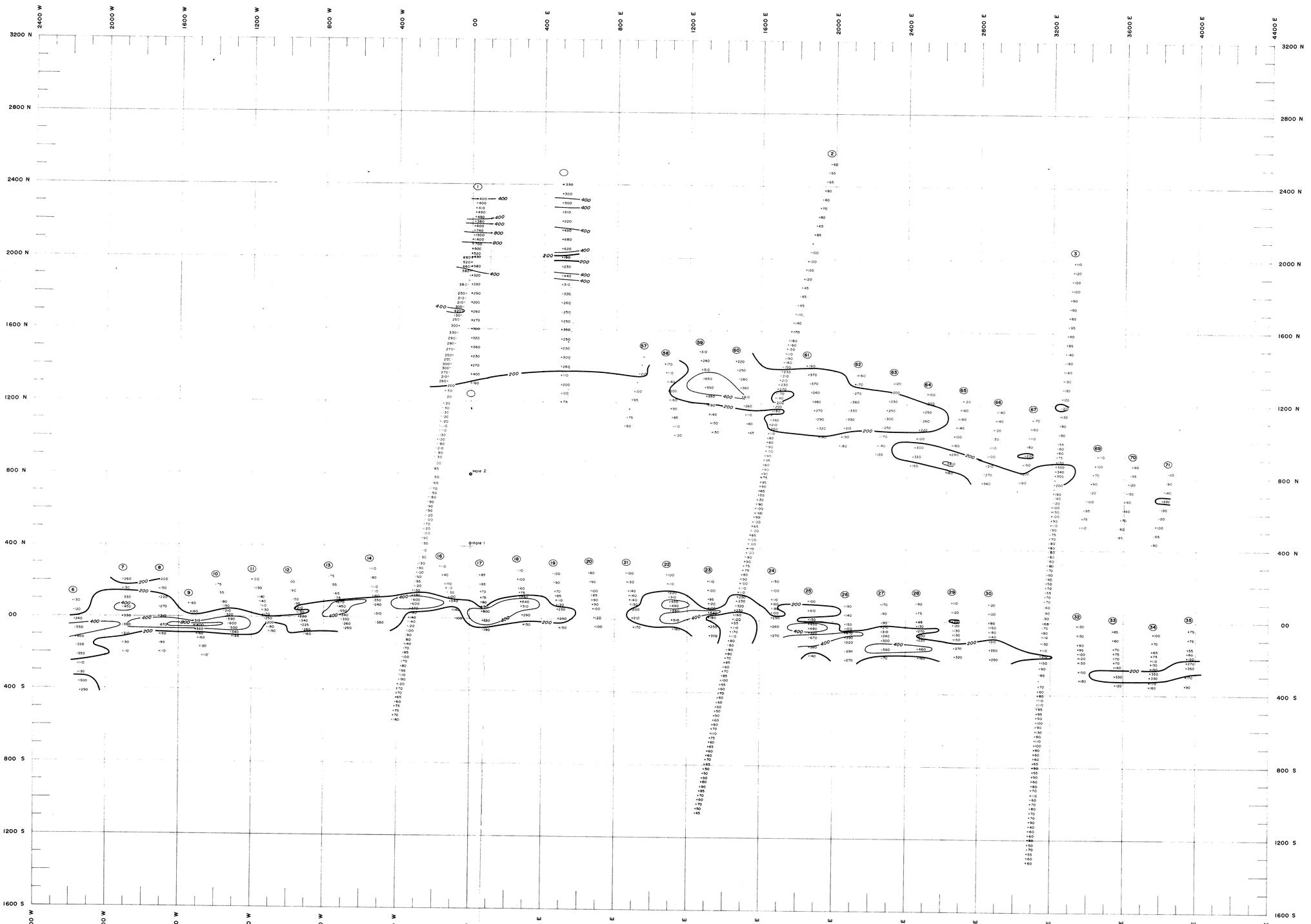
PATAWARTA
ZINC PROSPECT
SML 557

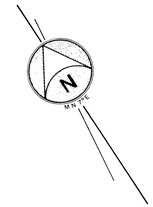
GEOLOGICAL MAP

GEOLOGY BY R.E. READ

DRN:- R.G.	DATE:- OCT. 1971	SCALE:- 1" rep. 200'

DWG 557-14





NOTES ON SAMPLING & ANALYSIS

LINES 1-35 SAMPLED AT 6" DEPTH.

ALL OTHER SAMPLES AS NEAR TO BEDROCK AS POSSIBLE

SAMPLES SIEVED TO 80 FRACTION

ANALYSIS BY MOPHAR GEOPHYSICS PTY. LTD.

BY AAS ON .25gm SAMPLE FOLLOWING CONC. HCIO4 LEACH FOR ONE HOUR

SCALE

200 100 0 200 400 600 800 1000

FEET

NFM North Flinders Mines N.L.

PATAWARTA

ZINC PROSPECT

SML 557

GEOCHEMICAL SOIL SURVEY

SHOWING

Zn RESULTS- P.P.M.

RECEIVED 4 FEB 1972 DEPT. OF MINES SECURITY 16.12.72

DRN:- R.G. | DATE:- OCT. 1971 | SCALE:- 1" rep. 200'

DWG. 557-15

ENV 1638 (IV) -18

1638 IV -18

I. INTRODUCTION

S.M.L. 557, covering an area of approximately 1,000 square miles in the Central Flinders Ranges of South Australia, was granted for a period of 2 years. The area comprises former Special Mining Leases 290, 292 and 293.

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II PERSONNEL

Exploration programmes have continued with the same or similar personnel, work-crews and consultants (principally McPhar Geophysics Pty. Ltd.), as for the previous periods.

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III SUMMARY OF OPERATIONS

A. REGIONAL EXPLORATION

Reconnaissance stream sediment sampling was completed by North Flinders Mines crews over the eastern portion of S.M.L. 557 (former S.M.L. 293), during the period. Areas underlain by Pound Sandstone were not sampled. This also applies to certain areas in the central portions of the Cambrian basin of the Irish-Well - Angus Hut area. Previous experience in the Point Well - Ben Lomond - Mt. McFarlane area had shown no geochemical response from sampling over the Nepabunna Siltstone - Parara Limestone outcrops. Some small areas of gently-dipping, ? Wilkawillina Limestone appear to have been neglected in sampling, and may be filled-in at a later date.

Several anomalous zones are apparent and some follow-up work will be required. A comprehensive report (Appendix I) on the stream-sediment reconnaissance, with recommendations for follow-up work, is appended (Dr. P.R. Donovan, McPhar Geophysics Pty. Ltd.).

B. FOLLOW-UP SURVEYS

Very little systematic follow-up work has yet been attempted in the eastern portion of the area (recently-sampled), although zinc anomalies in an area some 2 miles east of PointWell, appear to b e related to manganese and phosphate-rich outcrops associated with erosional features (old Kagarst-topography?), near the Wilkawillina-Parara boundary. Other anomalous zinc values some 2½ to 5 miles southeast of Narina Homestead, appear to be related to manganiferous outcrops within Wilkawillina Limestone. Further

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follow-up work will be undertaken in this eastern portion of S.M.L. 557, as soon as crews become available.

A report on follow-up work in the Nilpena Area (former S.M.L. 292) by R. Fiddler (McPhar Geophysics Pty. Ltd.) is appended (Appendix II). R. Read (geologist, North Flinders Mines Ltd.), has completed most of the recommendations contained in this report (see below, under "PROSPECTS"). Meanwhile, further follow-up of anomalous drainages indicated from reconnaissance stream-sediment sampling of the Nilpena Area, which had been previously overlooked, was carried out by R.Read (Report appended, Appendix IV).

A detailed stream-sediment and follow-up survey of the Wilkawillina Gorge Area was carried out by R. Fiddler (McPhar Geophysics Pty. Ltd.), after strong recommendations for a detailed investigation of the area by the Consultants (McPhar Geophysics Pty. Ltd.) This work has produced four narrow zones anomalous in lead and zinc which appear to trend northeasterly and could be related to fracturing in the Lower Cambrian sediments. The significance of these anomalies is at present unknown.

C. ASSESSMENT OF PROSPECTS

Following on recommendations by R. Fiddler and R. Read, several anomalous areas, old mining areas and prospects, have been further investigated by R. Read. These are:-

1. WEPOWIE LEAD MINE

Isolated old workings evidence the presence of small pockets of both galena and polysphaerite (lead phosphate)

along a strong north-south fault zone, which radiates from a small circular diapir to the north of the Blinman Diapir. R. Read concludes that the prospect does not offer sufficient tonnage-potential to be of interest to the Company (see Appendix V).

2, MT. MARY COPPER MINE

Mapping and sampling of available openings of the Mt.Mary Copper Mine indicated that, because of limited dimensions, further investigation by the Company is not warranted (See Appendix VII).

3. Occurrences 'D' & 'L' - Blinman Diapir.

Occurrence 'L' is associated with a small dolerite plug in the diapir and is of no further interest.

Further sampling and possible costeaning on occurrence 'D' has been recommended by R. Read. He considers the copper mineralization to be associated with a raft of siltstone-dolomite, possibly similar to the "mine-type" dolomite of the old Blinman Mine.

4. PATAWARTA ZINC PROSPECT

Several adjacent stream-sediment anomalies for zinc were located during stream-sampling of former S.M.L. 292, to the south of the Patawarta Diapir (Lady Lehman Area). As the source of the anomalies was not immediately apparent, three soil-sample lines were run across the strike of the shales-slates-dolomites of the Bunyeroo Formation. This work showed a number of zinc-rich zones, one of which was found to be associated with an apparently stratiform gossan, which outcrops intermittently over a length of 5,000 feet.

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Mineralogical examination of the gossan showed it to represent a weathered quartz-calcite-pyrite-sphalerite body.

The gossan zone itself and a narrow strip of ground northward to the southern margin of the Patawarta Diapir, have been gridded, mapped and soil-sampled (maps at present under preparation). Although gossan-thicknesses appear quite limited from the surface exposures available, consideration will be given to a restricted reconnaissance rotary-percussion drilling programme, to initially test the zone down-dip, and to determine whether further work is warranted.

5. BULLOCK HEAD GAP

An initial soil traverse was run across an anomalous zone in the vicinity of Bullock Head Gap and shows soil values ranging from 500 p.p.m. to 2000 p.p.m.Zn over a width of some 1200 feet. The exposed rocks are greenish siltstone-slate, presumably correlated with the Brachina Formation, stratigraphically below the ABC Quartzite. Some scattered pock-marking, presumably due to weathered pyrite, was observed in places.

Compass and tape gridding, geological mapping and further soil sampling have been commenced on this area.

6. ORATUNGA IP ANOMALY

A review of an earlier reconnaissance I.P. survey over the Blinman Diapir (Metals Exploration N.L. 1965-66) was carried out by McPhar Geophysics Pty. Ltd. (See Appendix VIII). While some further work was recommended to help determine whether the main I.P. anomaly was fully tested by the Metals Exploration diamond-drill hole, there does not appear to be sufficient encouragement in the results of this drillhole, to place a very high priority on such work.

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IV FUTURE PROGRAMMES

1. Complete small areas of stream sediment sampling on Wilkawillina Limestone areas, omitted from survey (eastern portion S.M.L. 557).

2. Follow-up anomalies as per recommendations of Dr. P.R. Donovan (Appendix I) - eastern portion S.M.L. 557.

3. Complete geological and geochemical maps on Patawarta Zinc Prospect followed by possible reconnaissance percussion drilling to determine whether further work is warranted.

4. Geological mapping and further sampling of Moro Gorge low-grade lead anomaly.

5. Complete mapping and sampling of Bullock Head Gap anomalous areas.

6. Further auger-sampling and possible costeaning or pitting on 'Occurrence D', Blinman Diapir.

7. Geological appraisal of low-order lead-zinc anomalies outlined by McPhar Geophysics in Wilkawillina Gorge area.

8. No further work is contemplated in the immediate future on:-
   1. Third Plain Willemite deposit.
   2. Phosphate deposits in Erina Waters and Point Well areas etc.
   3. Wepowie Lead Mine and other small mines and showings investigated.

APPENDIX III

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DETAILED STREAM SEDIMENT AND FOLLOW-UP SURVEY, WILKAWILLINA GORGE AREA, S.M.L. 557, SOUTH AUSTRALIA

FOR

NORTH FLINDERS MINES LIMITED

BY

R.W. FIDLER

McPHAR GEOPHYSICS PTY. LTD.

TELEPHONE 72 2133

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POSTAL ADDRESS: P.O. BOX 42, UNLEY, SOUTH AUSTRALIA 5061

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TELEX
"PHARGEO" AA82623

MEMORANDUM TO: NORTH FLINDERS MINES LIMITED

MEMORANDUM FROM: R. FIDLER, McPHAR GEOPHYSICS PTY. LIMITED

SUBJECT: DETAILED STREAM SEDIMENT AND FOLLOW-UP SURVEY, WILKAWILLINA GORGE AREA, S.M.L. 557, SOUTH AUSTRALIA

DATE: 6TH OCTOBER, 1971

INTRODUCTION

Previous work in the area has been summarized by Dr. P.R. Donovan in memoranda dated 4th August, 20th October, 21st October, 1969, and 26th February, 1970. The results of a similar follow-up survey carried out in the adjoining Ten Mile Creek area, S.M.L. 397, were reported in a memorandum dated 23rd August, 1971.

The present survey is concerned with an irregular area of about 5 square miles situated north of Wilkawillina Gorge.

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SURVEY METHOD

Very widely spaced reconnaissance samples taken in various earlier investigations had indicated that the area underlain by the Parara and Wilkawillina Limestone near Wilkawillina Gorge contained above average concentration of zinc in stream sediments. With this in mind, a dense stream sediment sampling program was carried out over the Cambrian limestone area. Stream sediment samples were taken from as many confluences as practical with additional samples being collected between confluences where necessary. In all, 375 samples were taken in the 5 square mile area.

The stream sediment survey was followed up with a modified ridge and spur survey. Samples were collected on the lower part of the slope above the level of alluvium in each of the creeks concerned. Sample points were about 300' apart and alternated from one side of the creek to the other. The anomalous areas were also inspected and rock chips collected for analysis.

In both surveys samples were sieved and a 250 mgm portion of the minus 80 mesh material reserved for analysis. Analysis was by atomic absorption spectrophotometry using a one hour hot perchloric acid sample leach.

The results were reported in batches CH 2734, 2833 and CH 2891 on 27th August, 9th September and 22nd September respectively.

DETAILED STREAM SEDIMENT SURVEY

COPPER:

Copper results were uniformly low (5 - 35 ppm) and none of the values was considered anomalous. To some degree this is surprising as traces of chalcopyrite were found in veins, but on the other hand it is consistent with similar observations in S.M.L. 397 and suggests that this mineralization is insignificant.

LEAD:

Values varied between 35 and 260 ppm.

A threshold of 100 ppm was selected. This is somewhat higher than the threshold used elsewhere in the S.M.L. but values from most other surveys cannot be directly compared owing to the different leaching agents used.

In the central section of the area, three anomalous drainages appear to be fed from a single source but otherwise anomalies were confined to single creeks. Lead values within the anomalous zones appear to vary little along the drainage, suggesting a weak source elongated in the direction of the creek rather than an intense point source.

The major anomalies are shown on Dwg. G.C. 3203A as A, B and C. Apart from the three anomalous areas, two single value anomalies were found in the far NW and the central eastern section (900001, 140 ppm and 900278, 100 ppm). Nearly all lead anomalies were related to zinc anomalies although the converse was not always true.

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ZINC:

Zinc values varied from 25 to 490 ppm and a threshold was set at 200 ppm. Although no doubt the perchloric acid digestion produced slightly different results to those obtained from the nitric acid attack used in previous surveys, it is felt that the generally elevated zinc content in the stream sediments reflects an enrichment of zinc in the rock body as a whole.

The principal anomalous area is shown as the area A on Dwg. G.C. 3204A. The lead anomaly A is also anomalous for zinc but relatively less intense. It is interesting to note that the trend of the major anomalous zone is generally transgressive of the rock boundaries and that some of the more intense anomalies extend into the Bunkers Sandstone, e.g. sample 900228, 490 ppm Zn. Two single value anomalies, 900001 (270 ppm) and 900203 (240 ppm) were also found in the NW and SE of the area.

A re-analysis of the samples found to contain more than 200 ppm zinc in the minus 80 mesh fraction was carried out using the minus 200 mesh fraction. Samples from the willemite bearing Third Plain area showed an increase in zinc content in the minus 200 mesh fraction over the minus 80 mesh result. Although some samples from this present survey were found to increase in value, the nett effect considering all samples was negligible, and was well within the bounds of normal analytical variation.

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FOLLOW-UP

The results of the ridge and spur survey confirmed the stream sediment results but, in addition, allowed some determination of the form of the anomalies to be made.

Although there are insufficient results to contour satisfactorily, if lines are drawn so as to enclose those areas where samples contain 100 ppm or more lead, four areas are outlined. Two of these are more than 1,000' in length and fairly elongate. The other two are somewhat smaller and, roughly speaking, aligned parallel to the axes of elongation of the other two areas.

By carrying out a similar process at the 200 ppm level with the zinc results, three of the four lead areas are found to have coincident zinc highs. The fourth high lead area is also largely covered by a zinc high but the zone is much extended to the SW. As these zones are fairly linear and oriented across the strike, rather than along it, and in a manner similar to that which would be expected from structural considerations, it is anticipated that such mineralization as is present would owe its position to structural rather than stratigraphic controls.

During the survey, only a very small amount of mineralization was actually observed. This consisted of a veinlet of goethite and pyrolusite enclosing sphalerite and galena. The mineralization was actually in Bunkers Sandstone but fell inside the extreme SW lead-zinc zone D and had a strike parallel to the axis of zone (sample 233 S(i)).

It is therefore tempting, in the absence of evidence to the contrary, to suggest that each of the zones has a similar origin. This would also be in keeping with the more detailed studies made in S.M.L. 397.

The analytical results from the rock chips show manganesic rocks are commonly rich in lead or zinc. This is not considered to be a "cause and effect" relationship but rather one of common origin. The topic is more fully discussed in the memorandum relating to S.M.L. 397. High lead-zinc values were not confined to this type of sample as several pink dolomite samples were also found to contain above average amounts of lead and zinc. Extensive pink dolomitization zones were not observed. The tabulated analytical results from the rock chip sampling are appended.

CONCLUSIONS

The stream sediments from the Wilkawillina Gorge area contain well above average concentrations of lead and zinc. The form and intensity of the anomalies, and the nature of the mineralization seen to date, suggest that these result from numerous small structurally controlled willemite? why and lead-zinc sulphide occurrences. Comparison of results from known willemite areas suggests that the probability of a large, partially exposed zinc silicate body being present in the area is remote, although the possibility of a blind ore body remains.

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RECOMMENDATIONS

As a final check for the presence of a partially exposed willemite body, a company geologist should visit the zone from which soil samples 124 to 138 were taken to collect additional chip samples (from the area of highest zinc values). If, on completion of this work, no substantial willemite mineralization is discovered, it is unlikely that significant readily accessible willemite mineralization exists in the area. A review of the data should then be made to decide whether to proceed to sub-surface exploration, carry out other prospecting, or relinquish the area.

(signed)
McPHAR GEOPHYSICS PTY. LTD.

R W Fidler

R.W. Fidler,
Geologist.

ROCK CHIP SAMPLES

No.		Description	Pb	Zn
84	S (i)	Calcite with sulphides (?)	70	35
129	S (i)	Iron and manganese oxides from fracture	70	680
	S (ii)	Silicified siltstone	70	1,500
139	S (i)	Pink dolomite	120	100
	S (ii)	Manganesic (?) material	1,200	1,900
	S(iii)	Manganesic (?) material	60	35
147	S (i)	Maroon Fe rich silicified dolomite	170	450
	S (ii)	Yellow ferruginous dolomite	100	100
	S(iii)	Limestone with manganese dendrites	90	50
219	S (i)	Pyrolusite	50	1,700
	S (ii)	Botryoidal calcite (?)	70	340
223	S (i)	Botryoidal calcite (?)	70	600
224	S (i)	Recrystallized dolomite	220	45
229	S (i)	Buff sandy dolomite	100	95
231	S (i)	Pyrolusite impregnated sandstone	40	1,700
233	S (i)	Galena with manganesic goethite	770	4400
245	S (i)	Manganese oxides on sandstone	50	540
251	S (i)	Buff fractured dolomite	120	640
259	S (i)	Dark crystalline limestone	110	110
318	S (i)	Orange dolomite	400	1,200
	S (ii)	Pink dolomite (float)	930	700

Sample 233 S (i) also contained 3 ppm Ag, <20 ppm Bi and 20 ppm Sb.

APPENDIX II

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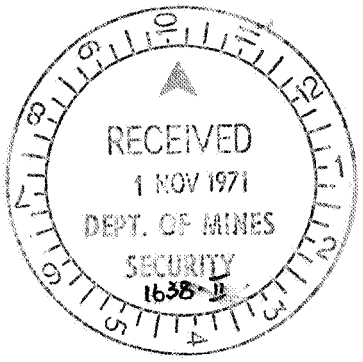

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STREAM SEDIMENT RECONNAISSANCE FOLLOW-UP
NILPENA AREA, S.M.L. 292
SOUTH AUSTRALIA

FOR

NORTH FLINDERS MINES N.L.

BY

R.W. FIDLER, GEOLOGIST

McPHAR GEOPHYSICS PTY. LTD.

TELEPHONE 72 2133

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"PHARGEO" AA82623

MEMORANDUM TO: NORTH FLINDERS MINES N.L.

MEMORANDUM FROM: R. FIDLER,
McPHAR GEOPHYSICS PTY. LTD.

SUBJECT: STREAM SEDIMENT RECONNAISSANCE FOLLOW-UP, NILPENA AREA, S.M.L. 292, SOUTH AUSTRALIA.

DATE: 1ST APRIL, 1971.

INTRODUCTION

Sections of the Nilpena area have been the subject of several stream sediment surveys prior to 1971. The results of earlier surveys and those from the current survey were summarized in a memorandum by Dr. P.R. Donovan dated 12th November, 1970. In that report a series of recommendations were made, some of which have already been carried out by Mr. G. Rogers and reported in a second memorandum by Dr. Donovan, 20th January, 1971. The remainder of the recommendations have now also been completed and, excluding those referring to mapping, are summarized in this report.

Analytical results are from batch CH 1753.

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SURVEY 0 97

I GEOCHEMICAL FOLLOW-UP

COPPER

Beltana Sheet

The two anomalies, 1146 (35 ppm) and 1147 (35 ppm) were confirmed by earlier resampling. The high copper values appear to correspond to the position at which ironstone debris from a reef (about 3' wide) enters the drainage system in creek 1147. Iron impregnations are also common in the head of creek 1147. Inspection of the ironstone revealed no fine boxwork structure although a gross irregular structure was apparent. A sample of float taken at random returned 110 ppm copper.

Cadnia Sheet

A single one value anomaly was obtained on the Cadnia sheet and resulted in the location of the Warioota Mine.

Two additional occurrences were located visually during follow-up. One is situated on the banks of the Warioota Creek about 3/4 mile NE of the Warioota Mine and the other 1/2 mile WNW of Dunbar Well. Both shed sediment almost directly into the main creek and thus escaped detection.

The first occurrence consisted of malachite staining on ironstone exposed in a small pit whilst the other was a series of small pits, an adit and a shaft set in what appeared to be basic rocks of diapiric origin. The grade of copper in both was quite low.

The Lady Lehman area has been confirmed as being anomalous and this and the Warioota Mine are discussed in a later section.

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Parachilna Sheet

No copper anomalies were located on this sheet.

Blinman Sheet

Unfortunately drainages 8 (80 ppm) and 20 (50 ppm) were unapproachable at the time of the survey due to rain. Mineralization will almost certainly be found in creek 8 and should be checked.

It is possible that mineralization exists in the small drainage 107 (50 ppm) (similar to occurrence G?) but none was seen. Any mineralization would have to be fairly closely confined as none of the small surrounding creeks are anomalous.

No mineralization was observed in drainage 203 (35 ppm) but the low level anomaly previously recorded was confirmed. It is likely that the mineralization at occurrence K (which is responsible for anomaly 204) extends sufficiently far to produce the anomaly in creek 203. This is supported by the fact that the upper parts of the creek which are not underlain by the mineralized basics (intrusives?) are low in copper.

The anomaly 213 (50 ppm) was confirmed by resampling although any mineralization would appear to be restricted to that part of the drainage within a few hundred feet of the confluence.

No mineralization was found in the drainage area contributing to sample 990 (80 ppm) nor was it confirmed by the additional samples taken.

A number of small prospecting pits were found near the top of creek 2862 (45 ppm) from which copper had been obtained. These pits extended south into the adjacent drainage. It was not possible to establish the tenor of the mineralization because nearly all of the pits had fallen in. Malachite was the sole copper mineral seen and it was present as an encrustation on specular haematite and ankerite.

LEAD

Beltana Sheet

No anomalies indicated.

Cadnia Sheet

Two lead anomalies remained to be inspected.

Sample 4965 (75 ppm) had previously been confirmed. No mineralization was seen. A fault crosses the area and was considered likely to be responsible for the anomaly. However, a sample taken just below the fault produced only 40 ppm lead, the highest value coming from the head of the creek. This contrasts with the previous sampling results which produced the highest values below (but not near) the fault. The reason for this erratic behaviour is not clear.

Anomaly 5347 (60 ppm), also previously confirmed, was traced to a bed of intraformational conglomerate. Some form of mineralization had been investigated previously as two small pits had been sunk into the band, but no mineralization was evident at that time of inspection. A sample submitted for analysis gave 2,100 ppm Pb and sample of calcite from a vein some hundreds of feet away gave 320 ppm.

Parachilna Sheet

No anomalies indicated.

Blinman Sheet

No anomalous areas to be inspected.

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ZINC

Beltana Sheet

No anomalies indicated.

Cadnia Sheet

Of the group 3585 (110 ppm), 3588 (240 ppm), 3815 (100 ppm) 3871 (100 ppm), 3883 (110 ppm), 3887 (95 ppm), 3889 (110 ppm) and 3893 (90 ppm), only 3585 and 3889 were confirmed. 3585 produced only a single value which was anomalous (90 ppm) but 3883 gave a series of values increasing to 150 ppm in sympathy with increase in surface haematite.

No mineralization was seen but the situation of the anomaly in a Cambrian limestone makes the chance of willemite mineralization fairly good.

The group of anomalies west of Patawarta Hill is considered confirmed (see recommendations).

Parachilna Sheet

No anomalies indicated.

Blinman Sheet

A group of 3 adjacent confirmed anomalies, 1976 (110 ppm), 1979 (110 ppm) and 1980 (95 ppm) were visited. The area is underlain by gently dipping quartzites and quartz rich shales with occasional areas of tension gashing which have been filled with calcite. It was suspected that these infillings might contain zinc but none of those sampled proved to be so mineralized.

The source of the high zinc values is thus unknown. The supplementary samples taken will be submitted for heavy mineral separation in an effort to establish the source of the mineralization.

II. MINE AND OCCURRENCE VISITATION

The Warioota Mine

The Warioota Mine mineralization consists principally of a joint plane fracture filled with calcite and malachite which attains a width of about 2'. This gash extends about 2,000' and is mineralized to some degree along most of this distance. A shaft has also been sunk to the SE of the main workings on what appears to be a parallel lode.

Visually, the Warioota Mine is not impressive nor is much encouragement given by the lack of geochemical anomalies around it. However, the samples taken previously range from 2% to 20% and could hardly be considered discouraging although the writer feels that these are unlikely to be even approximately representative of the 2' width.

The Lady Lehman Mine

This mine is currently being examined by Mr. R. Read and a comprehensive report will be prepared by him.

In view of the large geochemical anomalies detected and the diversity of elements found, including copper, cobalt, gold, barium and more recently zinc, the writer feels that it is difficult to escape the conclusion that the area shows considerable promise.

The Oratunga Mine

The Oratunga Mine consists of three deep, closely-spaced shafts surrounded by minor exploratory pits. Examination of the spoil heap indicates that the lode was calcareous and contained blebs of chalcopyrite of about 5 mm diameter scattered through it. Its surface expression is confined to malachite staining which, although not particularly widespread, is quite intense in places. The grade of ore could not be reliably estimated.

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The reason for the non detection of the mine in the stream sediment survey is not known as the check sample gave a value of 100 ppm Cu. The lack of an extensive geochemical halo and the absence of a gossanous outcrop does not recommend the area, but a rapid geophysical examination could be carried out with minimum difficulty if required.

The Ivy Queen Mine

The Ivy Queen proved to be somewhat disappointing in that very little mineralization of any type could be found.

The mine is fairly comprehensively described in Shackleton's report. Its position is not quite accurately shown on previous maps and is in fact very close to the main creek. A series of close-spaced samples failed to disclose any extensions of the mineralization to the west. The main creek prevented a geochemical check being made on the possibility of an eastward extension. No lead mineralization was found nor were any of the samples taken high in lead. A pile of barite, handpicked and neatly stacked to one side, was seen and it is possible that an error in identification had been made.

The exploratory work done by Admin Exploration Pty. Ltd. was not guided by geophysics and the relationship of the drilling to the sub-surface geology is largely unknown. However, their results are largely in keeping with surface observations.

The most encouraging feature of the Ivy Queen Mine is the presence of large quantities of iron oxide which may in part have been derived from sulphides. It is not considered that this is sufficient reason to initiate additional work on this area alone although it could be further tested as part of an overall programme.

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The Wepowie Lead Mine

The Wepowie Lead deposit was found to consist of two shafts sunk about 100' apart on two ferruginous lodes (2' and 9" in width). The lead is present as a green mineral with the approximate formula of polysphaerite (a lead phosphate).

A grab sample assayed 52.5% lead but only 11 ppm (about 6 dwts per ton) Ag. Argentiferous lead was reported in the Record of the Mines of S.A. as having been obtained at depth.

The mine is quite interesting mineralogically and lead grades are good but exploration, apart from grid geochemistry, might prove difficult as the lead is not easily recognized nor in the phosphatic form is it an electronic conductor. In addition, the amount of visible mineralization is not great, thus a considerable exploration effort would be required to demonstrate the presence of economic quantities of lead.

Wheal Butler

The grade of mineralization found at the Wheal Butler was not particularly high. However, the dumps have been fairly exhaustively picked over so that it is of dubious value to speculate on possible mine grades. The mineralization consists of highly crystalline malachite accompanied by specular haematite in quartz and is confined to a 2' wide quartz reef which has an apparent strike length of about 500'. Four quite large shafts have been sunk on the reef and appear to have followed it closely downwards. This type of mineralization does not appear to be a particularly attractive exploration target.

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"Mt. Elkinton Mine"

Despite a fairly exhaustive examination, no trace of the mine could be found in the general area of its supposed position. As the geochemical results show no anomalies, it is concluded that either the position of the mine is incorrect or it is very small and escaped detection.

The Ladder Mine

The Ladder Mine is exceedingly small and only two small adits, which are really little more than exploratory pits, were found. Its drainage train, however, is quite extensive and boulders of siderite - calcite with euhedral quartz and traces of malachite could be found in the creek-bed several miles downstream from the mine. Very little mineralization was seen in situ. The reason for its non-detection in the reconnaissance survey is that it discharges all debris directly into the main creek which, for reasons of its size, could not be profitably sampled.

The Mt. Mary Mine

The Mt. Mary Mine consists of a single shaft connected to a haulage adit. The ore is quartz, iron stained calcite and malachite. The presence of boxworks indicates that the malachite probably gives way to chalcopyrite at depth. The grade overall appears low and handpicking appears to have been practised. A sample of "average" ore gave 0.25% copper. No ore control was observed although the mineral assemblage suggests that it is probably a fracture infill.

Several claim pegs were found but the M.R. number was illegible and presumed out of date.

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The 'Mn-Pb' Mine

The mine consists of shaft which is now nearly full of refuse. Samples taken from the dump gave only 100 ppm lead and the low lead geochemical reconnaissance value was confirmed by resampling. The mullock heap provided no clue as to the purpose of the mine as no lead could be found, nor was the grade of manganese particularly high. If in fact lead mineralization is present, it does not appear to be very widespread.

Occurrence A

No mineralization could be found at the site A in spite of its distinctive position. The slates underlaying the area are virtually undisturbed and it would seem that if any mineralization is present it would in all probability be as staining. No geochemical anomaly was found.

Occurrence B

At occurrence B a trench about 70' long had been cut into the hill along two quartz-siderite-malachite-chalcopyrite veins. Malachite and some chalcopyrite has also penetrated the country rock. A sample of this mineralized country rock (particularly selected) assayed 13.0% copper. However, soil samples taken a short distance away indicated that the mineralized zone is not of any size and in fact the detailed geochem values failed to respond to the mineralization.

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Occurrences C and D

No mineralization was found at site C. A number of pits were found at Site D plus an additional pit further to the east (which was responsible for the 350 ppm anomaly). The mineralization at D consisted of chalcocite nodules of a few millimetres diameter partially oxidised to malachite set in yellow dolomite. The eastern pit was slightly different in that the "ore" consisted of flaky sediments coated with malachite. Grades were fair for the latter mineralization but probably do not exceed 1% copper.

Blue tapes tied to branches overhanging the creeks and close spaced hand auger holes to the west suggest that the area has been geochemically grid sampled very recently.

Occurrence E

Occurrence E was very similar geologically to occurrence D. The grade overall was low (1%) although mineralization was very patchy and confined to a single pit. Resampling confirmed the low stream sediment reconnaissance value (15 ppm) which apparently results partly from the small size of the occurrence and partly from the addition of unmineralized sediment from two other streams of comparable size.

Occurrence F

Occurrence F differed from previously mentioned occurrences in that the copper was present as chalcopyrite in a small vein, but the host rock, grade and occurrence size was about the same as D and E. A channel parallel to the main creek caused the displacement of the stream sediment anomaly from the anticipated position to one some hundreds of feet downstream (55 ppm).

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Occurrence G

No mineralization was found at the position (G) shown on the previous maps nor did the check stream sediment value indicate the presence of mineralization. A small occurrence was found in a side stream some distance away which was apparently previously unsampled (check value, 45 ppm). This consisted of a pit (lined with rock) in yellow dolomite and grey altered shale. Debris was stained with malachite and probably contained about 1% copper.

Occurrence H

Copper staining was found on yellow dolomite at occurrence H in a largish pit. A second larger and slightly more highly mineralized pit was found a few hundred feet to the SW. The grade in each of these was low (1%). The non-detection of the mineralization from the pits is attributable to the fact that it is discharged directly into a large, unsampled creek.

Occurrence I

No mineralization was found at the position I nor was a stream sediment anomaly obtained in the appropriate place on close spaced sampling the zone.

Occurrence J

A small pit in mineralized yellow dolomite was found at the position J. As with previous occurrences in dolomite, the grade was about 1% and mineralization was not widespread.

The reason for its non-detection in the stream sediment survey is unknown.

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Occurrences K and L

Both of these occurrences consist of 3 or 4 pits on the margin of a basic mass (probably intrusive) and the copper is principally present as chalcopyrite. Occurrence K is very small although the mineralized material itself is quite rich. Occurrence L is considerably more extensive. Soil samples taken around the copper-specular haematite mineralization gave values up to 600 ppm although the stream sediment dispersion train decayed rapidly from 65 ppm below the occurrence to 20 ppm above the first confluence.

Occurrence M

Two tiny pits with virtually no mineralization were found at point M. Crystalline malachite was found in vughs in a single rock. A sample of material taken from the pit returned only 60 ppm copper.

Occurrences B to L are associated with the Blinman Dome and, with the exception of occurrences D and K, are quite small. Occurrences A and M are not associated with the diapir (but are also very small).

. . . . /14

RECOMMENDATIONS

The Lady Lehman Mine area presents itself as the most encouraging zone and should be gridded to allow a more detailed evaluation to be made. The sulphides in the area north of the Artimore Road should be an ideal IP target. The use of detailed geology should allow the IP effects from the cupriferous marginal zones to be distinguished from pyritized zones within the diapir. South of the Patawarta Road, close spaced geochemical grid sampling could be used to establish the source areas of zinc mineralization more exactly.

Outside the Lady Lehman area the following targets could be investigated although these are considered of lesser importance.

(1) Wepowie Mine

(2) Warioota Mine

(3) Oratunga Mine

(4) Mt. Mary Mine

(5) Occurrence L

(6) Occurrence D

(7) Anomaly 3883

Signed
McPHAR GEOPHYSICS PTY. LTD.

R.W. FIDLER
Geologist

17-6-86

0110

RECEIVED
11 JUN 1971
Ans'd .....

Sm L 292

McPHAR GEOPHYSICS PTY. LTD.

TELEPHONE 72 2133

50-52 MARY STREET, UNLEY, SOUTH AUSTRALIA
POSTAL ADDRESS: P.O. BOX 42, UNLEY, SOUTH AUSTRALIA 5061

CABLE
"PHARGEO" ADELAIDE
TELEX
"PHARGEO" AA82623

MEMORANDUM TO: NORTH FLINDERS MINES N.L.

MEMORANDUM FROM: R.W. FIDLER, McPHAR GEOPHYSICS PTY. LTD.

SUBJECT: HEAVY MINERAL SEPARATIONS

DATE: 10TH JUNE, 1971.

On completion of the reconnaissance stream sediment followup in S.M.L. 292, a group of zinc anomalies had been confirmed but no mineralization could be found in the drainage area (Samples 1976, 1979, 1980). The position of the drainage system in the Precambrian Wockerawirra Dolomite was not considered a favourable site for zinc mineralization and thus, to distinguish between a high background lithology and mineralization, heavy mineral concentrates were prepared from the stream sediments. Microscopic examination of the concentrates showed willemite was present in sample 1979 and was probably present in sample 1980 (see Mineralogical Report 583) indicating that zinc mineralization is probably the source of the anomalies.

Considering the very small quantities of willemite found and, to a lesser extent, the rather restricted drainage area involved, it is unlikely that the mineralization has economic significance but it does bear out the original results.

Signed
McPHAR GEOPHYSICS PTY. LTD.
R W Fidler

McPHAR GEOPHYSICS PTY. LTD.

50-52 MARY STREET, UNLEY, SOUTH AUSTRALIA
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bl

7th June, 1971

MINERALOGICAL REPORT NO. 583

by D.H. McColl

To: Mr. Bruce Wilson,
North Flinders Mines N.L.
23 Greenhill Road,
WAYVILLE. S.A. 5034

COPY TO: Mr. R. Fidler,
McPhar Geophysics Pty. Ltd.,
50 Mary Street,
UNLEY. S.A. 5061

YOUR REFERENCE: Material submitted on your behalf by Mr. R. Fidler

MATERIAL: Geochemical stream sediment samples prefixed 0156.

IDENTIFICATION: Samples Numbered 281976
281979
281980

WORK REQUESTED: Washing of samples, heavy mineral separation using tetrabromoethane (S.G.=2.96) and identification of principal components by low power microscopy with special regard for zinc minerals.

SAMPLES: Returned to Mr. Fidler.

McPHAR GEOPHYSICS PTY. LTD.

D.H. McColl

Washing and heavy mineral separation was carried out on the milled and pulverised sample after geochemical assay. This would tend to show a selective preference for the physically stronger and larger grains which should be taken into account in considering relative mineral abundances (listed in decreasing order).

Number 281976

- ferrocrete, maghemite, zircon, (topaz (?), hornblende, carbonate (?)

Number 281979

- limonite, maghemite, ferrocrete, zircon, topaz (?), willemite

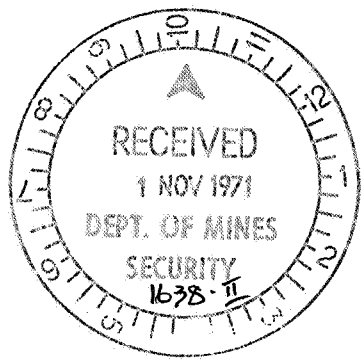
Number 281980

- ferrocrete, maghemite, limonite, zircon, topaz (?), willemite (?)

(?) indicates identification doubtful

APPENDIX I

0113



0114

STREAM SEDIMENT RECONNAISSANCE SURVEY
PART OF BLINMAN-WIRREALPA AREA, S.M.L. 557
(FORMERLY NARINA SPRINGS AREA S.M.L. 293)
SOUTH AUSTRALIA

FOR

NORTH FLINDERS MINES LIMITED

BY P.R. DONOVAN, Ph.D., M.A.E.G.

McPHAR GEOPHYSICS PTY. LTD.

TELEPHONE 72 2133

50-52 MARY STREET, UNLEY, SOUTH AUSTRALIA
POSTAL ADDRESS: P.O. BOX 42, UNLEY, SOUTH AUSTRALIA 5061

CABLE
"PHARGEO" ADELAIDE
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MEMORANDUM TO: NORTH FLINDERS MINES LIMITED

MEMORANDUM FROM: DR. P.R. DONOVAN
McPHAR GEOPHYSICS PTY. LIMITED

SUBJECT: STREAM SEDIMENT RECONNAISSANCE SURVEY, PART OF BLINMAN-WIRREALPA AREA, S.M.L. 557, (FORMERLY NARINA SPRINGS AREA S.M.L. 293) SOUTH AUSTRALIA

DATE: 8TH OCTOBER, 1971

INTRODUCTION

S.M.L. 557, in the central part of the North Flinders Ranges of South Australia, covers an area of approximately 1,000 square miles. It is comprised essentially of former S.M.L.'s 290, 292 and 293.

The first two S.M.L.'s have already been covered by stream sediment reconnaissance and follow-up surveys (see memoranda by writer dated 26/2/70, 23/7/70, 12/11/70 and 20/1/71) and this memorandum covers the area of former S.M.L. 293, an area of approximately 379 square miles.

A report covering a stream sediment follow-up survey of the Moro Springs area in the former S.M.L. 293 has already been prepared by the writer for North Flinders Mines N.L. (16/2/70): the results are incorporated into the maps accompanying this memorandum and are re-discussed.

The purpose of the survey was to carry out a reasonably thorough reconnaissance of this large area to establish priorities for more detailed exploration work. Only Cu, Pb and Zn have been analysed at this stage.

Approximately 102 square miles, underlain by various formations, or Quaternary deposits, were omitted, leaving a total surveyed area of 277 square miles.

The sampling was partially carried out by McPhar crews and partially by North Flinders Mines crews over the period December, 1969 to August, 1971.

In all 3414 sediment samples were collected yielding a density of approximately 12.3 samples per square mile.

The 60-chain topographic sheets of the S.A. Mines Department were used as base maps.

S.M.L. 557 lies entirely within the Copley 1:250,000 sheet (in preparation) and also on parts of the Balcanoona, Cadnia and Arrowie 1 mile sheets of the S.A. Geological Survey.

GEOLOGY

The rocks of the area consist of sediments ranging from Proterozoic Sturtian and Marinoan to Lower Cambrian in age.

Essentially there are two large Lower Cambrian basins, one centred around Narina Creek in the southern part of the area and one centred near Orange Tree Dam in the northern part of the area.

0117

Diapiric structures are developed at Bullock Head Gap and Nantawarrinna.

Minor mineralizations, mainly copper, are scattered throughout the area. These are listed in the text below.

ANALYSIS

All samples were sieved to minus 80-mesh and analysed for Cu, Pb and Zn by AAS on a 0.25g sample. Approximately half the samples were leached by hot 25% HNO_3 and half by hot 72% $HClO_4$ as follows:-

Batch	Date	Sample Nos.	No.	Leach
G 1655	9.12.69	917001 - 917189	258	25% HNO_3
G 1723	24.12.69	Misc.		"
CH 0706	13.11.70	930001 - 375	928	"
CH 0730	13.11.70	930376 - 625		"
CH 0828	24.11.70	930626 - 928		"
CH 2027	13. 5.71	1002/001 - 250	250	72% $HClO_4$
CH 2138	7. 6.71	1002/251 - 600	349	"
CH 2203	18. 6.71	1002/601 -1150	550	"
CH 2312	13. 7.71	1002/1151 - 1197	543	25% HNO_3
		1002/1205 - 1700		
CH 2780	2. 9.71	1002/1198 - 1204	7	72% $HClO_4$
		1002/1702 - 2232	529	"
		TOTAL	3,414	

For purposes of comparison, all anomalies have been checked by analysis by 25% HNO_3; however, the original value has generally been left on the map.

Overall the $HClO_4$ values are generally slightly higher than those following the HNO_3 leach. There appears to be no distinct advantage in either acid.

RESULTS

The sample locations and metal values are shown on Dwg's G.C. 4179A - 4182A. Threshold values were selected based on previous experience in adjacent areas rather than on statistical analysis.

Copper (Dwg. G.C. 4180A)

Values ranged from <2 to 280 ppm; a value of 35 ppm was selected as threshold (T_{Cu}) and in all there were 50 anomalous values as follows:

24 possibly anomalous	($\geqslant T_{Cu}$ - $<2T_{Cu}$)	(35 - 65 ppm)
14 probably anomalous	($\geqslant T_{Cu}$ - $<3T_{Cu}$)	(70 - 100 ppm)
12 definitely anomalous	($\geqslant 3T_{Cu}$)	(110 ppm and above)

Only one possible anomaly occurred within the Moro Springs area (previously surveyed).

Lead (Dwg. G.C. 4181A)

Values ranged from <20 to 1,000 ppm; a value of 80 ppm was selected as threshold (T_{Pb}) and in all there were 62 anomalous values as follows:

49 possibly anomalous	($\geqslant T_{Pb}$ - $<2T_{Pb}$)	(80 - 150 ppm)
5 probably anomalous	($\geqslant 2T_{Pb}$ - $<3T_{Pb}$)	(160 - 230 ppm)
8 definitely anomalous	($\geqslant 3T_{Pb}$)	(240 ppm and above)

Of these. 40 occurred within the Moro Springs area

Zinc (Dwg. G.C. 4182A)

Values ranged from 5 - 1,700 ppm; a value of 100 ppm was selected as threshold (T_{Zn}) and in all there were 108 anomalous values as follows:

92 possibly anomalous ($\geqslant T_{Zn}$ - $< 2T_{Zn}$) (100 - 190 ppm)
10 probably anomalous ($\geqslant 2T_{Zn}$ - $< 3T_{Zn}$) (200 - 290 ppm)
6 definitely anomalous ($\geqslant 3T_{Zn}$) (300 ppm and above)

Of these 40 occurred within the Moro Springs area (previously surveyed).

The distribution and significance of the anomalies are considered on each of the one-mile sheets in turn.

ARROWIE SHEET.

Coverage:

West and north of Rivers Bluff an area of Pound Quartzite was not sampled.

The Nepabunna Siltstone and higher Lower Cambrian beds (around Orange Tree Dam) were not sampled. However, south of One Tree Bore and north of Donkey Water Spring approximately 13 square miles of Wilkawillina Limestone have not been sampled, although this formation contains copper, lead and zinc anomalies elsewhere on the sheet.

North of Mt. Roebuck approximately 4 square miles of Marinoan sediment have not been covered although there are several Cu anomalies and occurrences in these rocks nearby.

Copper:

The 60-chain geological sheet shows ten copper occurrences, A - J, mostly within the Marinoan Wonoka formation on the eastern side of the Ranges, although F is actually positioned in the top of the underlying Bunyeroo formation. These are not shown on the 1-mile geological map, and they did not give rise to any Cu geochemical anomalies.

There is another Cu occurrence (K) shown on the 60-chain geological sheet, one mile North of Top Well, again in the Wonoka formation. This also did not give rise to a geochemical anomaly.

There is a copper occurrence (L) 3 miles ENE of Mt. Roebuck in the Wearing Dolomite Member of the Bunyeroo Formation, a known cupriferous horizon in this part of the North Flinders Ranges. There was no associated geochemical anomaly, possibly due to its location away from drainage. This occurrence is shown on both the 1 mile and 60-chain geological maps.

Apart from this there are three copper occurrences, M, N and O, marked on the most recent 60-chain topographic map that are not present on either geological map.

M, 3 miles NNE of Mt. Roebuck, appears to lie on the large NE-SW fault, while N, a little to the east, is on the Wearing Dolomite member. There is an associated copper anomaly in this area 1824 (95 ppm).

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O, 2½ miles east of Mt. Roebuck, is probably related to the Wearing Dolomite again, although this member has not been mapped at this position. It is very close to the diapiric stringer. There was no geochemical anomaly.

Occurrence P, marked as a Cu working by the crew, 1 mile east of Top Well Bore, also gave no anomaly.

The final occurrence, Q, was located by the crew. It is situated within the Wilkawillina Limestone and surrounded by 7 anomalies, 3 of them definite. The possibility of associated mercury mineralization should not be overlooked here, although there were no related Pb and Zn anomalies.

Apart from these, there was a well defined cluster of 8 possible and probable Cu anomalies, possibly related to the E-W fault north of Mt. Roebuck.

Anomaly 1673 (45 ppm) appears to be related to a NW-SE quartz vein 2 miles east of Mt. Roebuck while 1722 (45 ppm) is an isolated anomaly in the Marinoan 3 miles east of Roebuck Bore.

Lead:

There are no known Pb occurrences on this sheet.

There are two isolated Pb anomalies within the Wilkawillina Limestone, samples 1962 (120 ppm) and 2044 (320 ppm). The latter is also definitely anomalous in Zn.

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Zinc:

There are no known Zn occurrences within the area of S.M.L. on this sheet.

There are two well defined zones of zinc anomalies.

Zone A is within the Wilkawillina Limestone, north of Rivers Bluff.

It consists of 24 anomalous samples, one of which 2044, is also anomalous in Pb. The zone extends northwards to the Balcanoona sheet and all anomalies are within the Wilkawillina limestone.

Zone B, south of Roebuck Bore and Well consists of 3 possible Zn anomalies, 1732, 1734 and 1735 within the Marinoan.

Apart from these two zones there is one isolated possible anomaly 1967 (180 ppm) within the Wilkawillina limestone NE of Double Gap Bore.

BALCANOONA SHEET.

Coverage:

Apart from several square miles of Pound Quartzite west and east of the Nantawarrinna Diapir which were purposely not sampled, there are approximately 10 square miles of Wilkawillina limestone unsampled to the east of Alerumba Creek.

A few square miles of the higher Lower Cambrian formations (Nepabunna Siltstone and Parara limestone) were also unsampled.

On the other hand, approximately 10 square miles of Quaternary overburden east of Erragoona Hill were unnecessarily sampled.

Copper:

There is only one known copper occurrence within the S.M.L. on this sheet, within the Wilkawillina limestone near a NW-SE fault south of Arrowie Gorge. Although this does not give rise to an anomaly as it drains out of the S.M.L., there is a well defined group of 8 Cu anomalies just to the north-west in the same setting.

There are 3 copper anomalies within the Nantawarrinna Diapir, two of which, 2164 (70 ppm) and 2162 (90 ppm), are in the same drainage. There is a known Cu occurrence just outside the S.M.L. on the NW edge of the diapir.

Apart from this there is an isolated Cu anomaly, 2232 (55 ppm), within the Wilkawillina limestone 3 miles east of Nantawarrinna Spring, and a single anomaly (917138 - 45 ppm) probably related to the Mt. John fault in the Moro Springs area.

Lead:

Apart from the 40 Pb anomalies within the Wilkawillina limestone in the Moro Springs area, there are another possible 4 anomalies in the same formation on the western limb of the syncline, south of Nantawarrinna Bore. These are not anomalous in either Cu or Zn.

One of these has already been detailed (2187/540) and a maximum value of 180 ppm Pb obtained.

Zinc:

There were no zinc anomalies outside the Moro Springs area.

CADNIA SHEET.

Coverage:

Only areas of Pound Quartzite were omitted from sampling on this sheet, except for one or two square miles of Marinoan along the eastern edge of the S.M.L., north of Mt. Brooke.

Copper:

There is one known Cu occurrence, R, which occurs 2 miles SE of Bullock Head Gap. This gave no geochemical anomaly as the adjacent creek was not sampled.

The main group of copper anomalies occur southwestwards from Bullock Head Gap, probably related to the major NE-SW fault in this area. In all there are 11 anomalies, two of them definite. There are associated Pb and Zn anomalies. It should be noted that the southernmost sample 435 (80 ppm Cu, 500 ppm Pb and 540 ppm Zn) may be contaminated as it was collected below the road.

Apart from this there are several isolated possible and probable anomalies.

. . . . /11

Samples 82 (60 ppm) and 83 (80 ppm) occur in adjacent creeks, 1 mile east of Ann Hill, within the Wilkawillina limestone. These may be contaminated as old topographic maps show cart tracks at these points.

Sample 1136 (95 ppm) occurs 1 mile west of Mt. McFarlane within the Wilkawillina limestone. It is also anomalous in Pb and Zn.

Sample 1057 (70 ppm) 2 miles NE of Ben Lomond is also within the Wilkawillina limestone.

Sample 493 (50 ppm, 2 miles NW of Bullock Head Gap occurs within the Marinoan, just below the Pound Quartzite.

Finally sample 1769 (40 ppm) occurs 1 mile east of Bullock Head Gap within a zone of faulting in Marinoan sediments.

It should be noted that sample 1195 which is anomalous in Cu and Zn has not been located on the crew's field sheets to date.

Lead:

There is one Pb occurrence shown on the topographic maps 2 miles ESE of Bullock Head Gap. This appears to occur within a tillite band. It did not give rise to a geochemical anomaly although 1 mile further north in a similar setting sample 1769 showed 80 ppm Pb.

. . . /12

There are 6 Pb anomalies in the Bullock Head Gap zone, mentioned above. The Pb values range up to 500 ppm.

Northeast of Bullock Head Gap, near a diapir and NE-SW fault but located within the Lower Cambrian, there are 4 Pb anomalies including a high of 1,000 ppm (sample 1253). There are no associated Cu or Zn anomalies.

Samples 560 (80 ppm) and 561 (80 ppm) occur within the Wilkawillina limestone near the same NE-SW fault just north of Narina.

Apart from this there are a number of isolated anomalies.

Sample 1136 has already been mentioned under "copper" above.

Sample 469 (80 ppm) occurs within the Marinoan S-W of Bullock Head Gap.

Sample 546 (80 ppm) occurs in the Wilkawillina limestone just south of the NE-SW fault, 2 miles NE of Narina.

Zinc:

There are no known Zn occurrences on this sheet.

Apart from the Bullock Head Gap zone previously mentioned above, where there are values up to 1700 ppm Zn (sample 502), there is a well defined zone east of Mt. Brooke within the Wilkawillina limestone, extending over approximately 4 miles of strike.

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Sample 1067 (170 ppm) occurs 1 mile east of Ben Lomond, and samples 1138 (150 ppm) and 1136 (250 ppm) 1 mile west of Mt. McFarlane, all within the Wilkawillina limestone.

Sample 340 (120 ppm) occurs in the headwaters of Wildawildana Creek in the Lower Cambrian above the Wilkawillina limestone.

Sample 1212 occurs in approximately the same position 4 miles NE of Irish Well.

Samples 1088 (120 ppm) and 771 (120 ppm) are also located within the Wilkawillina limestone.

Samples 96 (290 ppm) and 99 (120 ppm) are adjacent within the upper Lower Cambrian beds 2 miles east of Point Well.

CONCLUSIONS

Due to the fact that the work was carried out over a longer period than other S.M.L.'s covered by the company, and that the work was performed by various crews at different times, the coverage is not entirely rational. Some formations of possible importance such as the Wilkawillina limestone have not been entirely covered, whereas other formations such as the Nepabunna siltstone and Parara limestone have been partially sampled, although this was not intended.

As a result of the survey several zones have been outlined which may contain mineralization of possible economic interest.

On the other hand, there are indications that the Wilkawillina limestone has local areas of high Zn values probably unrelated to mineralization, although the possibility of phosphate deposits cannot be overlooked.

The NE-SW structural trends appear to play a significant role in the localization of mineralization in the area, in particular the Bullock Head Gap fault which is traceable for approximately 18 miles through the area. Copper occurrences L, K and O are located near this fault zone. The most important anomaly of this type, containing some of the highest Zn and Pb values encountered in uncontaminated sediments in the Flinders Ranges, and also Cu anomalies, occur over a length of 4-5 miles near Bullock Gap itself.

Apart from this the most important anomalies appear to be those of copper in Arrowie Gorge and Q, in the Wilkawillina limestone, and the lead anomaly NW of Mt. Roebuck.

RECOMMENDATIONS

1. A decision should be made whether to cover the remaining areas of Wilkawillina limestone on the Balcanoona and Arrowie sheets, and the small area of Marinoan north of Mt. Roebuck on the Arrowie sheet.

2. The possible copper occurrences A - L, O, P and R, which did not give rise to geochemical anomalies, should be visited and assessed by a geologist.

3. The lead occurrence 2 miles SW of Mt. Roebuck should be treated in the same way.

. . . /15

4. All anomalous samples should be submitted for an emission spectrographic scan for the following elements: Co, Ni, Cr, V, W, Mo, Mn, Nb, Be, Sn, Cd, Bi, Ag, An, As, Sb, Ti.

5. The following areas are considered to be established exploration targets. They should be inspected by a senior geologist and exploration programmes drawn up if warranted:

(a) The Arrowie Gorge copper anomaly
(b) The Q copper anomaly
(c) The Bullock Head Gap copper-lead-zinc anomaly
(d) The Mt. Roebuck lead anomaly
(e) The Mt. Roebuck copper anomaly

6. The following 11 copper anomalies should be resampled and followed up by detailed sampling to the head of the creek. Working from north to south -

2164, 2172, 2232, 1824, 493, 1136, 1769, 1722, 1057, 82 and 83

7. The following 9 lead anomalies should be treated in the same way:

1962, 2044, 2191, 2185, 2182, 560, 561, 469, 546

. . . . /16

0130

8. The following 8 zinc anomalies should be treated in the same way:

1732, 1734, 1735, 1967, 1067, 1138, 340, 1212.

9. Samples from the follow-up of 6 - 8 should be analysed for Cu, Pb and Zn by AAS following a hot 25% HNO_3 leach.

(signed)
McPHAR GEOPHYSICS PTY. LTD.

P.R. Donovan, Ph.D., M.A.E.G.

0131

REPORT ON ROTARY PERCUSSION DRILLING

PATAWARTA ZINC PROSPECT

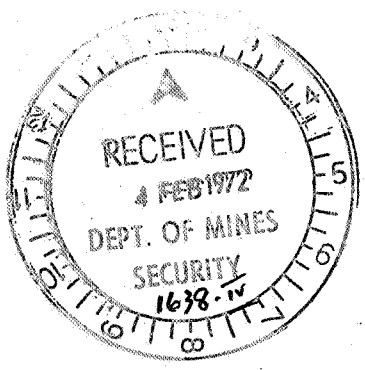
S.M.L. 557

R.E. READ.

Geologist

NORTH FLINDERS MINES LIMITED

November, 1971



CONTENTS:

0132

APPENDICES

ACCOMPANYING PLANS

Drawing No. 557-14	Geological map of Patawarta Zinc Prospect 1 in. rep. 200 ft.
Drawing No. 557-15	Soil sampling Plan of Patawarta Zinc Prospect 1 in. rep. 200 ft.
Drawing No. 557-35	Section 00 Patawarta Zinc Prospect 1 in. rep. 200 ft.

I INTRODUCTION

A rotary percussion drilling programme reconnaissance of two holes totalling 490 feet was carried out in November, 1971 on the Patawarta Zinc Prospect.

The Prospect is located 25 miles to the north of Blinman by road and eight miles east of Mooloolo Homestead on the Mooloolo Artimore road.

The holes were drilled to test an apparently stratiform gossan carrying a few thousand p.p.m. zinc which was associated with a zone geochemically anomalous for zinc.

II GEOLOGY

The Prospect occurs in siltstones situated stratigraphically above the ABC Sandstone and thought to be equivalent to the Bunyeroo Formation. The siltstones dip at about 20^{o} northwards and are inter-bedded with dolomites about 1 ft. thick and two thin greywackes.

To the north is the western extension of the Narina Fault, striking nearly east-west. Immediately north of the fault, on the up-thrown side is the Patawarta Diapir. The fault has caused drag-folding of the siltstones immediately to the south.

...../2

A gossan float occurs intermittently, over a strike length of about 3,000 feet. Petrological examination of the gossan showed it to be a true gossan with relict structures after pyrite and sphalerite (Appendix IV).

Costeaning exposed a maximum gossan-thickness of $1\frac{1}{2}$ ft. The gossan appears to occur as a series of lenses parallel to the strike of the siltstones.

III GEOCHEMICAL SURVEY

The area was first shown to be anomalous in zinc by reconnaissance stream-sediment sampling.

The gossanous beds were tested by soil sample lines 300 feet in length and 200 feet apart. Samples were taken at spacings of 25 ft. and 50 ft. (see soil sampling plan for details). The results showed anomalous zinc values in soil around the gossan float and also other anomalies in areas of outcropping shale. These latter are apparently due to siltstones carrying a few thousand p.p.m. zinc.

A second horizon anomalous for zinc, also probably due to zinc-rich siltstones occurs 1,000 ft. north of the gossan. This was tested by soil-lines 400 ft. long and 200 ft. apart, with 50 ft. spacings between samples.

...../3

IV ROTARY-PERCUSSION DRILLING PROGRAMME

a) Hole 1.

Hole 1 was drilled vertically to test the presumed down-dip projection of the gossan at 150 ft. Only pyritic-siltstones were encountered and drilling was stopped at 170 ft. Assays showed only minor amounts of zinc.

b) Hole 2.

Hole 2 was drilled vertically to intersect the down-dip projection of the gossan at 300 ft. Again only pyritic-siltstones with minor amounts of zinc were found and drilling stopped at 320 ft.

V. ANALYSIS

Samples were assayed by McPhar Geophysics Pty. Ltd., using AAS following a perchloric acid leach for one hour on a 0.25g. sample.

Results are tabulated on the drill log sheets in Appendix II.

In addition one sample was submitted for a spectrographic scan (Appendix III), This did not detect any elements in concentrations of potential economic interest.

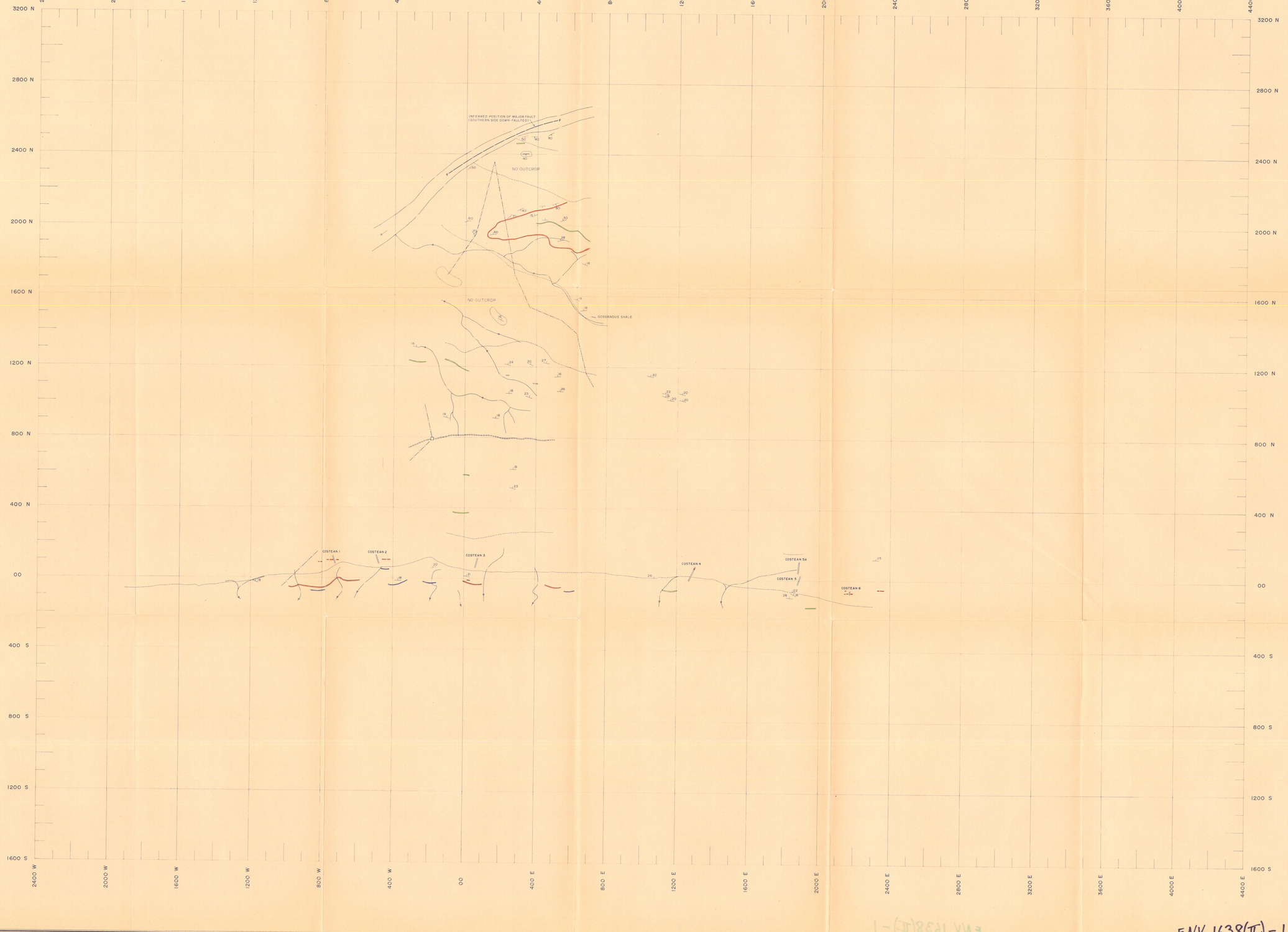
VI CONCLUSIONS AND RECOMMENDATION

The results show that there is little hope of finding a bedded zinc sulphide deposit of economic grade at this Prospect.

No further work is warranted on this Prospect.

R. E. Read

R.E. READ.



N
M.N.

REFERENCE

- MASSIVE CHERTY SILTSTONE
- DENSE BLUE-SILTY DOLOMITE
- GREYWACKE: LITHIC GREYWACKE WITH PEBBLES UP TO 10mm ACROSS
- GOSSAN, OUTCROP-FLOAT
- APPROXIMATE BOUNDARY OF AREAS OF NO OUTCROP
- FAULT
- CREEK
- FENCE
- STRIKE & DIP OF BEDDING (NOTE: DIPS >25° TO NEAREST 5°; <25° TO NEAREST 1°)

SCALE

200 100 0 200 400 600 800 1000

FEET

North Flinders Mines N.L.

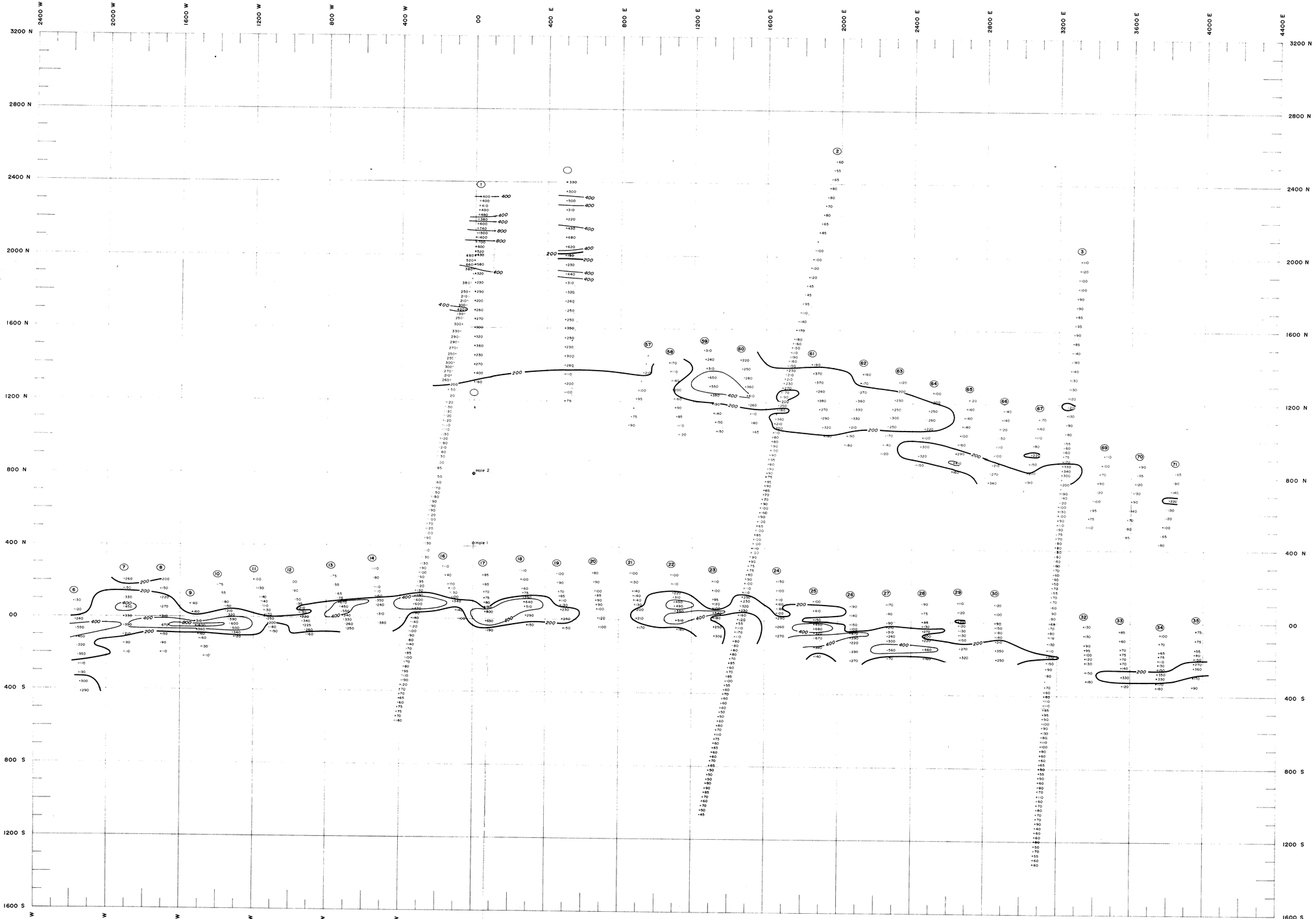
PATAWARTA
ZINC PROSPECT
SML 557

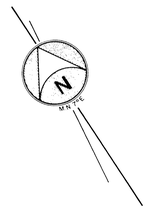
GEOLOGICAL MAP

GEOLOGY BY R.E. READ

DRN:- R.G.	DATE:- OCT. 1971	SCALE:- 1" rep. 200'

DWG 557-14





NOTES ON SAMPLING & ANALYSIS

LINES 1-35 SAMPLED AT 6" DEPTH.

ALL OTHER SAMPLES AS NEAR TO BEDROCK AS POSSIBLE

SAMPLES SIEVED TO 80 FRACTION

ANALYSIS BY McPHAR GEOPHYSICS PTY. LTD.

BY AAS ON .25gm SAMPLE FOLLOWING CONC. HClO4 LEACH FOR ONE HOUR

SCALE

200 100 0 200 400 600 800 1000

FEET

NFM North Flinders Mines N.L.

PATAWARTA

ZINC PROSPECT

SML 557

GEOCHEMICAL SOIL SURVEY

SHOWING

Zn RESULTS- P.P.M.

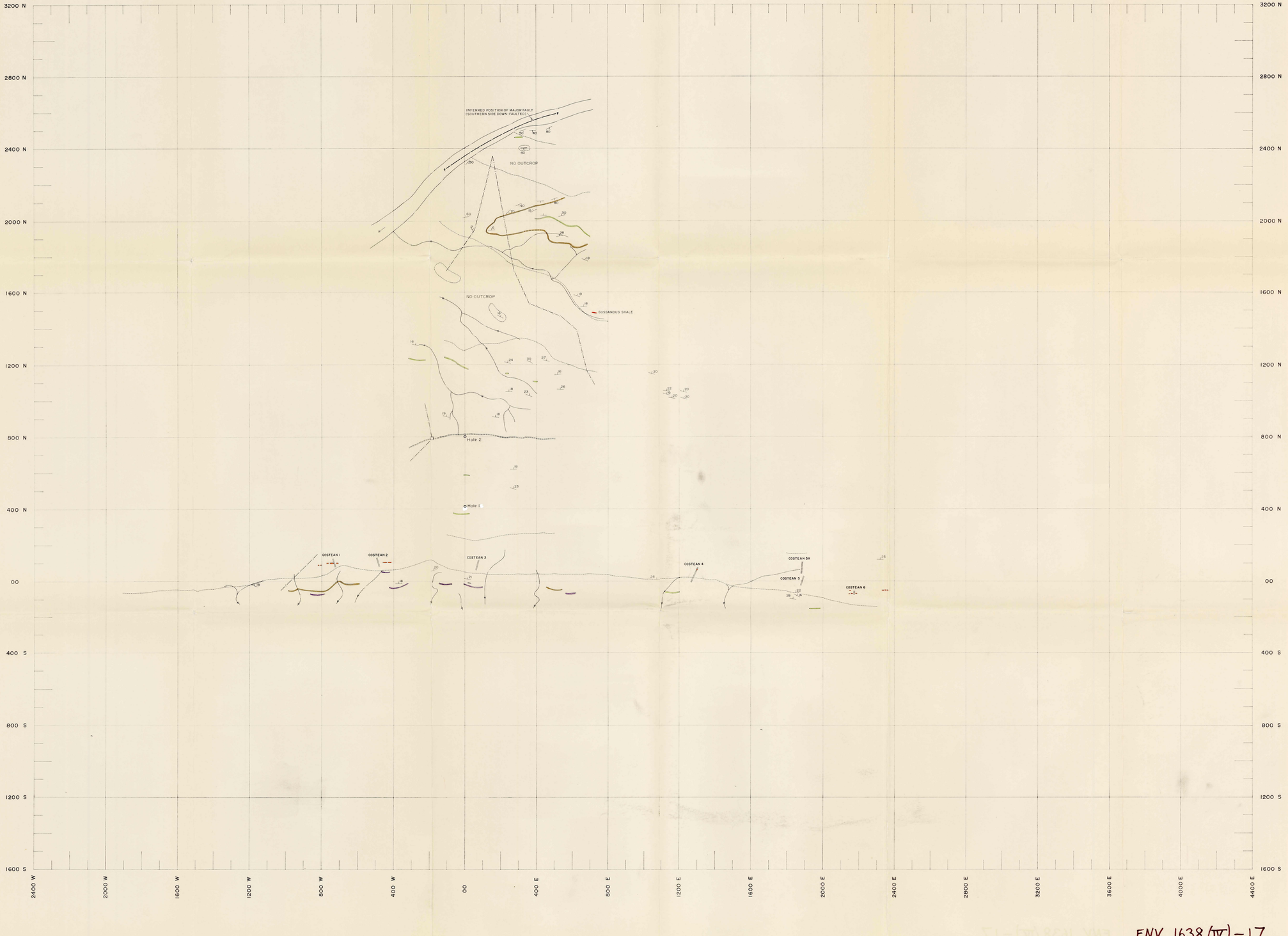
RECEIVED 4 FEB 1972 DEPT. OF MINES SECURITY 1638 IV

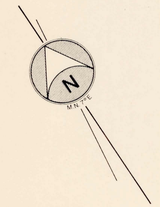
DRN:- R.G.	DATE:- OCT. 1971	SCALE:- 1" rep. 200'

DWG 557-15

ENV 1638 (IV) -18

1638 IV -18





REFERENCE

- MASSIVE CHERTY SILTSTONE
- DENSE BLUE-SILTY DOLOMITE
- GREYWACKE, LITHIC GREYWACKE WITH PEBBLES UP TO 10mm ACROSS
- GOSSAN, SUB-OUTCROP
- APPROXIMATE BOUNDARY OF AREAS OF NO OUTCROP
- FAULT
- CREEK
- FENCE
- STRIKE & DIP OF BEDDING (NOTE: DIPS >25° TO NEAREST 5°, <25° TO NEAREST 1°)

SCALE

200 100 0 200 400 600 800 1000

FEET

North Flinders Mines N. L.

PATAWARTA
ZINC PROSPECT
SML 557

GEOLOGICAL MAP

GEOLOGY BY R.E. READ

DRN:- R.G. | DATE:- OCT. 1971 | SCALE:- 1" rep 200'

DWG. 557-14

ENV 1638 (IV) - 17

APPENDIX I

SUMMARY

Patawarta Zinc Prospect

Hole No.	Coords E.	Coords N.	Hole Size	Depth Water-Cut	G.P.H. (Approx)	Sample Nos.	Total Depth.
1	00	415	6"	55'	200	3701-34	170'
2	00	800	6"	55'	2,500	3735-98	320'

NORTH FLINDERS MINES LIMITED

APPENDIX II

DRILL LOG FORM

0137

PROJECT PATAWARTA

Drill Hole No. 1 Sheet ____ of 2 Grid Co-ords 415N 00E

Azimuth ____ Dip Vertical

Type of Drill Drillmaster - Rotary-Percussion.

Driller ____ Collar Datum ____

Logged by R.E. Read Depth of Hole 170 ft.

Commenced 20.11.71 Completed 21.11.71

Depth Water Struck 55 ft. G. P. H. ____

Depth Water Struck ____ ft. G. P. H. ____

Depth Water Struck ____ ft. G. P. H. ____

% Core Recovered ____ Length of Casing in hole 3 ft.

LOG				ASSAYS		
From (ft)	To (ft)	Sample No.	Lithology	Zn ppm AAS		
0	5	3701	Laminated grey-green siltstone.	190		
5	10	02	As above.	270		
10	15	03	As above.	310		
15	20	04	As above.	530		
20	25	05	As above	410		
25	30	06	Grey-green silstone with dark laminations 1 mm. thick.	440		
30	35	07	Blue-grey silty dolomite, 30% silstone, as before.	290		
35	40	08	Blue-grey dolomitic silstone (about 30% dolomite) effervescing weakly with acid when powdered. 30% grey stilstone as before.	510		
40	45	09	Dark grey siltstone.	480		
45	50	3710	As above.	760		
50	55	11	Grey stilstone, 30% dark grey siltstone.	530		
55	60	12	Grey silstone with 2% Pyrite, as cubes up to 0.1 mm across but chiefly finer.	200		
60	65	13	Grey siltstone with 2% Pyrite as cubes, up to 0.3 mm across, but mostly 0.05 mm. A few qtz veins 1 mm thick.	170		
65	70	14	Grey silstone with 2% very fine-grained pyrite.	240		

NORTH FLINDERS MINES LIMITED DRILL LOG FORM CONTINUATION SHEET

Drill Hole No. 1 Sheet 2 of 2

Project Patawarta

0138

LOG				ASSAYS
From (ft)	To (ft)	Sample No.	Lithology	Zn ppm AAS
70	75	3715	Grey silstone with 2% pyrite, up to 5% pyrite in some fragments. Pyrite very fine grained, max. 0.05 mm. Some pyrite in bands parallel to the bedding.	290
75	80	16	Grey silstone, as above.	270
80	85	17	Grey siltstone, as above. 20% Black pyritic siltstone.	680
85	90	18	Grey stilstone, 1% very fine - grained pyrite.	780
90	95	19	Grey siltstone with 1% fine- grained pyrite.	980
95	100	3720	Black laminated silstone, 1% fine-grained pyrite.	1000
100	105	21	Black shaly siltstone, 2% fine-grained pyrite.	1100
105	110	22	Black siltstone, 2% fine-grained pyrite.	660
110	115	23	As above	390
115	120	24	Black siltstone, 5% fine-grained bedded pyrite.	570
120	125	25	Black micaceous siltstone, 1% pyrite.	970
125	130	26	Black siltstone, 3% pyrite.	2500
130	135	27	Black siltstone, 5% pyrite.	1100
135	140	28	60% Black siltstone, 5% Pyrite. 40% Grey siltstone, 3% Pyrite.	430
140	145	29	60% Black siltstone, 5% fine grained bedded pyrite. 40% Grey siltstone, 3% Pyr	450
145	150	3730	Black silstone, 1% pyrite.	210
150	155	31	Black siltstone, 1% Pyrite.	2600
155	160	32	Black pyritic siltstone, 1% pyrite. 1% sphalerite. 1% Qtz-pyr. vein fragments.	2100
160	165	33	Grey siltstone. 1% pyrite.	490
165	170	34	Grey siltstone. 1% Pyrite grains up to 0.2 but mostly very fine-grained.	mm 150

NORTH FLINDERS MINES LIMITED

DRILL LOG · FORM

0139

PROJECT PATAWARTA

Drill Hole No. 2 Sheet 1 of 4 Grid Co-ords 800N 00E

Azimuth — Dip Vertical

Type of Drill Drillmaster – Rotary Percussion.

Driller — Collar Datum —

Logged by R.E.Read Depth of Hole 320 ft.

Commenced 20.11.71 Completed 22.11.71

Depth Water Struck 55 ft. G. P. H. —

Depth Water Struck — ft. G. P. H. —

Depth Water Struck — ft. G. P. H. —

% Core Recovered — Length of Casing in hole 6 ft.

LOG				ASSAYS		
From (ft)	To (ft)	Sample No.	Lithology	Zn ppm AAS		
0	5	3735	Soil with weathered siltstone.	170		
5	10	36	Yellow weathered siltstone and clay.	250		
10	15	37	Green-grey laminated silstone	230		
15	20	38	Siltstone as above.	470		
20	25	39	Grey to black siltstone. Some limonite spotting, probably due to pyrite.	570		
25	30	3740	Grey stilstone.	370		
30	35	41	Grey siltstone with fine-grained mica.	350		
35	40	42	Siltstone as above.	250		
40	45	43	Siltstone as above.	190		
45	50	44	Grey siltstone with mica and rare pyrite.	170		
50	55	45	Grey siltstone, 0.2% pyrite as thin seams parallel to the bedding.	170		
55	60	46	Dark grey siltstone, 0.2% pyrite, chielfy as very fine grains.	260		
60	65	47	70% Black siltstone with 1% pyrite in thin seams. 30% Grey siltstone, 0.1% pyrite. 1% mica.	430		
65	70	48	Grey & Black siltstone, 0.1% pyrite.	280		
70	75	49	As above.	180		
75	80	3750	Grey pyritic siltstone. Fragments with up to 10% Pyrite. Total pyrite 0.2%.	220		

NORTH FLINDERS MINES LIMITED DRILL LOG FORM CONTINUATION SHEET

Drill Hole No. 2 0140 Sheet 2 of 4

Project Patawarta

LOG				ASSAYS		
From (ft)	To (ft)	Sample No.	Lithology	Zn ppm AAS		
80	85	3751	Grey siltstone, 0.2% pyrite.	180		
85	90	52	Grey and black siltstone, Pyrite both scattered through the rock as fine grains	170		
			& as thin seams 0.05 mm thick. 0.5% pyrite.			
90	95	53	Grey & Black siltstone with 0.5% very fine pyrite.	160		
95	100	54	As above.	120		
100	105	55	Grey & Black siltstone & silty shale with 0.5% pyrite as very thin seams parallel	110		
			to the bedding.			
105	110	56	Grey & Black silstone with pyrite, As before.	160		
110	115	57	Siltstone as above.	200		
115	120	58	Siltstone as above.	230		
120	125	59	Siltstone with fine scattered pyrite.	280		
125	130	3760	Grey siltstone with short thin seams of fine-grained pyrite (0.2%)	140		
130	135	61	SIltstone as above.	160		
135	140	62	Grey & Black siltstone with 0.1% fine pyrite.	200		
140	145	63	Grey & Black siltstone with very fine pyrite (0.1%)	240		
145	150	64	Grey & Black siltstone with 0.2% pyrite as thin seams.	100		
150	155	65	Grey & Black siltstone with 0.2% pyrite as scattered grains and in thin seams. Pyrite	100		
			cubes up to 0.1 mm. but mostly much finer.			
155	160	66	Siltstone as above.	150		
160	165	67	Siltstone as before with bands carrying up to 2% pyrite. 0.5% pyrite.	110		
165	170	68	Grey & Black siltstone with 0.5% pyrite, both scattered through the rock & as thin	130		
			seams up to 0.2 mm thick.			
170	175	69	Grey siltstone with 0.1% scattered pyrite.	130		
175	180	3770	As above	140		

NORTH FLINDERS MINES LIMITED DRILL LOG FORM CONTINUATION SHEET

Drill Hole No. 2 Sheet 3 of 4

Project Patawarta 0141

LOG				ASSAYS		
From (ft)	To (ft)	Sample No.	Lithology	Zn ppm AAS		
180	185	3771	Grey siltstone with 0.2% pyrite, scattered through the rock and as thin seams.	160		
185	190	72	Grey & Black siltstone, 0.5% pyrite.	330		
190	195	73	Black siltstone, 0.5% fine-grained pyrite.	130		
195	200	74	Black siltstone with 1% fine-grained pyrite	120		
200	205	75	Black siltstone with 0.5% fine-grained pyrite.	65		
205	210	76	As above.	120		
210	215	77	As above	170		
215	220	78	Black siltstone, with 1% pyrite chiefly in thin irregular seams, generally parallel to the bedding.	110		
220	225	79	As above, calcite veinlets.	1100		
225	230	3780	Black siltstone, 0.5% pyrite.	360		
230	235	81	Grey and black siltstone with 0.5% pyrite.	170		
235	240	82	Black siltstone, 0.5% pyrite.	200		
240	245	83	Black siltstone, 1% pyrite.	1100		
245	250	84	Grey siltstone, 1% pyrite as very fine grains.	940		
250	255	85	Grey siltstone, 0.5% pyrite.	370		
255	260	86	Black siltstone with 1% fine-grained pyrite, occurring as thin seams and lenses up to 0.2 mm thick.	1000		
260	265	87	Black siltstone with 0.5% pyrite in thin seams.	320		
265	270	88	Black siltstone, 0.1% pyrite.	390		
270	275	89	Grey & black siltstone, 0.1% pyrite.	200		
275	280	3790	As above.	230		
280	285	91	Grey & Black siltstone, as above, Fragments of solid pyrite seam 2 mm thick, 1% pyrite.	140		
285	290	92	Grey & Black siltstone. 0.5% pyrite, chiefly fine grained with grains up to 0.2 mm across.	120		
290	295	93	Black siltstone. 0.3% pyrite.	120		

NORTH FLINDERS MINES LIMITED — DRILL LOG FORM — CONTINUATION SHEET

Drill Hole No. 2 — 0142 — Sheet 4 of 4

Project Patawarta

LOG				ASSAYS		
From (ft)	To (ft)	Sample No.	Lithology	Zn ppm AAS		
295	300	3794	Grey siltstone, 0.2% pyrite.	140		
300	305	95	Grey siltstone, 0.1% pyrite.	90		
305	310	96	Grey siltstone, 2% sand-size quartz, grains. Rare pyrite.	110		
310	315	97	As above	100		
315	320	98	Grey siltstone	130		

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QUARTERLY REPORT S.M.L. 557

PERIOD ENDED DECEMBER, 1971

R.B. WILSON

Chief Geologist

NORTH FLINDERS MINES LIMITED

C O N T E N T S :

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APPENDICES

ACCOMPANYING PLANS

Plan No. 557-19 Bullock Head Gap Geochemical Soil Survey, Copper Results, Scale 1 in. to 100 ft.

Plan No. 557-20 Bullock Head Gap Geochemical Soil Survey, Lead Results, Scale 1 in. to 100 ft.

Plan No. 557-21 Bullock Head Gap Geochemical Soil Survey, Zinc Results, Scale 1 in to 100 ft.

Plan No. 557-16 Henry's Range Copper Prospect, Geochemical Soil Survey Copper Results. Scale 1 in to 100 ft.

I INTRODUCTION

S.M.L. 557, covering an area of approximately 1000 square miles in the Central Flinders Ranges of South Australia, was granted for a period of 2 years. The area comprises former Special Mining Leases 290, 292, and 293.

II PERSONNEL

Exploration programmes have continued with the same, or similar personnel, work-crews and consultants (principally McPhar Geophysics Pty. Ltd), as for the previous periods

Owing to sickness of geologist T. Tulp, at the time of the impending rotary-percussion drilling programme at Mt. McTaggart (S.M.L. 575), it was necessary for geologist R.E. Read to supervise the above drilling programme for a period of several weeks (including equipment-breakdowns etc.,). This has caused an interuption of some weeks to the proposed work-programmes on Special Mining Lease 557.

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III SUMMARY OF OPERATIONS

A. REGIONAL EXPLORATION

No further regional geological or geochemical surveys have been conducted within S.M.L. 557 since the completion of the reconnaissance stream-sediment sampling programmes.

B. FOLLOW-UP SURVEYS

Geologist R. Read commenced follow-up work as per recommendations of P.R. Donovan in the eastern portion of S.M.L. 557, after completion of supervision of the Mt. McTaggart Drilling Programme, and prior to the Christmas leave-period. No results of this work are yet available.

A crew consisting of Student-Geologist, S. Carthew and an assistant spent some three weeks in the eastern portion of S.M.L. 557 on both detailed follow-up stream-sediment sampling, some preliminary soil-gridding and some follow-up of stream-anomalies.

The detailed stream-maps were obtained by photo-enlargement of a direct tracing of streams from the normal 1:50,000 scale aerial photographs(S.A. Dept. of Lands). Final scale of the enlarged stream-maps is approximately 1" to 1000 feet.

Four principal areas, namely Mt. Roebuck area, Orange Tree area, Rivers Bluff Area, and Moro Springs area were re-sampled during this programme. Some follow-up work to locate mineralized outcrops was carried out concurrently with the detailed stream-sediment sampling and some preliminary soil traverses were run across mineralized areas. Further work in at least some of these areas seems warranted. A full report (together with maps) is included as Appendix I to this report.

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C. ASSESSMENT OF PROSPECTS

More detailed investigation of several Prospects and/or anomalous areas has been carried-on during the period, although, due to R. Read's temporary transfer to S.M.L. 575 (Mt. McTaggart) and also to Christmas leave-breaks, this work has not advanced as quickly as programmed.

Detailed investigations were continued on the following prospects:-

1. Patawarta Zinc Prospect

As stated in the previous quarterly report, follow-up work as a result of anomalous stream sediment values in zinc, resulted in the discovery of a narrow but persistent zinc-rich gossan, which after geological mapping and some limited costeaning, appeared to be of stratiform character.

Subsequent to the completion of the rotary-percussion drilling programme at Mt. McTaggart the drilling rig was diverted to the Patawarta Prospect en-route to Adelaide.

Two shallow rotary-percussion holes were drilled as a preliminary test of the prospect to ascertain whether detailed geological and geochemical surveys were warranted, prior to a more comprehensive drilling programme. These were designed to intersect the down-dip projections of the gossanous horizon at approximate depths of 150 feet and 300 feet respectively. In both holes, only pyritic-siltstones with minor zinc values were encountered. No further work is warranted on the Prospect. A'Report on Rotary-Percussion Drilling at Patawarta Zinc Prospect, S.M.L. 557' by R.E. Read is appended herewith. (Appendix I).

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2. Bullock Head Gap Prospect

Follow-up soil geochemical surveys of the Bullock Head Gap anomalous zone, as detected from stream-sediment sampling, were completed during the period.

Generally anomalous values in copper, lead and zinc are apparent within the gridded area and extending southeastward beyond the grid. A vague correlation of anomalies in the three elements is apparent in both the northeastern and southeastern quadrants of the gridded area, giving perhaps two indefinite trends.

The area has not yet been geologically mapped but from general observation, the underlying rocks are grey-brown siltstone-shale of the Brachina Formation, stratigraphically below the A.B.C. Quartzite and located to the immediate north of the major Narina Fault. Some pyritic pock-marking in the slates is apparent throughout the area, although no definite gossanous horizons, such as that investigated in the Patawarta area, have been noticed.

A more comprehensive appraisal of the geochemical results will be possible on completion of geological mapping of the Prospect-area, to determine whether further work is warranted.

3. Henry's Range Prospect

A further prospect, brought to the notice of R. Read by local prospectors, was investigated in some detail. A representative chip sample across a 25 feet width, taken by W.G. Shackleton, assayed 2.5% copper.

Six preliminary soil sampling traverses by R. Read have outlined some anomalous zones. (See enclosed Plan).

Geological mapping will be required before an appraisal can be made on this prospect.

0150

IV FUTURE PROGRAMMES

1. Completion of follow-up investigations mainly in eastern portion of S.M.L. 557.
2. Geological mapping and further sampling of Moro Gorge low-grade lead anomaly.
3. Geological mapping and more detailed rock-chip sampling and/or trenching over more highly anomalous zones on Bullock Head Gap Prospect. Appraisal of results prior to further programmes.
4. Further auger-sampling and possible costeaning or pitting on Occurrence 'D', Blinman Diapir.
5. Geological mapping and possible trenching of anomalous zone on Henry's Range Copper Prospect.
6. Geologic appraisal of low-order lead-zinc anomalies outlined by McPhar Geophysics in Wilkawillina Gorge Area.

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FOLLOW UP SAMPLING OF ANOMALOUS ZONES

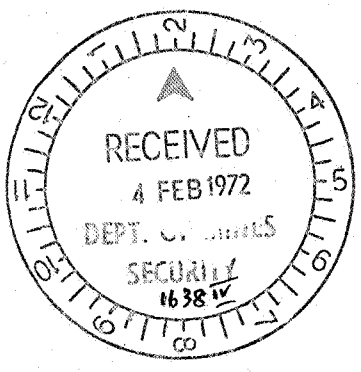
IN S.M.L. 557.

S.J. CARTHEW

Student Geologist

North Flinders Mines Limited

December, 1971



C O N T E N T S

ACCOMPANYING MAPS

Drawing No. 557-24	Mt. Roebuck, Sample Location Scale 1 in. = 1000 ft. approx.
Drawing No. 557-25	Mt. Roebuck, Copper Results. Scale 1 in. = 1000 ft. approx.
Drawing No. 557-26	Mt. Roebuck, Zinc & Phosphate Results Scale 1 in. = 1000 ft. approx.
Drawing No. 557-27	Mt. Roebuck, Lead Results Scale 1 in. = 1000 ft. approx.
Drawing No. 557-28	Mt. Roebuck, Soil Traverse. Scale 1 in. = 1000 ft. approx.
Drawing No. 557-22	Orange Tree Dam Area, Sample Location. Scale 1 in. = 1000 ft. approx.
Drawing No. 557-23	Orange Tree Dam Area, Copper Results Scale 1 in. = 1000 ft. approx.
Drawing No. 557-18	Orange Tree Dam Area, Geochemical Soil Survey, Copper P.P.M. Scale 1 in. = 1000 ft. approx.
Drawing No. 557-17	Orange Tree Dam Area, Geological Map. Scale 1 in. = 1000 ft. approx.
Drawing No. 557-29	Rivers Bluff Area, Sample Location. Scale 1 in. = 1000 ft. approx.
Drawing No. 557-30	Rivers Bluff Area, Zinc Results. Scale 1 in. = 1000 ft. approx.
Drawing No. 557-31	Rivers Bluff Area, Lead Results. Scale 1 in, = 1000 ft. approx.

.....cont'd.

Accompanying Maps cont'd.....

Drawing No. 557-32	Moro Springs Area, Sample Location Scale 1 in. = 60 chains.
Drawing No. 557-33	Moro Springs Area, Zinc Results Scale 1 in. = 60 chains.
Drawing No. 557-34	Moro Springs Area, Lead Results Scale 1 in. = 60 chains.

I INTRODUCTION

During December, 1971, anomalous zones of copper, lead or zinc mineralization, as defined in the reconnaissance survey by McPhar and North Flinders Mines Limited were resampled in greater detail. The four major zones of interest are:-

1) Mount Roebuck area (copper)
2) Orange Tree Dam Area (copper)
3) Rivers Bluff Area (zinc)
4) Moro Springs Area (zinc and lead)

The anomalous zones lie in the north-eastern portion of S.M.L. 557 as defined by the co-ordinates 139° longitude and 139° 15' and 30° 53' latitude to 30° 36'. This area lies about forty five miles north-east of Blinman.

The aim of this project was to carry out detailed stream sediment sampling of anomalous zones and to locate mineralized outcrops.

II PREVIOUS WORK

A sampling density of 12.3 samples per square mile has been conducted partially by McPhar crews and partially by North Flinders Mines Limited crews during the period December 1969 to August, 1971. Results of these surveys are reported on by P. Donovan (McPhar Geophysics Ltd, October, 1971), and also P. Donovan (McPhar Geophysics Ltd, February, 1970).

...../2

During the sampling, V. Jones (North Flinders Mines Limited) located copper occurrences labelled O, M, N, Q and R on the stream sediment reconnaissance survey (copper results p.p.m.) map. The other occurrences, A, B, C, D, E, F, G, H, I, J, K, L and P were located during the geological mapping of the area by the Mines Department. (Horwitz 1961 - Arrowie Sheet) or by companies who held portions of the lease previous to North Flinders Mines Limited.

Mr. M. Garman reported in March 1970 and August, 1970 on the follow up of lead and zinc anomalies in the Moro Springs Area.

III GEOCHEM STREAM SEDIMENT RESULTS

1. Mt. Roebuck Area

One hundred and seventy-five samples of creek sediments were taken in an area of about 12 square miles. The average density of sampling is $14\frac{1}{2}$ samples per square mile. At the Mount Roebuck mineral occurrence, four soil line traverses were taken to test for copper mineralization in a bold outcropping quartz reef and the associated splinter faults. Five soil samples were taken fifty feet apart, on each traverse line which run north-south and are spaced two hundred feet apart.

At the Top Well Mine, similar soil traverses were taken across a faulted zone.

i) Copper

An extensive zone of copper mineralization has been indicated by assay results from stream sediments. This zone lies generally east of Mount Roebuck along an east-west shear zone which forms the contact between the Marinoan slates and the Sturtian glacials. Assay results indicate that copper mineralization follows this structural-contact zone for approximately one and a half miles. Copper mineral-

ization has been found (see section IV) in the quartz reefs.

Sample M.R. 176 (50 p.p.m. Cu and 210 p.p.m. Pb) was taken in a creek that drains from a brecciated zone to the west of Mt. Roebuck.

ii) Lead

Six samples are possibly anomalous for lead. They are at sample location numbered M.R.5, M.R. 24, M.R. 26, M.R. 159 and M.R. 176. The first four samples were taken in Cambrian Bunkers Sandstone, or the equivalent series to the Oraparinna Shales. Sample M.R. 159 drains from the fault and quartz reefs that contain copper mineralization east of Mt. Roebuck. Sample M.R. 176 (210 p.p.m. Pb) is also anomalous for copper and has been described in the above section.

iii) Zinc

No anomalous zinc results were obtained.

iv) Phosphate

Eight stream samples were assayed for Phosphate but all indicated less than 1% phosphate.

2. Orange Tree Area

Fifty four samples were taken from creek sediments in an area of about seven square miles; an average of eight samples per square mile. Sampling was undertaken for extensions of copper mineralization along a shear zone at the Orange Tree mineral occurrence. A pace and compass grid at this mineral occurrence was undertaken in an attempt to define the anomalous zone. A plot of the copper results from the soil samples taken, is at the back of this report (see also section IV for 'Location of Mineralized Outcrops'.

...../4

i) Copper

The following sample locations were anomalous for copper mineralization, O.T. / 32, 33, 36, 39, 25, 31. These results supplement the initial sampling survey and also define the zone of interest at the Orange Tree Prospect.

ii) Lead

No anomalous streams.

iii) Zinc

No anomalous streams.

3. Rivers Bluff

In the Rivers Bluff area ninety-four samples were taken in an area of about three square miles, giving a density of thirty samples per square mile. Close sampling was undertaken to locate the source of lead and zinc anomalies outlined on the McPhar Geophysics - North Flinders Mines reconnaissance survey.

i) Copper

Samples R.B. 19 to R.B. 54 were assayed for copper, the anomalous samples being R.B. 20 (45 ppm Cu), R.B. 22 (55 ppm Cu), R.B. 25 (40 ppm Cu), R.B. 27 (55 ppm Cu), R.B. 28 (45 ppm) and R.B. 32 (40 ppm).

ii) Lead

The lead anomalies indicated by the earlier reconnaissance survey, were not confirmed on this survey.

iii) Zinc

Twenty six samples were assayed as anomalous (about 100 p.p.m. Zinc). The table below classifies each anomaly in one of three groupings:-

..../5

0159

Possible Anomalous >100 <200 ppm Zn.	Probably Anomalous >200 <300 ppm Zn.	Anomalous >300 ppm Zn.
R.B. 15 - 100 p.p.m.	R.B. 20 - 220 p.p.m.	
R.B. 18 - 100 p.p.m.	R.B. 21 - 280 p.p.m.	
R.B. 23 - 120 p.p.m.	R.B. 22 - 250 p.p.m.	
R.B. 24 - 110 p.p.m.	R.B. 27 - 260 p.p.m.	
R.B. 25 - 140 p.p.m.	R.B. 29 - 240 p.p.m.	
R.B. 28 - 160 p.p.m.		
R.B. 32 - 160 p.p.m.		
R.B. 38 - 110 p.p.m.		
R.B. 42 - 100 p.p.m.		
R.B. 45 - 110 p.p.m.		
R.B. 58 - 170 p.p.m.		
R.B. 62 - 100 p.p.m.		
R.B. 72 - 140 p.p.m.		
R.B. 78 - 110 p.p.m.		
R.B. 83 - 170 p.p.m.		
R.B. 84 - 170 p.p.m.		
R.B. 85 - 150 p.p.m.		
R.B. 88 - 120 p.p.m.		
R.B. 92 - 130 p.p.m.		
R.B. 177 - 180 p.p.m.		

4. Moro Springs

A total of fifty-three samples were taken in an area of five square miles, thus giving an average density of $10\frac{1}{2}$ samples per square mile. On some streams (e.g. those north of Moro Springs) supplementary samples to that of the reconnaissance survey were taken.

i) Copper

No samples assayed for copper.

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ii) Lead

Twenty seven samples were found to be anomalous for lead. The anomalous assay results have been tabulated in the following table:

Possibly Anomalous >80 <150 ppm Pb.	Probably Anomalous >150 <240 ppm Pb	Anomalous >240 ppm Pb.
M.S. 3 - 80	M.S. 7 - 160	M.S. 16 - 270
M.S. 8 - 120	M.S. 10 - 150	M.S. 17 - 240
M.S. 9 - 130		M.S. 19 - 270
M.S. 12 - 80		
M.S. 14 - 90		
M.S. 15 - 90		
M.S. 18 - 100		
M.S. 24 - 80		
M.S. 26 - 100		
M.S. 34 - 110		
M.S. 35 - 110		

iii) Zinc

Forty-three samples were assayed as being anomalous (above 100 p.p.m. Zn). Classification of these anomalies would be as follows:-

Possibly Anomalous >100 <200 ppm Zn	Probably Anomalous >200 <300 ppm Zn	Anomalous >300 ppm Zn
M.S. 1 - 120	M.S. 12 - 250	M.S. 24 - 330
M.S. 2 - 110	M.S. 27 - 210	M.S. 30 - 300
M.S. 3 - 190	M.S. 36 - 220	M.S. 31 - 330
M.S. 6 - 160		
M.S. 7 - 140		
M.S. 8 - 100		
M.S. 9 - 130		
M.S. 10 - 140		
M.S. 11 - 120		

Possibly Anomalous
>100 <200 ppm Pb.

M.S. 13 - 150
M.S. 14 - 160
M.S. 15 - 170
M.S. 16 - 120
M.S. 17 - 120
M.S. 20 - 180
M.S. 21 - 120
M.S. 22 - 160
M.S. 23 - 150
M.S. 25 - 160
M.S. 26 - 180
M.S. 28 - 180
M.S. 29 - 170
M.S. 32 - 130
M.S. 34 - 120
M.S. 35 - 130
M.S. 38 - 130
M.S. 39 - 140
M.S. 44 - 110
M.S. 45 - 170
M.S. 47 - 110
M.S. 48 - 100
M.S. 50 - 100
M.S. 51 - 120
M.S. 52 - 100
M.S. 53 - 130

IV LOCATION OF MINERALIZED OUTCROPS

1) Mt. Roebuck Area.

Copper

a) Mt. Roebuck mineral occurrence.

Copper mineralization was located in a quartz reef along a fault zone about two and one quarter miles east of Mt. Roebuck. Malachite crystals and stains occur with iron and manganese in the quartz reef.

The copper mineralization which is contained in a prominent quartz reef, crops out two thirds of the way up the ridge. The reef itself is over one hundred feet wide and has a strike length of about three thousand feet. Copper staining also occurs in the overlying yellow calcareous siltstones.

Rock chips samples from a quartz-haematite zone (ten feet by thirty feet) assayed 1.4% copper. Four soil traverses, spaced two hundred feet apart were sampled every fifty feet across the quartz reef. Line 1 is furthest west and line 4 is the most easterly traverse. Sampling was from north to south and the following results were obtained:-

Line 1.	Sample 1 - 900 p.p.m. Cu.
	Sample 2 - 610 p.p.m. Cu.
	Sample 3 - 410 p.p.m. Cu.
	Sample 4 - 1,200 p.p.m. Cu.
	Sample 5 - 530 p.p.m. Cu.
Line 2.	Sample 1 - 770 p.p.m. Cu.
	Sample 2 - 1,400 p.p.m. Cu.
	Sample 3 - 2,200 p.p.m. Cu.
	Sample 4 - 820 p.p.m. Cu.
	Sample 5 - 200 p.p.m. Cu.
Line 3.	Sample 1 - 440 p.p.m. Cu.
	Sample 2 - 560 p.p.m. Cu.
	Sample 3 - 600 p.p.m. Cu.
	Sample 4 - 240 p.p.m. Cu.
	Sample 5 - 300 p.p.m. Cu.

...../10

Line 4 Sample 1 - 450 p.p.m. Cu.
Sample 2 - 530 p.p.m. Cu.
Sample 3 - 560 p.p.m. Cu.
Sample 4 - 430 p.p.m. Cu.
Sample 5 - 450 p.p.m. Cu.

The anomalous creeks for copper with sample locations 1672, 1673, 1783, 1785 and 1682 have been accounted for. The other copper anomalies in this zone were not accounted for on this sampling survey.

Occurrence M

Leached malachite stains in yellow-green Marinoan shales and slates were found exposed at the surface. In an old pit, malachite is found in a dolomitic (?) ferruginous vein. On the eastern face of the pit, the vein is six inches wide, but on the west face it is up to twenty four inches wide. The vein rapidly narrows with depth, while on the surface, the vein cannot be followed. From this vein some diffusion of copper mineralization has occurred into the surrounding pebbly yellow-brown shales.

This vein is in a brecciated shear zone which is up to four feet in width.

Copper Anomaly 95 p.p.m.
Sample Location 1824

Some of the copper mineralization from the dumps of occurrence M drains into this creek, but only partially accounts for this anomaly. The other source of copper mineralization is from brown iron enriched slate bands with malachite along the joints; or from malachite and pyrite in a narrow quartz reef.

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Occurrence R.

A small pit has been dug on a six inch wide quartz-gossan vein with malachite stains. The vein is exposed only in the pit and occurs in grey green shales and dolomites near to the head of a small stream.

Occurrence N and O.

Weak copper staining in grey-green shales occurs at localities N and O. At these occurrences the mineralization has negligable width and strike length.

Copper Anomaly 40 p.p.m.
Sample location 1769.

Weak copper stains in manganiferous slates and also in small shear zones account for this anomaly. The mineralization had negligable width and length.

Occurrence K.

Sparse chalcopyrite with some malachite staining crops out in cream coloured dolomite. The copper mineralization has a strike length of about ten feet but its width is only four inches.

Top Well Mine

Copper mineralization is to be found associated with ferruginous and manganiferous breccia or gossan? along a prominent shear zone. Malachite occurs in a fine stockwork or in joints and openings within the gossan or breccia. Along the shear zone, the copper mineralization occurs sporadically. Weak copper mineralization has diffused into the surrounding micaceous and dolomitic siltstones. Soil sampling across the mineralized fault zone, gave disappointing results. These results may help to explain why the stream draining the occurrence is not anomalous for copper.

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2) Orange Tree Area

Orange Tree Mineral Occurrence. (Occurrence Q)

Malachite can be found in joints, vughs and as a fine stock-work in brecciated, silicified and calcified yellow brown shales. The copper mineralization appears to trend along two fault zones which underlie the lateritized peneplained surface. The copper mineralization is found about forty feet below the old surface. A soil grid survey and a geological map of this prospect are appended to the back of this report.

From the soil sample results, the highest value obtained was 1600 p.p.m. The geochemical anomalous zone greater than 500 p.p.m. is not around the old mine workings but follows the yellow brown slate and dark, grey-brown, soft weathering dolomite contact zone which follows minor shear zones. A single grab sample from the mine dumps assayed 4.2% copper.

3) & 4) Rivers Bluff and Moro Springs

i. Copper

Whilst sampling in these areas no copper mineralization was located.

ii. Zinc

Follow up sampling suggests that the source of the zinc mineralization is to be found in one or a combination of the following ways:-

1) Zinc rich limestones
2) Ironstone and/or manganese blows.
3) Zinc and lead being trapped in joint fillings in the host rock.
4) A concentration of zinc on the peneplained surface.

The creek with the anomalous samples 2028, (150 p.p.m. Zn), 2031 (100 p.p.m. Zn), 2032 (120 p.p.m. Zn), 2033 (120 p.p.m. Zn),

2034 (130 p.p.m. Zn), 2035 (100 p.p.m. Zn), on the reconnaisaince survey on resampling had only three possible anomalies R.B. 38 (100 p.p.m.) R.B. 42 (100 p.p.m.), and R.B. 45 (110 p.p.m.). In this creek system, four rock chip samples were assayed for zinc:-

1) Sample 9807 was taken on the dissected Tertiary peneplain and assayed 0.12% Zn, 0.15% Mn and 0.022% Cu.

The sample description is ferruginous-manganese? capping with haematite and limonite.

2) Sample 9808 is a gossanous ? type ferruginous-manganiferous rock and assayed 0.25% Zn and 0.43% manganese.

3) Sample 9808 is a haematite and limonitic rock with numerous vughs. It assayed 80 p.p.m. Zn.

4) Sample 9810 which is from a ferruginous-manganiferous capping assayed 120 p.p.m. Zn.

The anomalous creek with sample locations at 2040 (220 p.p.m. Zn), 2045 (360 p.p.m. Zn), 2046 (400 p.p.m. Zn) was confirmed anomalous. The source of the anomalies is thought to be the dissected Tertiary surface along which there are 'local' highs of heavy mineral concentration. This is indicated by different stream results and noted in the field at the time of sampling. Sample 9813 was taken from the iron and manganiferous capping to the west of stream sediment sample 20. This sample assayed 0.89% Zn and 27.2% Mn.

The sample at location 2044 was not confirmed anomalous.

This stream was draining the Parara ? or Wilkawillina Limestone. Anomalies at sample locations 913, 902, 917, 923, were confirmed anomalous and may have their sources in isolated remnants of the Tertiary erosion surface.

...../14

Sample R.B. 77 (180 p.p.m. Zn) was taken from a stream which drained the contact between the Cambrian and Tertiary sediments. The surrounding samples which are not anomalous were taken from streams draining the Tertiary.

Samples 850 (100 p.p.m.) and 857 (100 p.p.m.) were confirmed anomalous, the sources being zinc rich pockets on the erosional surface. However, sample 860 (100 p.p.m. Zn) was not confirmed anomalous. Seven anomalous samples R.B. 83, R.B. 84, M.S. 11, M.S. 12, M.S. 13, M.S. 14, and M.S. 15, drain from the erosional surface.

To the north of this group of anomalies sampling is from the Wilkawillina Limestone. All the anomalies except sample 831 (100 p.p.m.) on the reconnaissance survey were confirmed anomalous.

iii. Lead

In the Rivers Bluff area, follow up sampling did not confirm anomalous lead results. In the Moro Springs area, the anomalous lead values supplement those obtained in the previous survey.

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V CONCLUSIONS

In the stream sediment follow up programme, a number of anomalies for copper, lead and zinc have been confirmed. The soil results from Mt. Roebuck and Orange Tree occurrences indicate the source and trends of mineralization in each area. The preliminary soil grid sampling did not define the length of the anomalous zone and further sampling may be warranted.

In the Rivers Bluff and Moro Springs areas, the source of the lead and zinc anomalies may be explained in one or more of the following ways:-

1) Zinc rich beds in the limestone.

2) Iron stone and/or manganese blows along faults and joints.

3) Zinc and lead being trapped in joint fillings of the host rock.

4) A concentration of zinc in ferruginous and manganiferous cappings of the Tertiary erosional surface.

5) A concentration of zinc and lead (?) mineralization in the synclinal structure north-east of Rivers Bluff.

S.J. Carthew

S.J. CARTHEW

NORTH FLINDERS MINES LTD.
MT. ROEBUCK AREA

S.M.L. 557.
SCALE 1 INCH = APPROX 1000 FEET.

SAMPLE LOCATION MAP.

N

L1 L2 L3 L4

ENV 1638(~~VI~~)-8

DWG - 557 - 84

NORTH FLINDERS MINES LTD.

MT. ROEBUCK AREA

S.M.L. 557.

SCALE 1 INCH EQUALS APPROX 1000 FEET

COPPER RESULTS - P.P.M.

1.4% Cu

X Cu

X Cu

X Cu

X Cu

NORTH FLINDERS MINES LTD.

MT. ROEBUCK AREA

S.M.L. 557.

SCALE - 1 INCH EQUALS APPROX. 1000 FEET

ZINC & PHOSPHATE RESULTS

Zn - P.P.M

P. - %

NORTH FLINDERS MINES LTD.

MT. ROEBUCK AREA

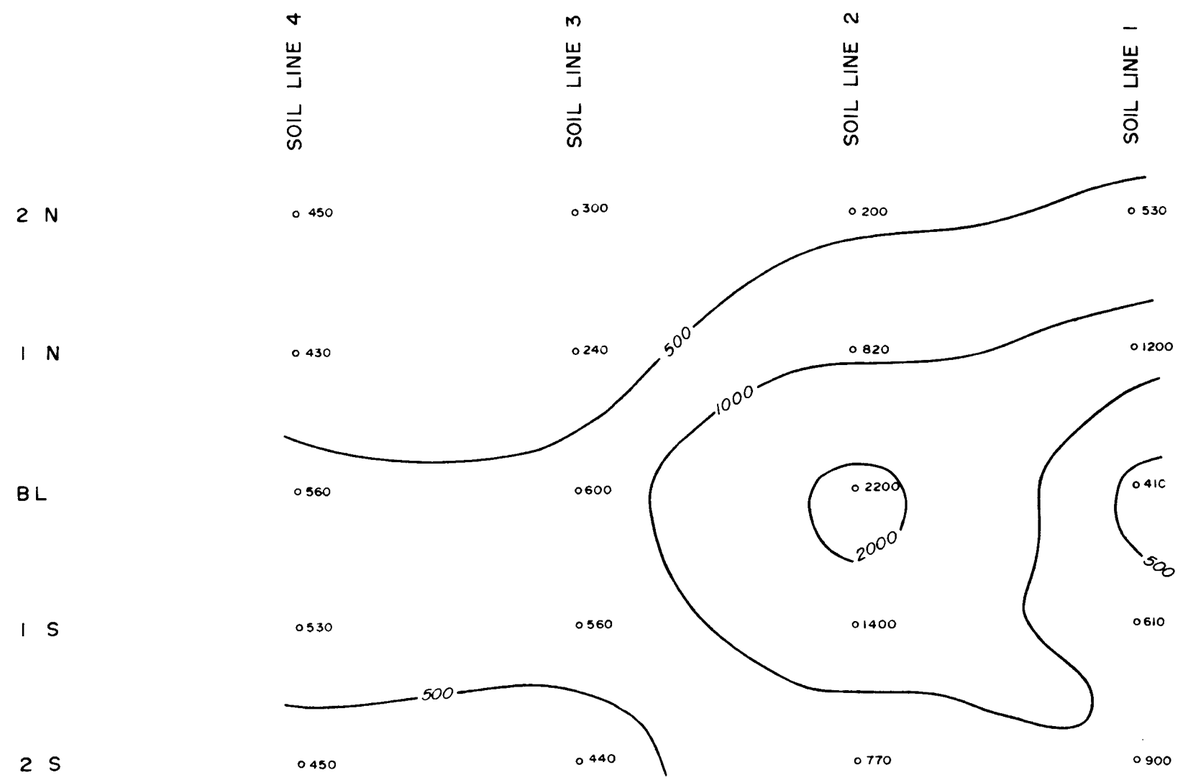
S.M.L. 557.

SCALE 1 INCH EQUALS APPROX 1000 FEET

LEAD RESULTS - P.P.M.

N

70 60 60 60 80 75 60 35 35 35 80 70 60 66 110 65 75 45 30 35 55 38 36 35 30 35 35 40 40 30 40 70 100 40 35 40 35 80 35 30 30 30 40 30 40 25 30 210



SURVEY

Survey by pace & compass

SAMPLING

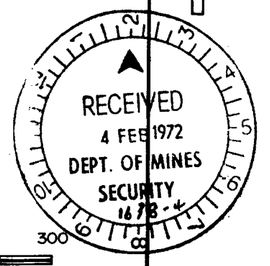
Samples taken at 6"depth by S.J Carthew & G D.Korner

ANALYSIS

Sample sieved to -80. Cu by AAS
following conc $HClO_4$ leach for 1 hour
on 0·25g sample by Mc Phar Geophysics Pty Ltd

100 50 0 100 200 300

SCALE IN FEET



North Flinders Mines N. L.

MAP OF

MT ROEBUCK PROSPECT

SML 557

SOUTH AUSTRALIA

SHOWING RESULTS OF

GEOCHEMICAL SOIL SURVEY

COPPER - P.P.M.

DRN:- M.C.C.	DATE:- JAN 1972	SCALE:- 1 INCH REPS 100 FEET

ENV 1638 IV - 5

DWG. 557-28

ORANGE TREE DAM

NORTH FLINDERS MINES LTD.

ORANGE TREE PROSPECT

SML 557 S.AUST.

SAMPLE LOCATION MAP

SCALE 1 INCH = APPROX 1000 FEET

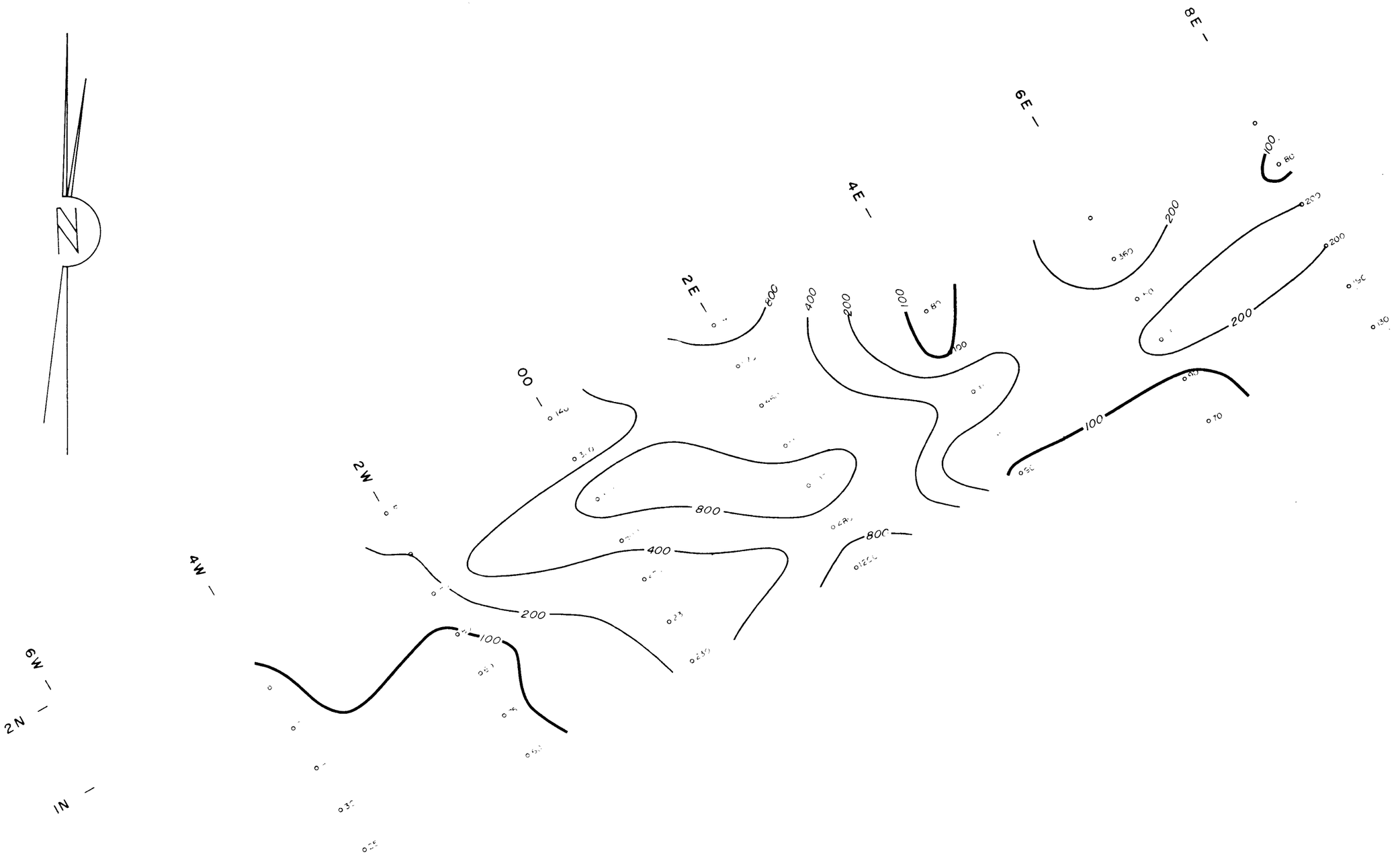
NORTH FLINDERS MINES LTD.

ORANGE TREE PROSPECT

SPL. 557 S.W.S.L.

COPPER RESULTS - P.P.M.

SCALE 1 INCH = APPROX 1000 FEET



SURVEY

Survey by pace & compass

SAMPLING

Samples taken at 9"depth by S J Carthew

ANALYSIS

Sample sieved to -80 Cu by AAS following hot 25% HNO_3 leach in latter stages for 1 hour on 0·25 g sample by Mc Phar Geophysics Pty Ltd

100 50 0 100 200 300

SCALE IN FEET

North Flinders Mines N. L.

MAP OF

ORANGE TREE PROSPECT

SML 557

SOUTH AUSTRALIA

SHOWING RESULTS OF

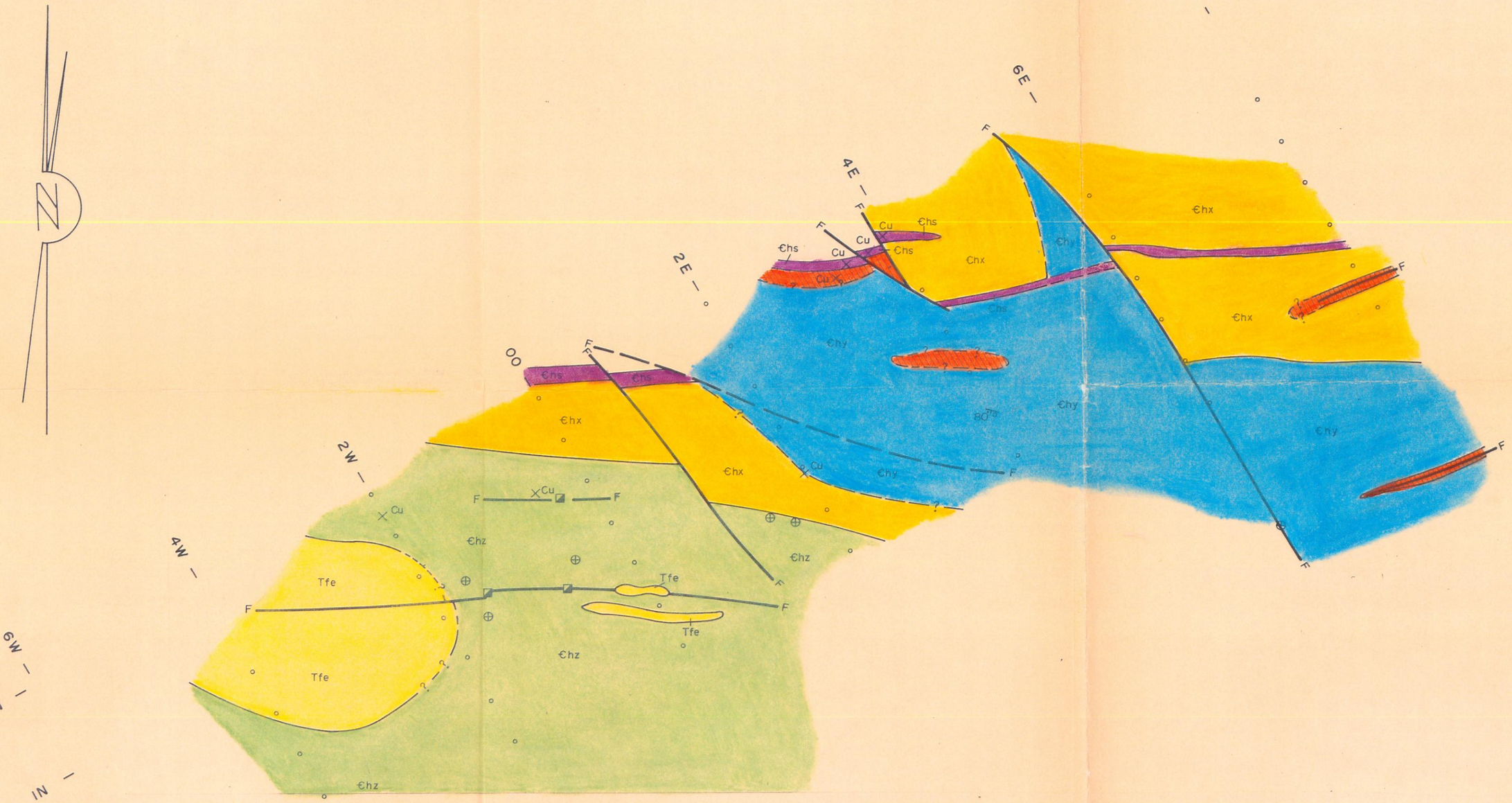
GEOCHEMICAL SOIL SURVEY

COPPER - P.P.M.

DRN:- M.C.C	DATE:- JAN 1972	SCALE:- 1 INCH REPS 100 FEET

DWG. 557-18

ENV 1638(IV)-11



Shaft

Pit

Copper occurrence ×Cu

Fault —F

Inferred fault – –F

Dip and strike ∠80°

Chs — Brown-yellow siliceous dolomitic limestone

Tfe — Hard iron siliceous dolomite - duricrust ?

Chx — Yellow-brown slate

Fe-Mn or laterite(?) along fault zone

Chy — Iron stained slate and sandstone with white kaolinized clay interbedded with yellow pebbly slates.(Perhaps laterized slates)

Chz — Dark grey brown, soft weathering dolomite.

100 50 0 100 200 300

SCALE IN FEET

North Flinders Mines N.L.

MAP OF

ORANGE TREE PROSPECT

SML 557

SOUTH AUSTRALIA

SHOWING

GEOLOGY

MAPPING BY S J CARTHEW DEC. 1971

DRN:- M.C.C.	DATE:- JAN 1972	SCALE:- 1 INCH REPS. 100 FEET

 DWG. 557-17

NORTH FLINDERS MINES LTD.

RIVERS BLUFF – MORO SPRINGS AREA

S.M.L. 557 S. AUST.

SAMPLE LOCATION MAP

SCALE 1 INCH EQUALS APPROX 1000 FEET.

N

ENV 1638(VI)–5

DWG 557-29

NORTH FLINDERS MINES LTD.

RIVERS BLUFF – MORO SPRINGS AREA

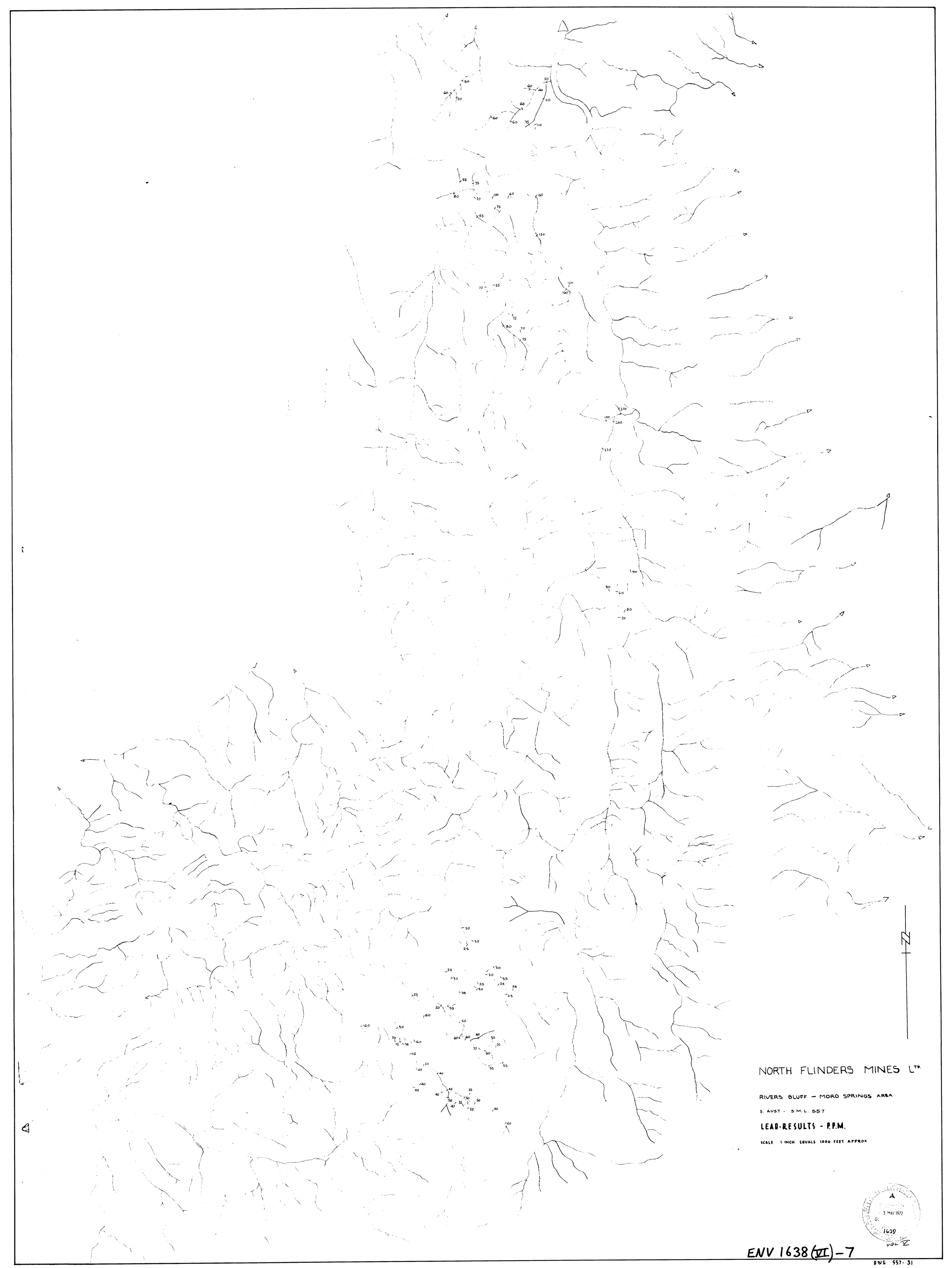
S.M.L. 557 S. AUST.

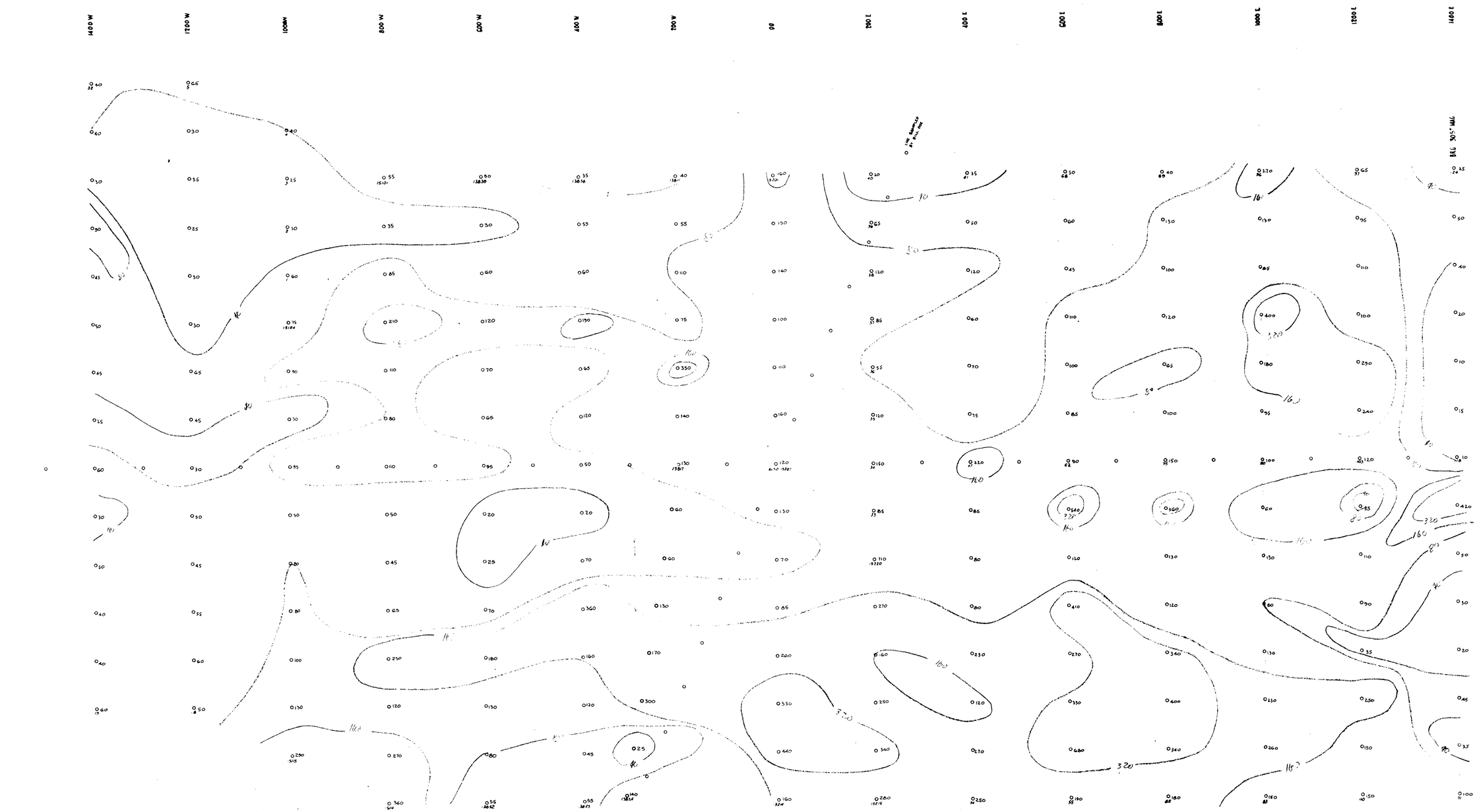
ZINC RESULTS - P.P.M.

SCALE :- 1 INCH EQUALS APPROX 1000 FEET.

ENV 1638(VI)-6

DWG 557-30


NORTH FLINDERS MINES LTD.
RIVERS BLUFF – MORO SPRINGS AREA
S. AUST - S.M.L. 557
LEAD-RESULTS - P.P.M.
SCALE 1 INCH EQUALS 1000 FEET APPROX
N
3 MAY 1972
1638
VOL V
ENV 1638(VI)-7
DWG 557-31



CROP PEG
SAMPLE N°
FOR N°S 1 - 124 READ BHG/1 ETC

BULLOCK HEAD GAP - S.M.L. 557

GEOCHEMICAL SOIL SURVEY

SHOWING Co RESULTS - PPM

SAMPLES TAKEN JUST ABOVE BEDROCK
ANALYSIS BY McPHAR $HClO_4$ LEACH
ON -80 FRACTION

SAMPLED BY R.E. KNAP
OCT - NOV 1971

SCALE 1 INCH = 100 FEET.

PRELIMINARY ONLY

ENV 1638(IV) - 8

DWG 557-19

1400 W | 1200 W | 1000 W | 800 W | 600 W | 400 W | 200 W | 0 | 200 E | 400 E | 600 E | 800 E | 1000 E | 1200 E | 1400 E

800 N | 700 N | 600 N | 500 N | 400 N | 300 N | 200 N | 100 N | B.L. | 100 S | 200 S | 300 S | 400 S | 500 S | 600 S | 700 S

BRG 305° MAG

GRID PEG
SAMPLE N°
FOR N°s 1 - 124 READ 1ING/1 ETC

BULLOCK HEAD GAP - S.M.L. 557

GEOCHEMICAL SOIL SURVEY

SHOWING Pb RESULTS - PPM

SAMPLES TAKEN JUST ABOVE BEDROCK
ANALYSIS BY McPHAR $HClO_4$ LEACH
ON -80 FRACTION

SAMPLED BY R.E. READ
OCT - NOV 1971

SCALE 1 INCH = 100 FEET

DWG 557-20

GRID PEG o
SAMPLE N° 15537
FOR N°s 1 - 124 READ BHG/1 ETC

BULLOCK HEAD GAP · S.M.L. 557

GEOCHEMICAL SOIL SURVEY

SHOWING Zn RESULTS - PPM

SAMPLES TAKEN JUST ABOVE BEDROCK
ANALYSIS BY McPHAR $HClO_4$ LEACH
ON -80 FRACTION

SAMPLED BY R.E. HEAP
OCT - NOV 1971

SCALE 1 INCH = 100 FEET

PRELIMINARY
ONLY

ENV 1638(IV) - 6

DWG 557-21

HR/1 ◎ 10, 30, 15
∘ 10, 25, 15
∘ 15, 30, 15
∘ 20, 30, 20
◎ 25, 35, 20
∘ 30, 30, 15
∘ 110, 40, 30
∘ 75, 50, 25
HR/9 ◎ 40, 40, 25

HR/10 ◎ 10, 20, 10
∘ 10, 20, 10
∘ 25, 25, 10
∘ 25, 30, 15
◎120, 30, 20
∘ 120, 35, 20
∘ 130, 40, 20
∘ 65, 35, 15
HR/18 ◎ 35, 30, 10

HR/19 ◎ 10, 30, 10
∘ 10, 25, 10
∘ 5, 20, 5
∘ 30, 30, 20
◎190, 45, 20
∘ 130, 50, 20
∘ 50, 55, 20
∘ 20, 50, 10
◎ 20, 50, 10
HR/27

100 PPM Cu

LINE 1

LINE 2

LINE 3

LINE 4

LINE 5

LINE 6

HR/28 ◎ 20, 30, 10
∘ 40, 35, 20
∘ 10, 55, 15
∘ 10, 60, 15
∘ 10, 60, 10
◎ 20, 60, 10
∘ 15, 60, 15
∘ 15, 60, 15
∘ 25, 60, 15
HR/36 ◎ 20, 50, 15

HR/37 ◎ 150, 45, 20
∘ 95, 45, 20
∘ 20, 55, 10
∘ 70, 60, 15
◎160, 55, 15
∘ 80, 40, 20
∘ 20, 50, 10
∘ 45, 50, 20
HR/45 ◎ 45, 50, 15

100 PPM Cu

HR/46 ◎ 30, 50, 25
∘ 20, 60, 30
∘ 30, 50, 30
∘ 30, 45, 30
◎ 20, 50, 30
∘ 30, 50, 30
∘ 20, 55, 25
∘ 20, 45, 30
◎ 20, 45, 35
∘ 15, 45, 35
∘ 15, 40, 35
∘ 15, 40, 35
HR/58 ◎15, 40, 35

100 50 0 100 200 300
SCALE IN FEET

REFERENCE

Grid peg	◎
Sample location	∘
Sample number	HR/9
Analysis result PPM - Cu, Pb, Zn	50, 30, 25

SURVEY

Sample lines surveyed by tape & compass. Distances between lines paced only

SAMPLING

Samples taken at 9" depth every 25' by P L Player & R E Read.

ANALYSIS

Sample sieved to -80. Cu, Pb, Zn by AAS following hot 25% HNO_3 leach in latter stages for 1 hour on 0·25 g sample by Mc Phar Geophysics Pty Ltd

North Flinders Mines N. L.

MAP OF

HENRY'S RANGE COPPER PROSPECT

SML 557

SOUTH AUSTRALIA

SHOWING RESULTS OF

GEOCHEMICAL SOIL SURVEY

DRN:- M.C.C.	DATE:- JAN 1972	SCALE:- 1 INCH REP. 100 FEET

 DWG 557-16

amdel
The Australian Mineral Development Laboratories
Flemington Street, Frewville, South Australia 5063
Phone 79 1662, telex AA82520

0169

RE...
17 JAN 1972
Ans'd.....

Please address all correspondence to the Director
In reply quote: AN3/479/0 - 3022/72

5 January 1972

The Exploration Administrator
North Flinders Mines Limited
25 Greenhill Road
WAYVILLE SA 5034

REPORT AN3022/72

YOUR REFERENCE:	Order 3764
MATERIAL:	Crushed rock
IDENTIFICATION:	As listed
DATE RECEIVED:	14/12/71

Enquiries quoting AN3022/72 to Officer in Charge please.

Spectrographic Analysis by: R.R. Robinson

Officer in Charge, Analytical Section: A.B. Timms

for F.R. Hartley
Director

jw

JOB: ..30221.12 0170 Semi-Quantitative Spectrographic Analysis Schemes A1,A2,A3,A4,A5 & A6 BATCH ... .

Results in ppm unless otherwise stated. Detection limits in brackets

Sample No.	NFM 3726
A1	
Co (5)	10
Ni (5)	100
Cr (20)	60
V (10)	150
W (50)	x
Mo (3)	3
Mn (10)	300
Ta (100)	x
Nb (20)	x
Be (1)	3
Th (100)	x
Pt (10)	x
Pd (10)	x
Os (10)	x
Ir (2)	x
Rh (2)	x
Ru (2)	x
A2	
Cu (0.5)	40
Pb (1)	100
Zn (20)	1000
Sn (1)	1
Cd (3)	x
Bi (1)	x
Ag (0.1)	0.1
Au (3)	x
Ga (1)	10

Sample No.	NFM 3726
A2 Contd.	
Ge (1)	x
As (50)	x
Sb (30)	x
A3	
Te (20)	x
Tl (1)	x
P (100)	x
A4	
Na (50)	10,000
Li (1)	50
A5	
K (5)	5,000
Rb (10)	150
Cs (30)	x
A6	
Ba (50)	800
Sr (10)	x
Y (10)	10
La (100)	x
Ce (300)	x
Nd (300)	x
Pr (100)	x
Ti (100)	x
Er (100)	x
Sc (50)	x
Eu (50)	x
Hg (0.15)	x

Results are semi-quantitative. Elements apparently present in concentrations of economic interest should be redetermin by an appropriate accurate analytical technique. X = Not detected at limit quoted

A1 → A7 (1 x 49) = 49

0171

QUARTERLY REPORT S.M.L. 557

PERIOD ENDED MARCH, 1972.

R.B. WILSON.

CHIEF GEOLOGIST

NORTH FLINDERS MINES LIMITED

0172

C O N T E N T S :

APPENDICES

APPENDIX I – 'Report on Completion of Geochemical Follow-up Surveys, S.M.L. 557'
By R.E. Read.

APPENDIX II – 'Report on – Moro Gorge,
Bullock Head Gap Prospect
Henry's Range Prospect.'
By R.E. Read.

APPENDIX III – 'Report on – Orange Tree Prospect
Wilkawillina Gorge Area
Copper-Bearing Dolomites in
Blinman Diapir.'
By R.E. Read.

I INTRODUCTION

S.M.L. 557, covering an area of approximately 1000 square miles in the central Flinders Ranges of South Australia, and comprising former Special Mining Leases 290, 292, and 293, was granted for a period of 2 years.

II PERSONNEL

Geologist, R. E. Read has continued geological and geochemical programmes on Prospects of interest during February and March, 1972. Public and annual holidays occupied the latter part of December and most of January.

III SUMMARY OF OPERATIONS

A. REGIONAL EXPLORATION

No further regional geological or geochemical surveys have been conducted within S.M.L. 557 during the period.

B. FOLLOW-UP SURVEYS

Geologist R. E. Read has continued and almost completed follow-up investigations as per recommendations of Dr. P.R.Donovan for the eastern portion of S.M.L. 557.

Several anomalies were unconfirmed and many lead-zinc anomalies were confirmed to lie in the low first order range, on resampling. Many of these were found to be related to the Tertiary weathering profile. Some thin beds of Cambrian limestone appear to be anomalous in base-metals (Pb-Zn), as at Moro Gorge,

..../2

although it is probable that the metals are present in solid solution with the carbonate.

Follow-up of many copper anomalies resulted in the discovery of minor showings of copper carbonates which did not warrant further work. Two or three confirmed copper anomalies have yet to be followed-up in detail.

C. ASSESSMENT OF PROSPECTS

1. BULLOCK HEAD GAP PROSPECT

A programme of detailed rock-chip sampling was carried-out on the eastern portion of the gridded-area in an endeavour to pin-point the source of the previously-delineated soil anomalies.

The highest value obtained was 6000 p.p.m. zinc on line 4E from coordinates 050S to 100S. Geological inspection of such anomalous zones showed that the well bedded siltstones to fine-grained silty quartzites (?Ulupa Siltstone), contain thin stratiform limonitic layers up to $\frac{1}{2}$" thick. These are thought to represent weathered pyritic bands, which apparently contain some anomalous base-metals. In the remainder of the area limonitic spotting (formerly pyrite) is characteristic throughout the silty beds but also extends beyond the anomalous zones.

In summary, geological and geochemical surveys have confirmed low anomalous metal values in pyrite-spotted siltstone-shale of the Ulupa Siltstone, covering a strike length of 1200 feet by approximately 1200 feet outcrop-width (average dips 35^{o}-40^{o}). A contact between these beds and diapiric material, to the east, corresponds well with the cut-off in geochemical values. There is no visible distinction between iron-oxide-stained siltstones and slates within or outside the zone of anomalous base-metals.

..../3

2. HENRY'S RANGE COPPER PROSPECT

Copper-carbonate mineralization is associated with quartz-hematite veins or rafts within diapiric breccia along the Narrina Fault, some $1\frac{1}{2}$ miles east of Bullock Head Gap (near Pinda Springs Outstation). Similar quartz-hematite veins in the same vicinity carry no copper mineralization and the prospect appears too small to warrant further attention. A report on this Prospect forms portion of Appendix II.

3. ORANGE-TREE PROSPECT

Old workings, exposing copper carbonate mineralization in narrow breccia zones, were discovered as a result of follow-up of anomalous streams in the vicinity of Orange Tree Dam. The breccia zones may occur along splinter faults forming a 'feathering-out' of the major Narrina Fault.

Other soil-anomalies in the gridded area appear to be related to luterific cappings, which overly deeply weathered Cambrian Limestone (yellow Fe-Mn-rich silty beds).

In such a deeply weathered profile there is the possibility of a deeper zone of secondary sulphide enrichments, although the size of the targets are such that no further work is recommended. R. Read's report on this work forms portion of Appendix III.

..../4

4. MORO GORGE PROSPECT

Further rock-chip sampling in this area has closed-off the anomalous zone to the south.

The anomalous zone corresponds to a thin (15-25ft true thickness) bed of Cambrian Limestone, with no visible differences to the surrounding carbonate sediments. The zone is some 1200 feet in length, the highest rock-chip value being 5000 p.p.m. Pb.

In the absence of visible mineralization (base-metals assumed to be in solid solution with the carbonate), and restricted size of the anomalous zone, (exaggerated width of zone due to wide-spread low-angle dip-slope), the prospect is of no further interest.

A report on this work by R.E. Read forms portion of Appendix II.

5. WILKAWILLINA GORGE PROSPECT

Three soil lines were run across one of the narrow anomalies outlined by R. Fidler, in his follow-up survey of the Wilkawillina Gorge Area. Maximum value on these was 500 p.p.m. zinc. Geological inspection of these zones revealed no signs of gossanous material or visible mineralization, although it is suspected that the anomalous zones may coincide with minor north-east trending faults.

Some further geological inspection of other anomalous zones may be undertaken before the prospect is abandoned.

..../5

6. OCCURRENCE 'D' - BLINMAN DIAPIR

Although no further geochemical work has been carried out on this Prospect, the size of the mineralized zone would preclude further work by the Company.

7. MT. ROEBUCK PROSPECT

Large quartz reefs associated with faulting and diapirism in the Mt. Roebuck area carry minor anomalous amounts of copper, which appears to be of erratic and sparse distribution. Although the dimensions of the reef is large, the weak nature and patchy distribution of copper mineralization does not encourage further exploration.

..../ 6

IV FUTURE PROGRAMMES

1. Completion and rounding-off any further work and Report-writing on above-listed Prospects.

2. Completion of follow-up of several confirmed anomalies in the eastern portion of S.M.L. 557.

3. Geological inspection of other anomalous zones in Wilkawillina Gorge Area.

4. Surface geological map of Orange Tree Prospect to confirm relationship of anomalous zones with lateritic cappings.

5. Approximately 1 week's work, including some soil geochemistry, to investigate possibility of the existence of rafts of 'mine-type' dolomite within the Lady Lehman Diapir.

Quarterly Report

–

March 1972

Appendix 1

IS MISSING

0180

REPORT ON MORO GORGE, BULLOCK HEAD GAP, AND HENRY'S RANGE PROSPECTS.

S.M.L. 557

APRIL, 1972

R. E. READ
Geologist

NORTH FLINDERS MINES LIMITED

C O N T E N T S

ACCOMPANYING PLANS

Moro Gorge, Geological Map	Dwg. No. 557-37
" " Sample Location	Dwg. No. 557-38
" " Lead Results	Dwg. No. 557-39
" " Zinc Results	Dwg. No. 557-40
Bullock Head Gap, Geological Map.	Dwg. No. 557-41
" " " Soil Survey, Copper Results	Dwg. No. 557-44
" " " Soil Survey, Lead Results	Dwg. No. 557-42
" " " Soil Survey, Zinc Results	Dwg. No. 557-43
" " " Chip Sampling, Copper	Dwg. No. 557-45
" " " " " Lead	Dwg. No. 557-46
" " " " " Zinc	Dwg. No. 557-47
Henry's Range Copper Prospect, Geological Map	Dwg. No. 557-36
" " " " Soil Survey	Dwg. No. 557-16

I MORO GORGE LEAD-ZINC PROSPECT

1. Introduction

This prospect was originally located and chip-sampled by M. Garman, Further chip sampling and geological mapping have now been carried out.

2. Chip Sampling

The two additional chip-sample lines have closed off the anomaly to the south.

3. Geology

The prospect lies in Wilkawillina Limestone just below its contact with the Parara Limestone.

No difference could be observed between the lead-rich limestones and those with a normal lead content. No useful units could be distinguished for mapping.

It was observed that most of the high values obtained in earlier chip sampling lie on dip-slopes, and hence true thicknesses would be quite small.

4. Conclusions

The lead is contained in a lead-rich limestone of strike-length 1200 feet and thickness about 50 ft.

No further work is recommended.

.../2

II BULLOCK HEAD GAP COPPER-LEAD-ZINC PROSPECT

1. Introduction

This prospect was located by a stream sediment survey. The anomalous area was tape and compass gridded for soil-sampling, rock-chip sampling and mapping.

2. Geochemistry

a. Soils

Initially soil-samples were taken over the grid at 100 foot spacings on lines 200 feet apart. These showed that most of the high metal values were in the eastern half of the grid. At the far eastern end of the grid, in the diapir, values are low.

b. Rock-Chip

Lines 00E to 1000E were chip-sampled over 50 foot intervals. The zinc values are high, but surprisingly uniform over the area sampled. The copper and lead values are lower, but again have a limited range.

All assays were at least a factor of ten below economic grades.

3. Geology

The prospect lies in massive to shaly siltstones and quartzitic siltstones, believed to be part of the Ulupa Siltstone. Immediately south of the grid the Elatina Formation forms a prominent ridge.

At the eastern end of the grid is a shear fault which has been intruded by a small diapir. On the east side of the fault are Wonoka dolomites and dolo-siltstones.

..../3

Throughout the gridded area the siltstones contain varying amounts of limonite filled holes and thin limonitic seams apparently after pyrite. The 6,000 p.p.m. zinc value from 50S to 100S on line 400E was from rock with limonite seams up to $\frac{1}{2}$ inch thick.

No gossan outcrops were found.

The siltstones with low-heavy-metal contents also contain abundant limonite after pyrite and are visually indistingquishable from heavy-metal rich siltstones.

4. Conclusions

i. Heavy metals have been concentrated in pyritic sediments adjacent to a fault and a diapir.

ii. While the copper, lead and zinc contents of the siltstones are enough to explain the steam-sediment anomalies they are well below economic grade.

iii. The prospect is of no further interest.

..../4

III HENRY'S RANGE COPPER PROSPECT

1. Introduction

This prospect was first shown to the writer by Mr. A. Winkle. W.G. Shackleton recommended soil-sampling and mapping on the assumption that the copper-bearing quartz was a fault-filling in a large fault.

2. Geochemistry

Soil-sampling on lines 200 ft. apart indicated weak copper anomalies in the vicinity. Trenching on one line exposed calc-siltstones carrying about 400 p.p.m. copper.

3. Geology

Mapping showed that a diapir, with dolerite, has intruded along the fault. The copper-bearing quartz outcrop is merely a raft in the diapir with a strike-length of fifty feet.

The copper content of the quartz outcrop is uncertain, but probably under 1%.

4. Conclusions

The prospect is too small to be of any importance.

R.E. READ

GEOLOGIST

amdel
The Australian Mineral Development Laboratories
Flemington Street, Frewville, South Australia 5063
Phone 79 1662, telex AA82520

Please address all correspondence to the Director
In reply quote: AN3/284/0 - 4956/72

27 April 1972

0187

Dr J.R. Beevers
McPhar Geophysics Pty Ltd
50 Mary Street
UNLEY SA 5061

REPORT AN4956/72

YOUR REFERENCE:	Order CH3754
MATERIAL:	Pulverised rock
IDENTIFICATION:	BHG 284
DATE RECEIVED:	24/4/72

Enquiries quoting AN4956/72 to Officer in Charge please.

Analysis by: R.R. Robinson

Officer in Charge, Analytical Section: A.B. Timms

A. B. Timms

for F.R. Hartley
Director

jw

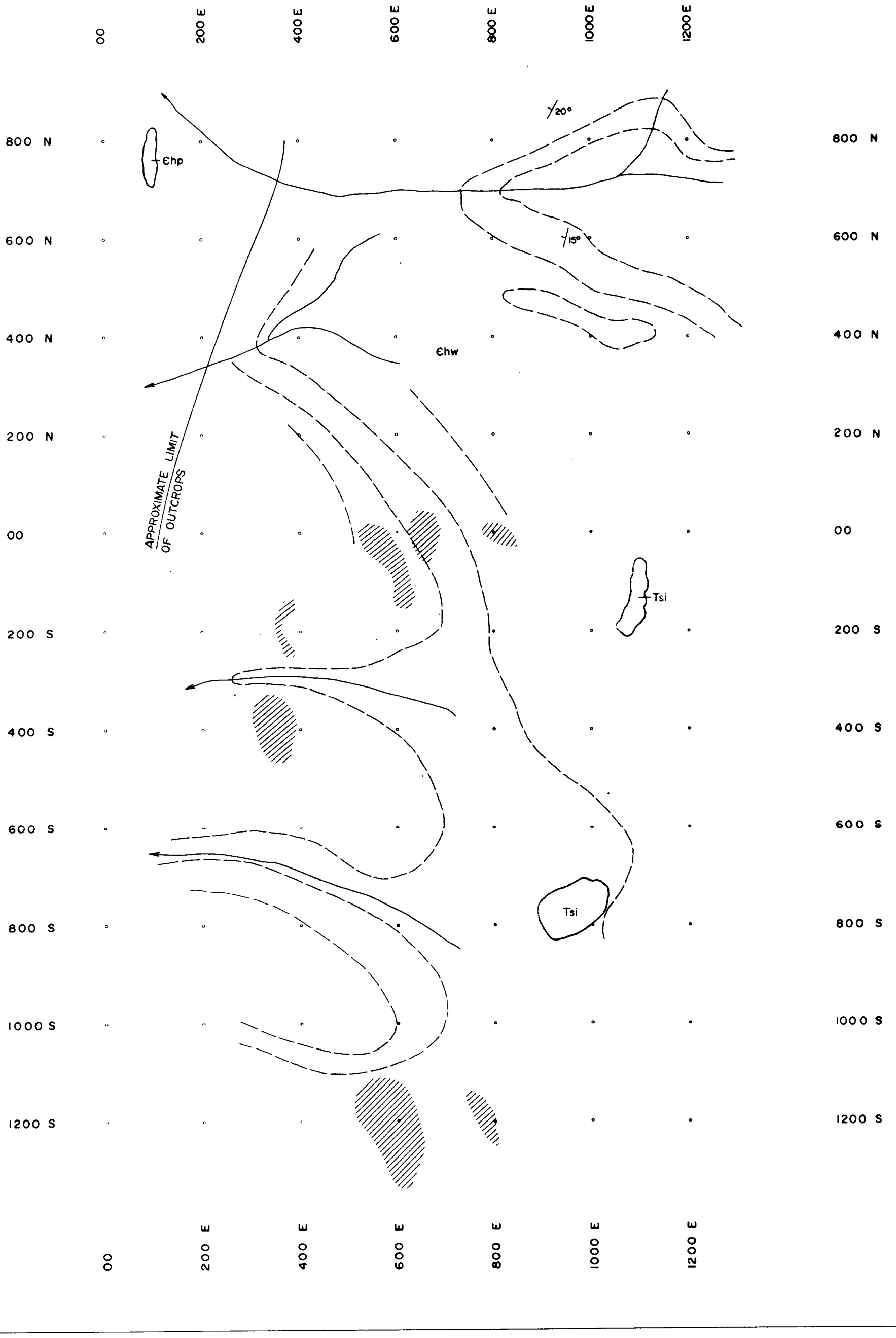
JOB: 17562 72 — Semi-Quantitative Spectrographic Analysis Schemes A1, A2, A3, A4, A5 & A6 — BATCH ....

Form 60 188 — Results in ppm unless otherwise stated. Detection limits in brackets

Sample No	BHG284
A1	
Co (5)	10
Ni (5)	50
Cr (20)	50
V (10)	100
W (50)	X
Mo (3)	X
Mn (10)	200
Ta (100)	X
Nb (20)	X
Be (1)	1
Th (100)	X
Pt (10)	X
Pd (10)	X
Os (10)	X
Ir (2)	X
Rh (2)	X
Ru (2)	X
A2	
Cu (0.5)	300
Pb (1)	1000
Zn (20)	1000
Sn (1)	1
Cd (3)	X
Bi (1)	X
Ag (0.1)	5
Au (3)	X
Ga (1)	10

Sample No	BHG284
A2 Contd.	
Ge (1)	X
As (50)	X
Sb (30)	X
A3	
Te (20)	
Tl (1)	
P (100)	
A4	
Na (50)	
Li (1)	
A5	
K (5)	
Rb (10)	
Cs (30)	
A6	
Ba (50)	
Sr (10)	
Y (10)	
La (100)	
Ce (300)	
Nd (300)	
Pr (100)	
Ti (100)	
Er (100)	
Sc (50)	
Eu (50)	

Results are semi-quantitative. Elements apparently present in concentrations of economic interest should be redetermi by an appropriate accurate analytical technique. X = Not detected at limit quot



Tsi REMNANTS OF SILICEOUS DURICRUST WITH MANGANESE AND IRON OXIDES.

Chp PARA LIMESTONE DARK GREY FLAGGY LIMESTONE.

Chw WILKAWILLINA LIMESTONE. MASSIVE LIMESTONE, BLUE GREY BROWN WHERE WEATHERED. SOMETIMES WITH PATCHES OF COURSELY CRYSTALINE CALCITE.

AREAS OF LIMESTONE WITH REPLACEMENT BY MANGANESE. USUALLY MINOR SILICIFICATION.

TREND OF BEDDING

/15° STRIKE AND DIP OF BEDDING

CREEK

SCALE

100 0 100 200 300 400 500

FEET

NFM North Flinders Mines N. L.

MORO GORGE LEAD-ZINC PROSPECT SML 557

GEOLOGICAL MAP

GEOLOGY BY R.E. REID

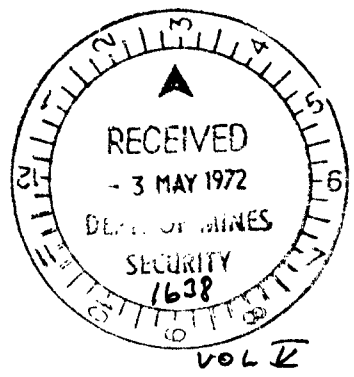
DRN:- H.R.W.	DATE:- APRIL '72	SCALE:- 1" = 200'

DWG 557-37

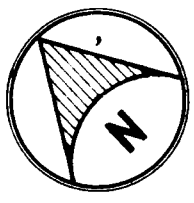
ENV 1638(V)-1

	00	200 E	400 E	600 E	800 E	1000 E	1200 E	
800 N	∘	∘	∘	∘	∘	∘	∘	800 N
600 N	∘	∘	∘	∘	∘	∘	∘	600 N
400 N	∘	∘	∘	∘	∘	∘	∘	400 N
200 N	•	∘	∘	∘	∘	∘	∘	200 N
00	∘	∘	∘	•	∘	∘	∘	00
200 S	∘	∘	∘	∘	∘	∘	∘	200 S
400 S	∘	∘	∘	∘	∘	∘	•	400 S
600 S	∘	∘	∘	•	∘	∘	∘	600 S
800 S	∘	∘	•	∘	•	∘	∘	800 S
1000 S	∘ 3672	∘ 3673	∘ 3674	∘ 3675	• 3676	∘ 3677	∘ 3678	1000 S
1200 S	∘ 3680	∘ 3681	∘ 3682	∘ 3683	∘ 3684	∘ 3685	∘ 3686	1200 S
	00	200 E	400 E	600 E	800 E	1000 E	1200 E	

GRID: 45° MAGN. NORTH.



VOL IV



SCALE

100 0 100 200 300 400 500

FEET

NFM North Flinders Mines N. L.

MORO GORGE
LEAD-ZINC PROSPECT
SML 557
ROCK CHIP SAMPLE LOCATION MAP

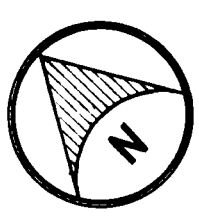
DRN:- H.R.W.	DATE:- APRIL' 72	SCALE:- 1" : 200'

DWG 557 – 38

ENV 1638 (IV) - 2

	00	200 E	400 E	600 E	800 E	1000 E	1200 E	
800 N				280	350	250	200	100	100	160	800 N
600 N			450	120	320	160	200	230	250	140	600 N
400 N	380+	200	2000	550	1800	220	250	260	150	160	130	400 N
200 N	70	280	600	900	5400	600	600	300	200	190	170	140	200 N
00		1000	3200	900	1400	3600	2000	800	380	150	170	190	00
200 S	560	800	1600	2000	430	430	240	270	170	190	1200	460	200 S
400 S	1300	1400	1400	800	800	200	150	110	150	100	190	100	100	400 S
600 S	320	800	2000	4000	700	800	210	120	100	110	100	110	600 S
800 S	290	240	450	4600	500	140	200	130	100	260	100	130	800 S
1000 S	110	120	210	100	190	540	420	70					1000 S
1200 S	90	85	490	130	120	250	120	250					1200 S
	00	200 E	400 E	600 E	800 E	1000 E	1200 E	

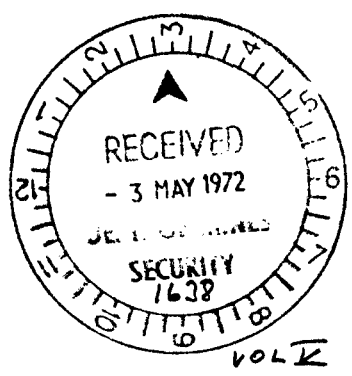
GRID: 45° MAGN. NORTH



SCALE

100 0 100 200 300 400 500

FEET



VOL K

NfM North Flinders Mines N. L.

MORO GORGE
LEAD-ZINC PROSPECT
SML 557
ROCK CHIP SAMPLING
Pb RESULTS - P.P.M.

DRN:- H.R.W.	DATE:-APRIL' 72	SCALE:- 1" : 200'

DWG 557-39

ENV 1638 (IV) - 3

	00	200 E	400 E	600 E	800 E	1000 E	1200 E	
800 N				90	160	290	230	220	120	240		800 N
600 N			240	170	160	160	270	350	200	130		600 N
400 N	140+	150	650	120	300	70	110	190	100	100	100	400 N
200 N	35	130	120	290	340	130	230	180	120	130	160	120	200 N
00		80	170	210	200	800	800	600	290	230	120	800	00
200 S	120	70	320	900	140	220	180	120	120	160	900	600	200 S
400 S	90	140	200	100	80	100	70	60	60	55	150	100	240	400 S
600 S	150	110	90	85	70	50	40	40	45	45	40	55	600 S
800 S	150	120	150	600	120	60	100	60	65	260	80	130	800 S
1000 S	50	40	55	50	50	45	35	50					1000 S
1200 S	60	55	80	40	80	75	75	100					1200 S
	00	200 E	400 E	600 E	800 E	1000 E	1200 E	

GRID: 45° MAGN. NORTH.

N

SCALE

100 0 100 200 300 400 500

FEET

VOL E

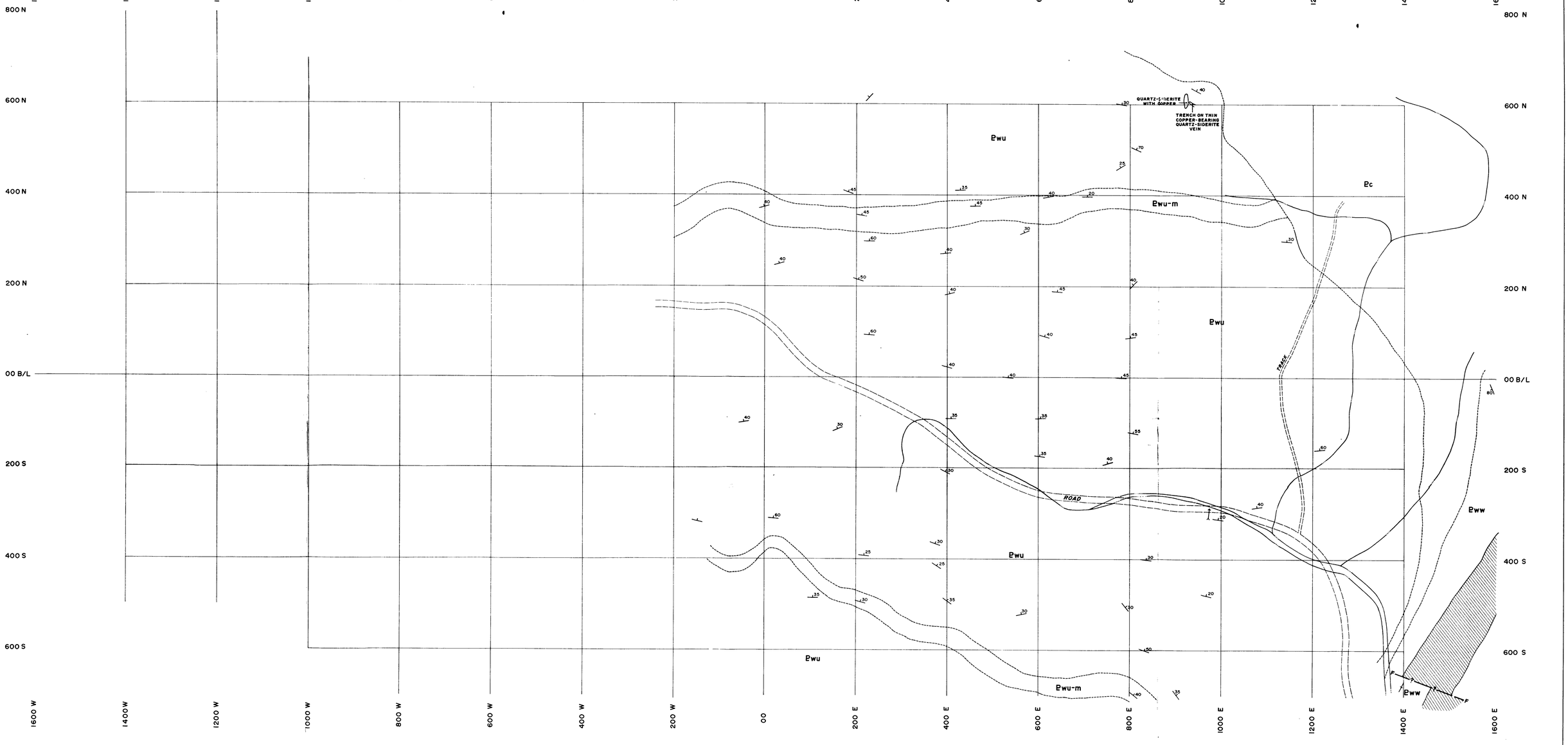
NFM North Flinders Mines N. L.

MORO GORGE
LEAD-ZINC PROSPECT
SML 557
ROCK CHIP SAMPLING
Zn RESULTS - P.P.M.

DRN:- H.R.W.	DATE:- APRIL '72	SCALE:- 1" = 200'

DWG 557-40

ENV 1638(V)-4



SCALE

100 0 100 200 300 400 500

FEET

REFERENCE

Pww	WONOKA FORMATION: BROWN DOLOMITE
Pwu	ULUPA SILTSTONE: MASSIVE TO FLAGGY SHALES AND SILTSTONES WITH ABUNDANT LIMONITE-FILLED CAVITIES AND THIN SEAMS AFTER PYRITE. SOME CROSS-BEDDING
Pwu-m	MORE MASSIVE AND STRONGLY OUTCROPPING BANDS OF THE ABOVE
Pc	BRECCIA WITH CARBONATE MATRIX AND SMALL RAFTS OF SHALE AND SANDSTONE. PRESUMED TO BE DIAPIRIC
	MASSIVE SILICEOUS OUTCROP, PROBABLY A FAULT CAPPING.

40 ..... STRIKE AND DIP OF BEDDING

\+ ..... VERTICAL DIP

→ ..... FACING OF BED

..... CREEK

F—?—F ..... FAULT (INFERRED)

N

NFM North Flinders Mines N. L.

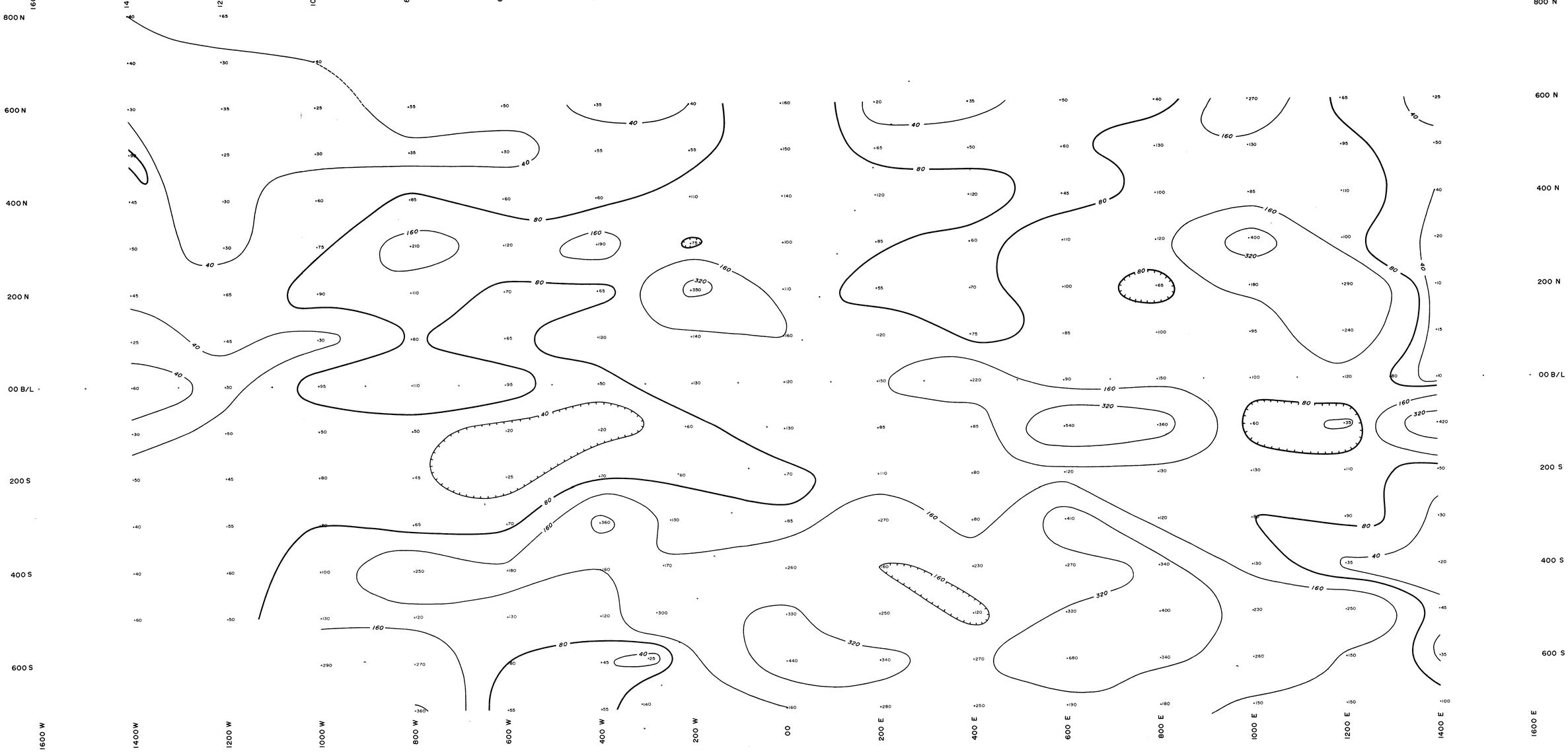
BULLOCK HEAD GAP
PROSPECT
SML 557
GEOLOGICAL MAP

BY R.E. READ

DRN:- R.G.	DATE:- APRIL '72	SCALE:- 1" rep. 100'

DWG 557-41

ENV 1638(W) - 5



SURVEY BY R.E.READ

MAP DRAWN BY R GERMANIS

SAMPLES TAKEN JUST ABOVE BEDROCK
ANALYSIS BY MPHAR GEOPHYSICS PTY. LTD.
Cu BY AAS FOLLOWING CONC. $HClO_4$ LEACH
FOR ONE HOUR ON .25 gm. SAMPLE
:-80 FRACTION

OCT.-NOV. 1971

SCALE

100 0 100 200 300 400 500

FEET

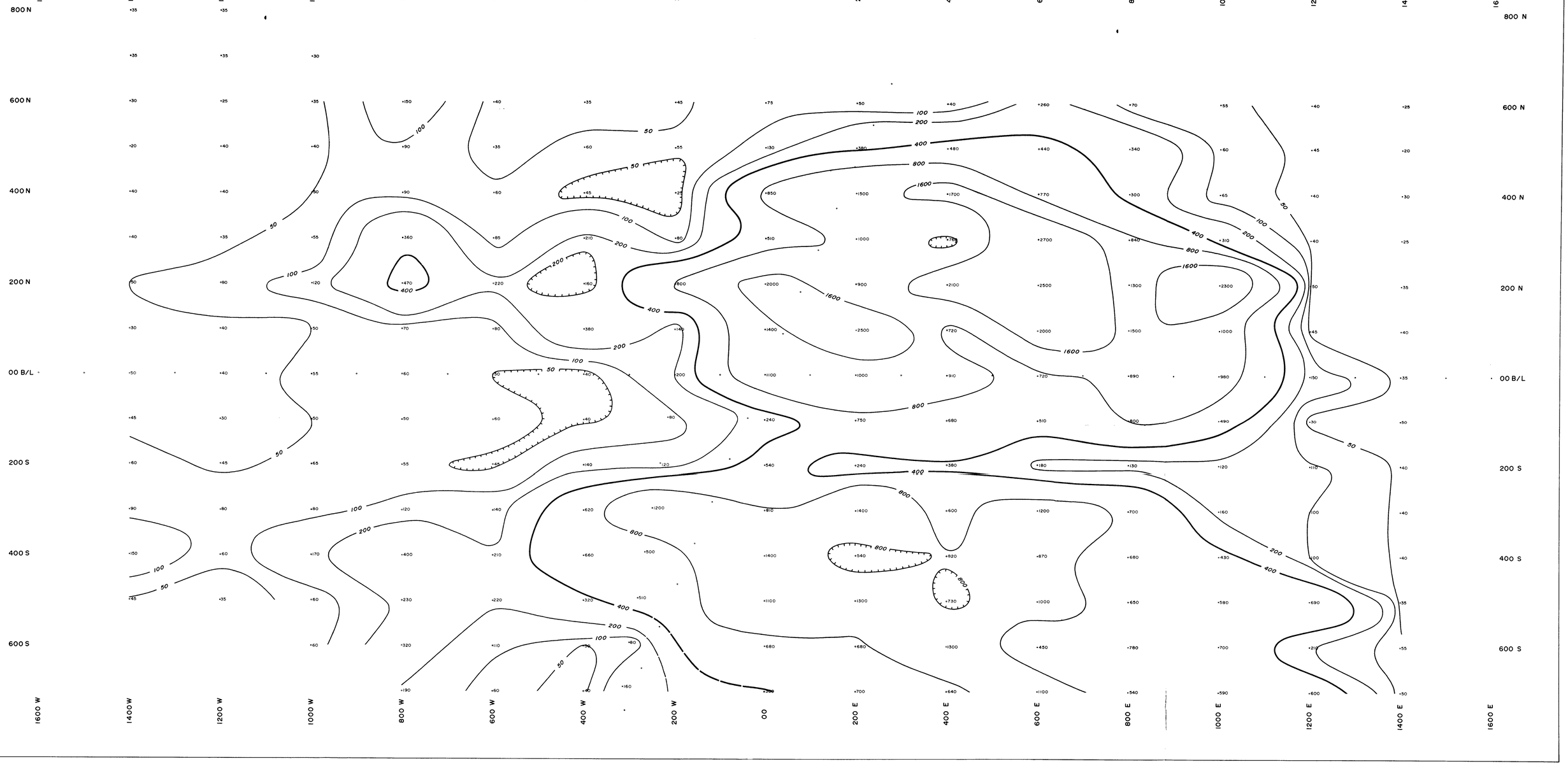
North Flinders Mines N. L.

BULLOCK HEAD GAP
PROSPECT
SML 557
GEOCHEMICAL SOIL SURVEY
SHOWING
Cu RESULTS - P.P.M.

DRN:- R.G.	DATE:- APRIL '72	SCALE:- 1" rep. 100'

DWG 557-44

ENV 1638(V) - 6



SURVEY BY R.E.READ

MAP DRAWN BY R.GERMANIS

SAMPLES TAKEN JUST ABOVE BEDROCK
ANALYSIS BY McPHAR GEOPHYSICS PTY. LTD.
Cu BY AAS FOLLOWING CONC. $HClO_4$ LEACH
FOR ONE HOUR ON .25 gm. SAMPLE
-80 FRACTION

OCT-NOV. 1971

SCALE

100 0 100 200 300 400 500

FEET

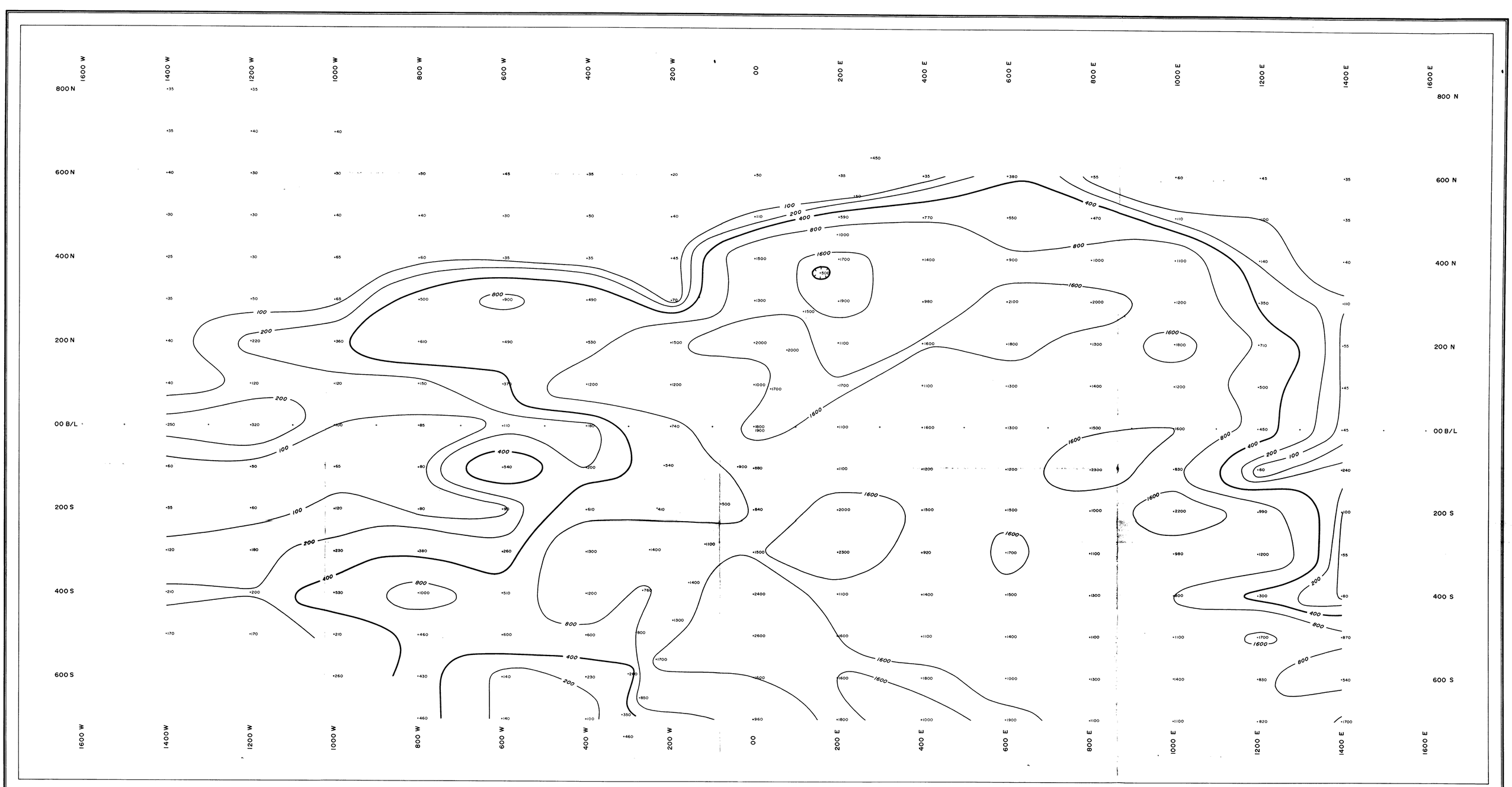
North Flinders Mines N. L.

BULLOCK HEAD GAP
PROSPECT
SML 557.
GEOCHEMICAL SOIL SURVEY
SHOWING
Pb RESULTS - P.P.M.

DRN:- R.G.	DATE:- APRIL '72	SCALE:- 1" rep. 100'

DWG 557-42

ENV 1638(I)-7



SURVEY BY R.E.READ

MAP DRAWN BY R GERMANIS

SAMPLES TAKEN JUST ABOVE BEDROCK
ANALYSIS BY McPHAR GEOPHYSICS PTY. LTD.
Cu BY AAS FOLLOWING CONC. $HClO_4$ LEACH
FOR ONE HOUR ON .25 gm. SAMPLE
1-80 FRACTION

OCT-NOV. 1971

SCALE

100 0 100 200 300 400 500

FEET

North Flinders Mines N. L.

BULLOCK HEAD GAP
PROSPECT
SML 557
GEOCHEMICAL SOIL SURVEY
SHOWING
Zn RESULTS- P.P.M.

DRN:- R.G.	DATE:- APRIL '72	SCALE:- 1" rep. 100'

ENV 1638(IV)-8

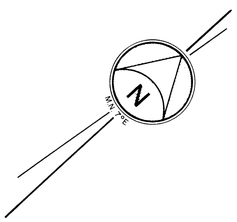
DWG 557-43

	1600 W	1400 W	1200 W	1000 W	800 W	600 W	400 W	200 W	00	200 E	400 E	600 E	800 E	1000 E	1200 E	1400 E	1600 E	
800 N																		800 N
600 N																		600 N
										60	30		70					
										120	85	320	80					
400 N									50	65	60	60	55	220				400 N
									75	30	90	50	55	350				
									70	80	30	65	55	1600				
									50	50	50	60	60	90				
200 N									65	45	75	60	90	120				200 N
										80	85	70	65	140				
									NO OUTCROP	80	80	65	40	85				
00 B/L									110	120	130	55	120	45				00 B/L
									70	90	110	85	110	230				
									75	400	100	240	220	110				
									70	160	95	320	110	95				
									40	75	140	75	95	60				
200 S									40	80	75	20	40	45				200 S
									45	85	70	55	30	35				
									80	75	60	110	90	25				
									85	65	160	240	65	55				
400 S									95	150	220	160	180	330				400 S
									80	80	310	130	260	140				
									55	120	200	230	240	210				
									220	130	110	330	230	180				
600 S									180	120	200	220	80	210				600 S
									80	140	110	110	95					
	1600 W	1400 W	1200 W	1000 W	800 W	600 W	400 W	200 W	00	200 E	400 E	600 E	800 E	1000 E	1200 E	1400 E	1600 E	

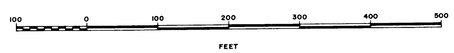
SURVEY BY R.E.READ

MAP DRAWN BY R.GERMANIS

ANALYSIS BY MOPHAR GEOPHYSICS PTY. LTD.
Cu BY AAS FOLLOWING CONC. $HClO_4$ LEACH
FOR ONE HOUR ON .25 gm. SAMPLE



SCALE



NFM North Flinders Mines N. L.

BULLOCK HEAD GAP
PROSPECT
SML 557
ROCK-CHIP SAMPLE SURVEY
SHOWING
Cu RESULTS - P.P.M.

DRN:- R.G.	DATE:- APRIL '72	SCALE:- 1" rep. 100'

DWG 557-45

	1600 W	1400 W	1200 W	1000 W	800 W	600 W	400 W	200 W	00	200 E	400 E	600 E	800 E	1000 E	1200 E	1400 E	1600 E	
800 N																		800 N
600 N																		600 N
400 N									310	120	130		900					400 N
									500	1000	900	320	540	25				
									370	680	1100	840	130	520				
200 N									1100	290	120	970	180	40				200 N
									1300	580	400	1700	1200	880				
										520	180	1900	830	520				
00 B/L									NO OUTCROP	570	310	650	2200	2600				00 B/L
									380	1600	940	600	1700	3200				
									830	2200	830	540	1200	1300				
									130	1300	830	1200	970	1200				
									100	1100	2100	520	370	1000				
200 S									50	1000	1300	1300	1100	570				200 S
									430	780	1100	500	440	250				
									240	95	310	95	350	110				
									920	610	100	45	50	40				
									270	420	760	40	160	35				
400 S									180	760	120	660	680	190				400 S
									360	340	500	1200	580	670				
									510	550	520	610	440	190				
									620	580	830	460	820	590				
600 S									210	860	740	380	620	650				600 S
									250	470	550	560	720	590				
										420	800	520	480					
										670	620	520	590					
	1600 W	1400 W	1200 W	1000 W	800 W	600 W	400 W	200 W	00	200 E	400 E	600 E	800 E	1000 E	1200 E	1400 E	1600 E	

SURVEY BY R.E.READ

MAP DRAWN BY R.GERMANIS

ANALYSIS BY McPHAR GEOPHYSICS PTY. LTD.
Pb BY AAS FOLLOWING CONC. $HClO_4$ LEACH
FOR ONE HOUR ON 25 gm. SAMPLE

SCALE

100 0 100 200 300 400 500

FEET

NFM North Flinders Mines N. L.

BULLOCK HEAD GAP

PROSPECT

SML 557

ROCK-CHIP SAMPLE SURVEY

SHOWING

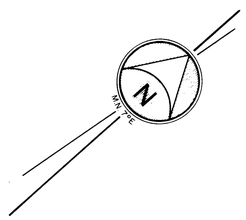
Pb RESULTS - P.P.M.

DRN:- R.G.	DATE:- APRIL '72	SCALE:- 1" rep. 100'

DWG 557-46

ENV 1638(II)-10

	1600 W	1400 W	1200 W	1000 W	800 W	600 W	400 W	200 W	00	200 E	400 E	600 E	800 E	1000 E	1200 E	1400 E	1600 E	
800 N																		800 N
										810	410		500					
600 N										1700	1200	580	1200					600 N
									1300	1400	1100	1000	170	960				
400 N									900	1300	650	1200	380	800				400 N
									720	810	300	1000	1000	1200				
									670	1100	420	1200	680	1200				
200 N									860	1000	480	480	1800	1600				200 N
										1600	520	630	960	800				
									NO OUTCROP	1400	1000	530	970	1200				
00 B/L									1400	1100	680	640	1600	800				00 B/L
									1200	760	1000	1200	1200	1200				
									460	1800	6000	620	1100	890				
									160	920	1700	630	770	1200				
200 S									120	930	1100	820	1100	750				200 S
									530	810	1200	1300	680	560				
									870	1000	1200	1500	490	630				
									1400	1400	980	1000	790	1800				
400 S									1000	2000	1600	1100	1300	1100				400 S
									1100	960	1400	1100	1400	1400				
									1100	1200	960	1000	2900	700				
									830	1200	800	1100	1100	1600				
600 S									880	920	1000	1200	1300	1100				600 S
									1400	1200	1300	720	1200	680				
									700	950	1100	1000	720					
	1600 W	1400 W	1200 W	1000 W	800 W	600 W	400 W	200 W	00	200 E	400 E	600 E	800 E	1000 E	1200 E	1400 E	1600 E	



SURVEY BY R.E.READ

MAP DRAWN BY R.GERMANIS

ANALYSIS BY McPHAR GEOPHYSICS PTY. LTD.
Zn BY AAS FOLLOWING CONC. $HClO_4$ LEACH
FOR ONE HOUR ON .25 gm. SAMPLE

SCALE

100 0 100 200 300 400 500

FEET

North Flinders Mines N. L.

BULLOCK HEAD GAP PROSPECT
SML 557

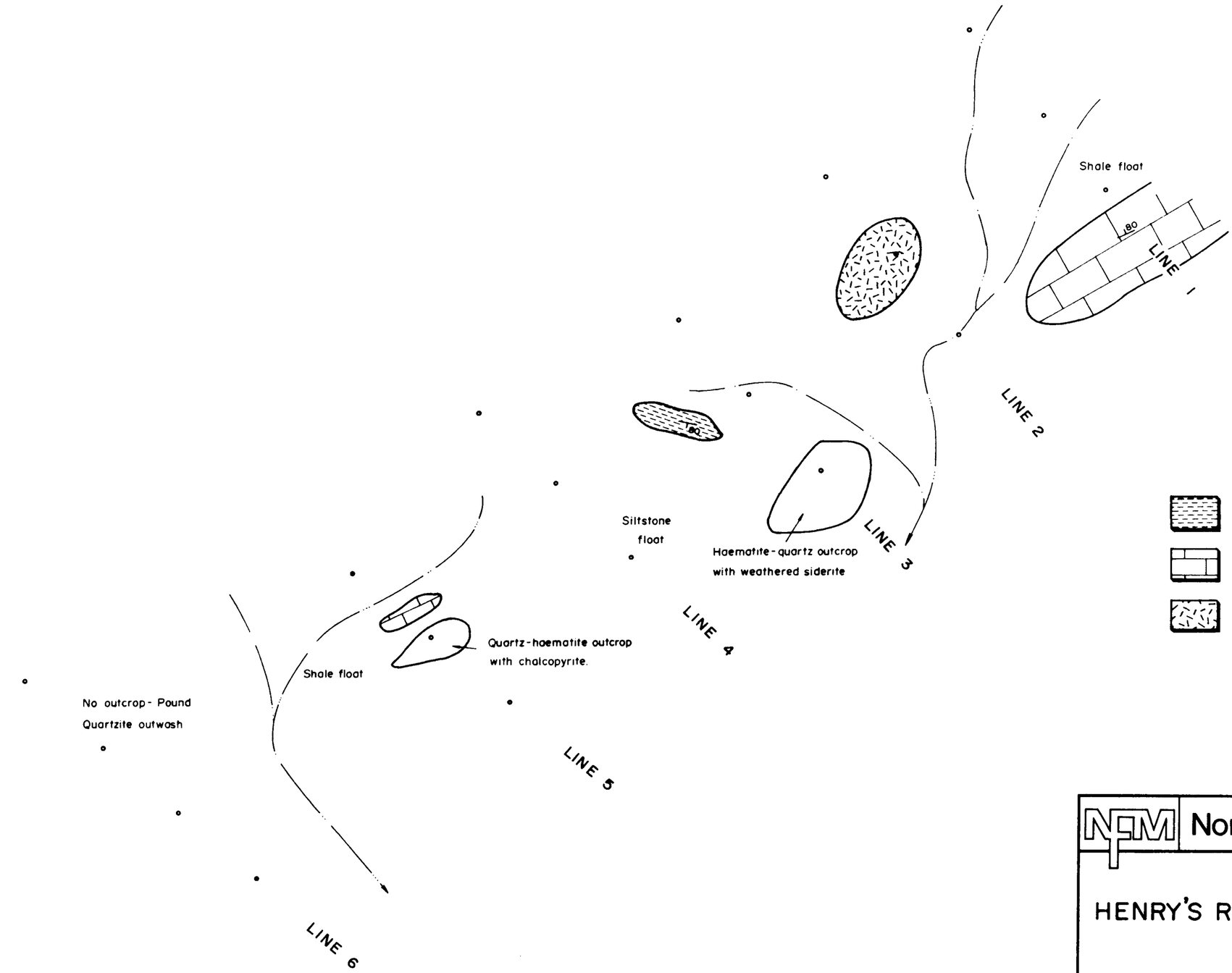
ROCK-CHIP SAMPLE SURVEY
SHOWING

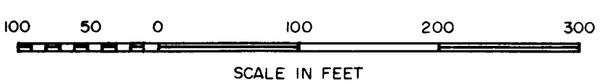
Zn RESULTS - P.P.M.

DRN:- R.G.	DATE:- APRIL '72	SCALE:- 1" rep. 100'

DWG 557-47

ENV 1638 (II) - 11





Shale, poorly outcropping

Dolomite Blue-grey with sandy bands and calcite-filled tension gashes

Dolerite Dark green medium-grained basic igneous rock

NFM North Flinders Mines N. L.

MAP OF

HENRY'S RANGE COPPER PROSPECT

SML 557

SOUTH AUSTRALIA

SHOWING

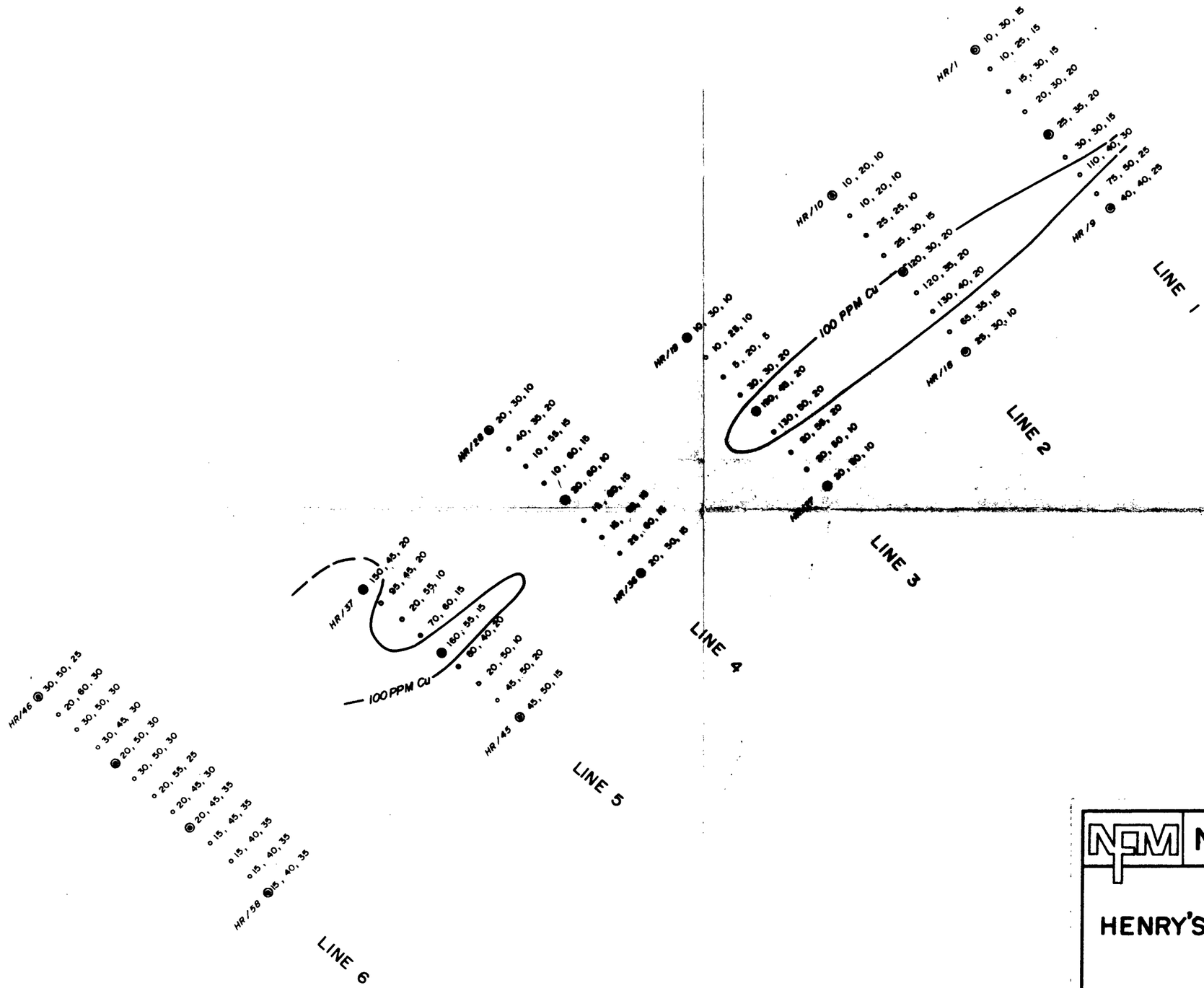
OUTCROP GEOLOGY

R E. READ JAN 1972

DRN:- M.C.C.	DATE:- FEB 1972	SCALE:- 1 INCH REP. 100 FEET

ENV 1638(~~64~~)-12

DWG: 557-36



100 50 0 100 200 300

SCALE IN FEET

REFERENCE

Grid pegs ●

Sample location •

Sample number HR/9

Analysis result PPM. - Cu, Pb, Zn 80, 30, 25

SURVEY

Sample lines surveyed by tape & compass. Distonces between lines paced only

SAMPLING

Samples taken at 9"depth every 25' by P.L. Player & R.E Read.

ANALYSIS

Sample sieved to -80. Cu, Pb, Zn by AAS following hot 25% HNO_3 leach in latter stages for 1 hour on 0·25g sample by Mc Phar Geophysics Pty Ltd

North Flinders Mines N. L.

MAP OF

HENRY'S RANGE COPPER PROSPECT

SML 557

SOUTH AUSTRALIA

SHOWING RESULTS OF

GEOCHEMICAL SOIL SURVEY

DRN:- M.C.C.	DATE:- JAN 1972	SCALE:- 1 INCH REP. 100 FEET

DWG 557-16

Quarterly Report

–

March 1972

Appendix 3

IS MISSING

0189

STREAM SEDIMENT FOLLOW-UP

PART OF BLINMAN-WIRREALPA AREA - S.M.L. 557

(formerly Narina Area, SML 293)

R. E. READ

Geologist

NORTH FLINDERS MINES LIMITED

0190

C O N T E N T S:

ACCOMPANYING MAPS

Blinman-Wirrealpa Area, Sample Location Map	Dwg. No. GC 4179A
" " " Copper Results	Dwg. No. GC 4180A
" " " Lead Results	Dwg. No. GC 4181A
" " " Zinc Results	Dwg. No. GC 4182A
Rivers Bluff-Moro Springs Area, Sample Location Map.	Dwg. No. 557-29
" " " " " Lead Results	Dwg. No. 557-30
" " " " " Zinc Results	Dwg. No. 557-31
Mt. Roebuck Area, Sample Location Map	Dwg. No. 557-24
" " " Copper Results	Dwg. No. 557-25

I INTRODUCTION

The reconnaissance survey of this area was reported on by Dr. P.R. Donovan on 8th October, 1971. Most of P.R. Donovan's recommendations have been carried out.

II COPPER

1. Individual Anomalies

Anomalies 2232, 493, 1136, 1769, 1057 and 83 were not substantiated.

Anomaly 1824 was confirmed and followed up by S.J. Carthew.

Anomaly 2164 seems to result from basic igneous rock just off the lease in a diapir. Tags and plastic tapes were found fastened to trees just outside the lease indicating that this area has been covered by detailed stream-sampling quite recently.

Anomaly 453 was confirmed, but values remained in the possibly anomalous range, suggesting an area of high background.

Anomaly 82 gave rise to only one possibly anomalous value. Anomaly 444, was confirmed, becoming definitely anomalous for copper and possibly anomalous for zinc.

Anomaly 1722 was confirmed, becoming probably anomalous. Of five nearby creeks not sampled in the reconnaissance survey four were anomalous.

2. Copper Occurrences

The sites of occurrences A to D were visited. In each case no evidence of mineralization was seen. As none of these occurrences gave rise to stream-sediment anomalies, and strata in the vicinity are undisturbed it is concluded that the occurrences

..../2

are probably small areas of copper stainings.

As occurrences E to J are in a similar environment, and likewise are not associated with stream sediment anomalies they were not examined.

Occurrences K, M, N, O, and R were examined by S.J. Carthew and found to be too small to justify any work.

3. Copper Prospects

a) Arrowie Gorge

This area was visited and check stream-samples were taken.

Anomalies 377, 378 and 379 seem to be due to a large iron - manganese fault capping with no workings on it. Values increase to 360 p.p.m. just below the outcrop.

Anomaly 381 was confirmed, rising to 1100 p.p.m. This is probably contaminated from workings on a large manganese outcrop with copper-stains.

Anomaly 382 was also confirmed, the source being another iron-manganese capping.

Most of this area is held under mineral claims. Recent drilling and mining operations have been carried out in drainage 381 and at the working marked as occurrence "S".

b) Orange Tree Prospect

This was formerly known as the Q Copper Anomaly.

Detailed sampling on this area was carried out by S.J.Carthew. Although coverage of the anomalous area was not complete the results indicate a zone anomalous in copper extending for two or three thousand feet.

..../3

Although there are workings at the western end of the anomaly most of the strike length is uncontaminated.

c) Mt. Roebuck Copper Anomaly

Detailed sampling was carried out in this area by S.J. Carthew. Generally copper values were in the 40 to 95 p.p.m. range, suggesting a widespread weak source rather than a more intense potentially economic source.

S.J. Carthew also gridded and soil-sampled a large quartz-reef which gave rise to the 210 p.p.m. anomaly. Although S.J. Carthew took a sample assaying 1.4% Copper, this apparently was material picked for its copper content.

Three representative samples taken along line 2 of the grid averaged about 540 p.p.m. copper over this reef, true thickness about 50 ft.

A chip sample of quartz over a 3 ft. width to the west of the grid assayed 6000 p.p.m. copper.

A sample of quartz with gossan assayed 5,000 p.p.m. Copper. This material is of limited extent, with a width of 12 ft. and length of 20 ft.

d) Bullock Head Gap

This area has been gridded, soil-sampled, chip-sampled and mapped. The results will be presented in a seperate report.

..../4

III LEAD

1. Lead Anomalies

Anomaly 2181 had already been sampled in detail and confirmed. The lead was traced to a bed of lead-rich limestone, samples of which assayed 200, 530 and 600 p.p.m. lead. The anomaly is considered to be explained.

Anomaly 2191 was confirmed, and appears to be due to the eastward extension of the lead-rich limestone in 2181.

Anomaly 2185 was confirmed but remained low-order.

Anomalies 560, 561, and 469 were confirmed, but remained first-order. These are probably due to high background.

Anomaly 541 was not confirmed. Anomaly 2044 was in the area covered by S.J. Carthew and was not confirmed.

2. Mt. Roebuck Lead Anomaly

This anomaly is due to contamination.

A few years ago, in an attempt to improve the Irish Well-Bullock Head Gap road, waste-rock from the Pinda Springs Lead Mine was deposited in the creek crossings. This material contains visible galena and has contaminated the creeks.

3. Lead Occurrence

The lead occurrence 2 miles S.W. of Mt. Roebuck was inspected. An adit-drive and a small open-cut have exposed thin quartz-galena veins with a maximum thickness of 2" and strike length of 30 ft. The occurrence is too small and of too low a grade to be of any economic interest.

..../5

IV ZINC

1. Zinc Anomalies

Anomalies 546 and 1067 were not confirmed.

Anomalies 1212, 1967, 1130 and 340, all in Cambrian Limestone were confirmed, but remained first-order. It is considered that they are unlikely to be draining prospects of economic interest.

Anomaly 1088 was confirmed, becoming probably anomalous.

Anomalies 1732, 1734 and 1735 were confirmed, 1734 giving values up to 410 p.p.m. The source of these anomalies is in pyrite-spotted siltstones and shales, very similar both stratigraphically and in appearance to those at Bullock Head Gap.

Anomalies 196 and 199 were followed up by Mr. W.Doe and shown to be due to a phosphate occurrence similar to Erina Waters.

2. Wirrapowie Area

There is a group of zinc anomalies west of Mt. Brooke along the Wirrapowie Creek.

Anomalies 243, 244, 245 were confirmed, with values of up to 280 p.p.m.

Chips of duricrust in the area assayed up to 1200 p.p.m. zinc, and may account for zome, at least, of the anomalies.

...../6

3. Rivers Bluff-Moro Springs Area

This was sampled and reported on by S.J. Carthew.

The source of anomalous samples 15 to 45 appears to be remnants of iron-manganese rich duricrust enriched in zinc, as suggested by S.J. Carthew.

With the density of sampling in the area it seems unlikely that first order anomalies could be of economic significance. Therefore, attempts have only been made to find the sources of second and third order anomalies.

a) Lead

Sampling upstream from sample location 7S (160 p.p.m. Pb) gave values of 920 p.p.m. and 680 p.p.m. at the first fork upstream. Check-sampling at these locations gave non-anomalous results. The cause of the earlier high values is unknown.

This anomaly is being further investigated by soil lines in an effort to find the source.

The drainages of samples 16S, 17S and 19S were soil-sampled in an effort to find their sources.

b) Zinc

Anomalies 31S and 30S were investigated by further soil-sampling.

Anomaly 24S fell to 130 p.p.m. on checking.

Anomalies 20, 21 and 25 appear to be related to the old erosion surface, as suggested by S.J. Carthew. It appears that zinc has somehow been concentrated near the surface.

..../7

V CONCLUSIONS

The following anomalies are worth further investigation, 444, 1722, 1988 and 105.

Anomalies 1732, 1734 and 1735 are geologically very similar to Bullock Head Gap. In view of the disappointing results at Bullock Head Gap, and the lesser extent of these anomalies they are not worth further investigation.

The Wirrapowie Area might be worth detailed sampling.

Although there are surface indications at Arowie Gorge previous attempts have failed to find any mineralization in depth under this kind of outcrop.

In addition, these areas are held under claim by outside interests.

The Mt. Roebuck quartz-reef is too low in copper to justify further work.

R.E. READ

GEOLOGIST

BALCANOONA

CADNIA

ARROWIE – 1 MILE GEOLOGICAL SHEETS

NOS. 1002/001 – 2232

Compiled by North Flinders

North Flinders Mines N. L.

BLINMAN – WIRREALPA AREA

S.M.L-557

(EX NARINA AREA – S.M.L. 293)

STREAM SEDIMENT RECONNAISSANCE SURVEY.

SAMPLE LOCATION MAP

DRN:- I S | DATE:- 16 12 70 | SCALE:- 60 chains = 1 inch

RECEIVED

BALCANOONA

CADNIA

ARROWIE - 1 MILE GEOLOGICAL SHEETS

North Flinders Mines N.L.

BLINMAN — WIRREALPA AREA

S.M.L-557

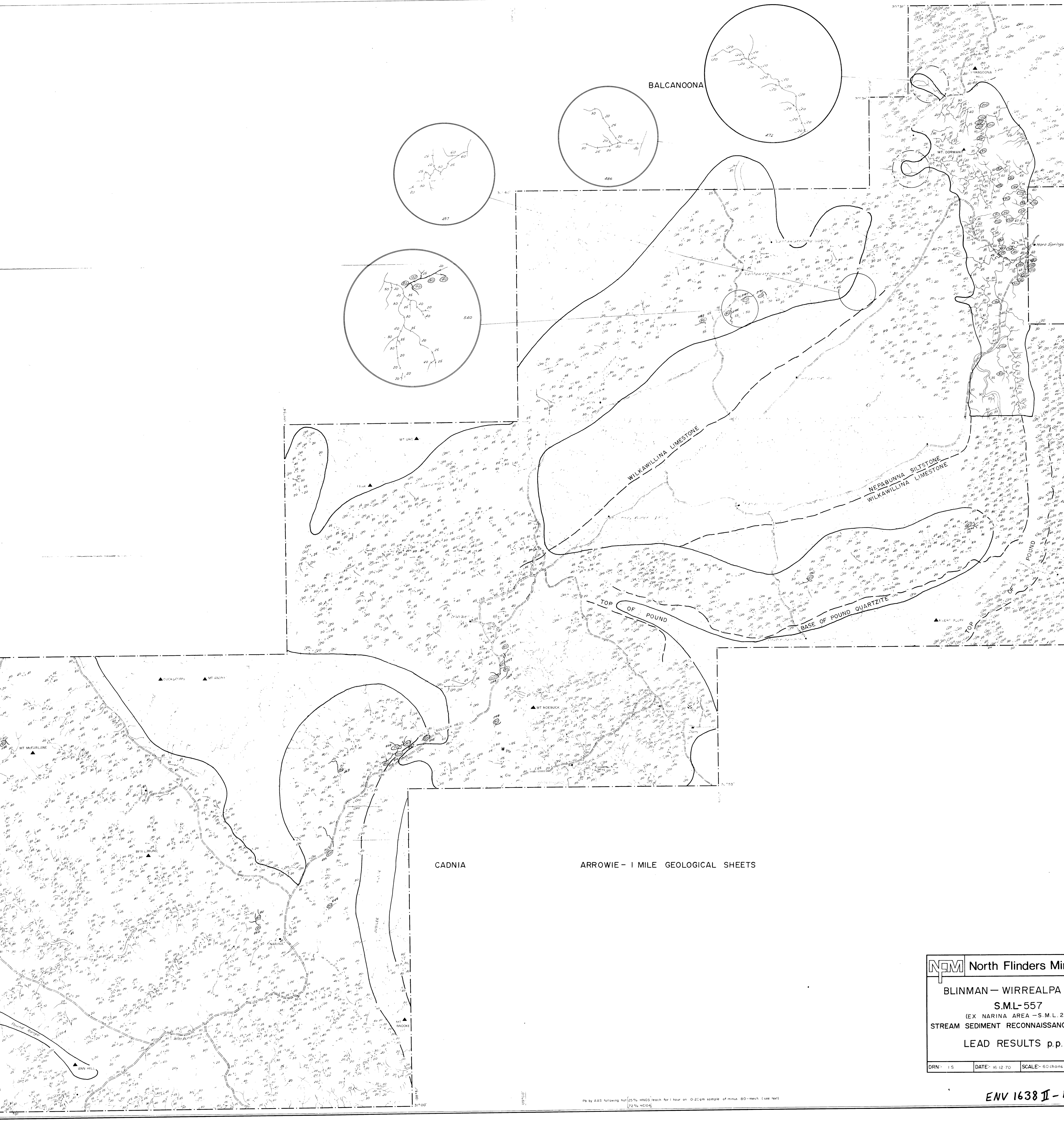
(EX NARINA AREA — S.M.L. 293)

STREAM SEDIMENT RECONNAISSANCE SURVEY.

COPPER RESULTS p.p.m.

DRN:- I S	DATE:- 16.12.70	SCALE:- 60 chains = 1 inch

McPHAR GEOPHYSICS PTY. LTD.



North Flinders Mi[nes]

BLINMAN — WIRREALPA

S.M.L-557

(EX NARINA AREA – S.M.L. 2

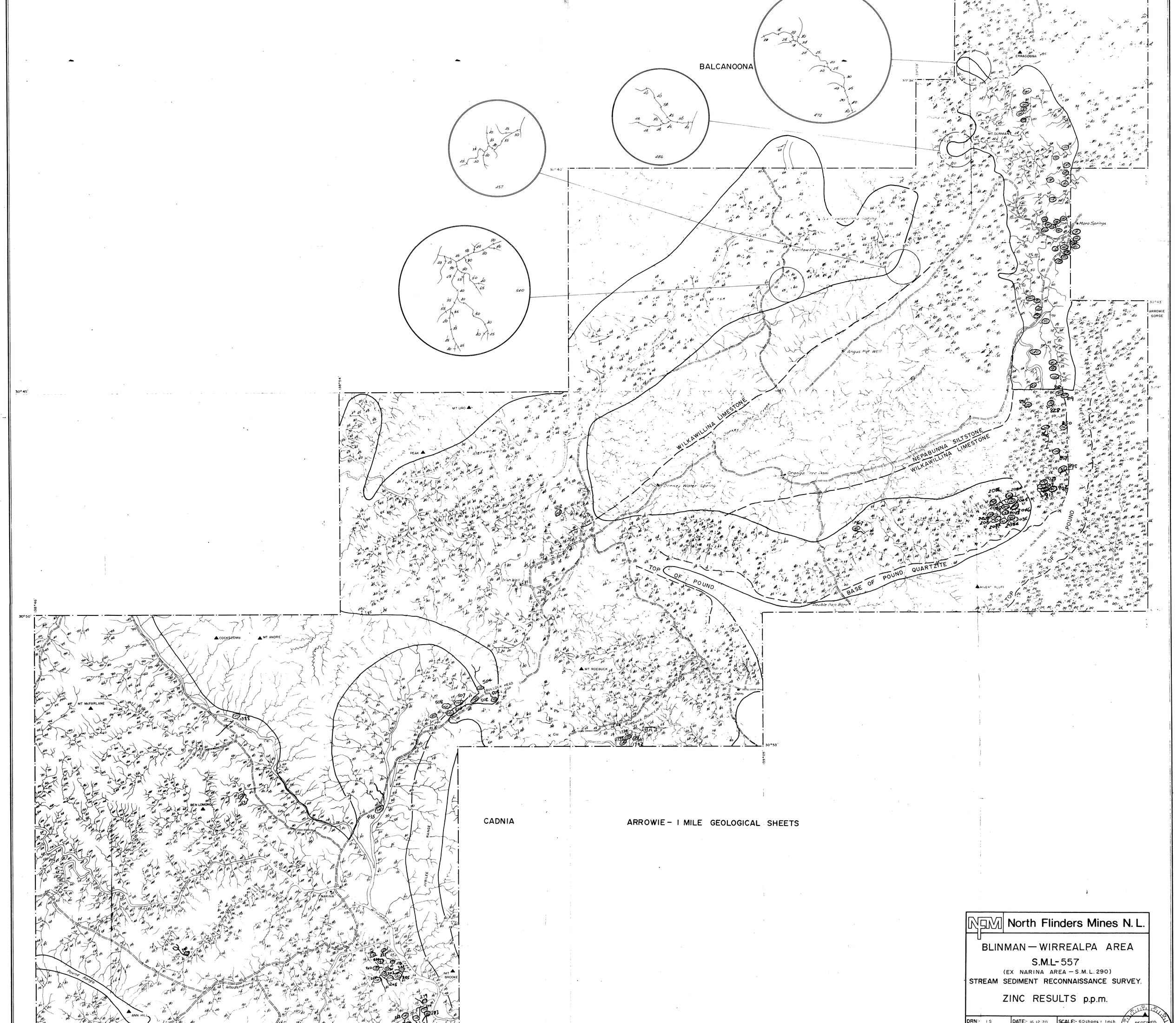
STREAM SEDIMENT RECONNAISSANC[E]

LEAD RESULTS p.p.

DRN:- I S	DATE:- 16·12·70	SCALE:- 60 chains

Pb by AAS following hot [25% HNO3 / 72% HClO4] leach for 1 hour on 0·25gm sample of minus 80-mesh. (see text)

ENV 1638 II -



ARROWIE – 1 MILE GEOLOGICAL SHEETS

North Flinders Mines N. L.

BLINMAN — WIRREALPA AREA

S.M.L-557

(EX NARINA AREA — S.M.L. 290)

STREAM SEDIMENT RECONNAISSANCE SURVEY.

ZINC RESULTS p.p.m.

DRN:- I S	DATE:- 16 12 70	SCALE:- 60 chains = 1 inch

NORTH FLINDERS MINES LTD.

RIVERS BLUFF – MORO SPRINGS AREA

S.M.L. 557 S. AUST.

SAMPLE LOCATION MAP

SCALE 1 INCH EQUALS APPROX 1000 FEET.

N

ENV 1638(VI)–5

DWG 557-29

NORTH FLINDERS MINES LTD.

RIVERS BLUFF – MORO SPRINGS AREA

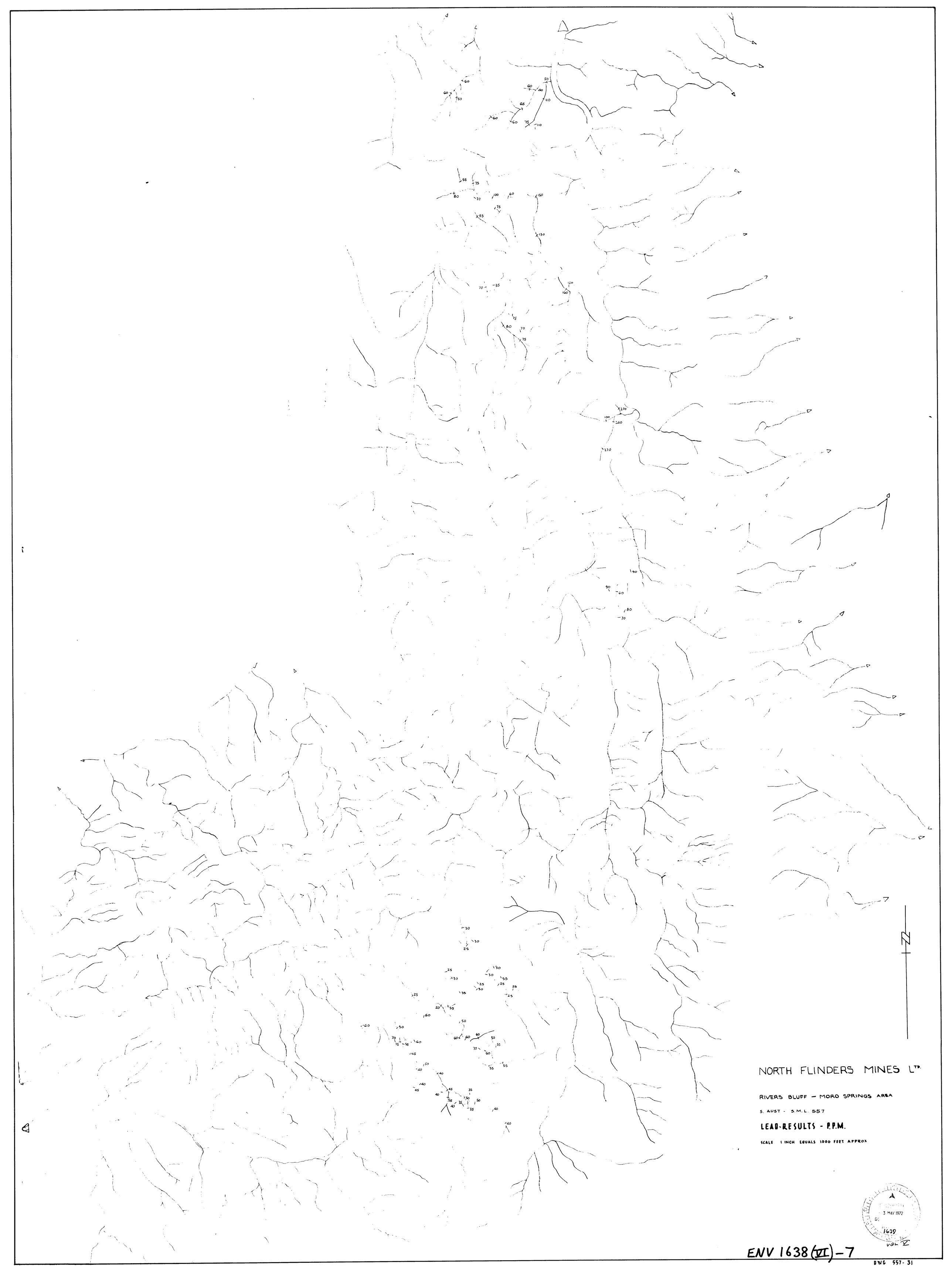
S.M.L. 557 S. AUST.

ZINC RESULTS - P.P.M.

SCALE :- 1 INCH EQUALS APPROX 1000 FEET.

ENV 1638(VI)-6

DWG 557-30


NORTH FLINDERS MINES LTD.
RIVERS BLUFF – MORO SPRINGS AREA
S. AUST - S.M.L. 557
LEAD-RESULTS - P.P.M.
SCALE 1 INCH EQUALS 1000 FEET APPROX
N
3 MAY 1972
1638
VOL V
ENV 1638(VI)-7
DWG 557-31

amdel
The Australian Mineral Development Laboratories

Flemington Street, Frewville, South Australia 5063
Phone 79 1662, telex AA82520

0199

Please address all correspondence to the Director
In reply quote: AN3/479/0 - 4155/72

RECEIVED
15 MAR 1972
Ans'd

14 March 1972

The Exploration Administrator
North Flinders Mines Limited
25 Greenhill Road
WAYVILLE SA 5034

REPORT AN4155/72

YOUR REFERENCE: Order 4045

IDENTIFICATION: 15378

DATE RECEIVED: 7/3/72

Enquiries quoting AN4155/72 to Officer in Charge please.

Analysis by: R.R. Robinson

Officer in Charge, Analytical Section: A.B. Timms

for F.R. Hartley
Director

jw

OB: ..4155.|.7.7 — Semi-Quantitative Spectrographic Analysis Schemes A1,A2,A3,A4,A5 & A6 — BATCH .....

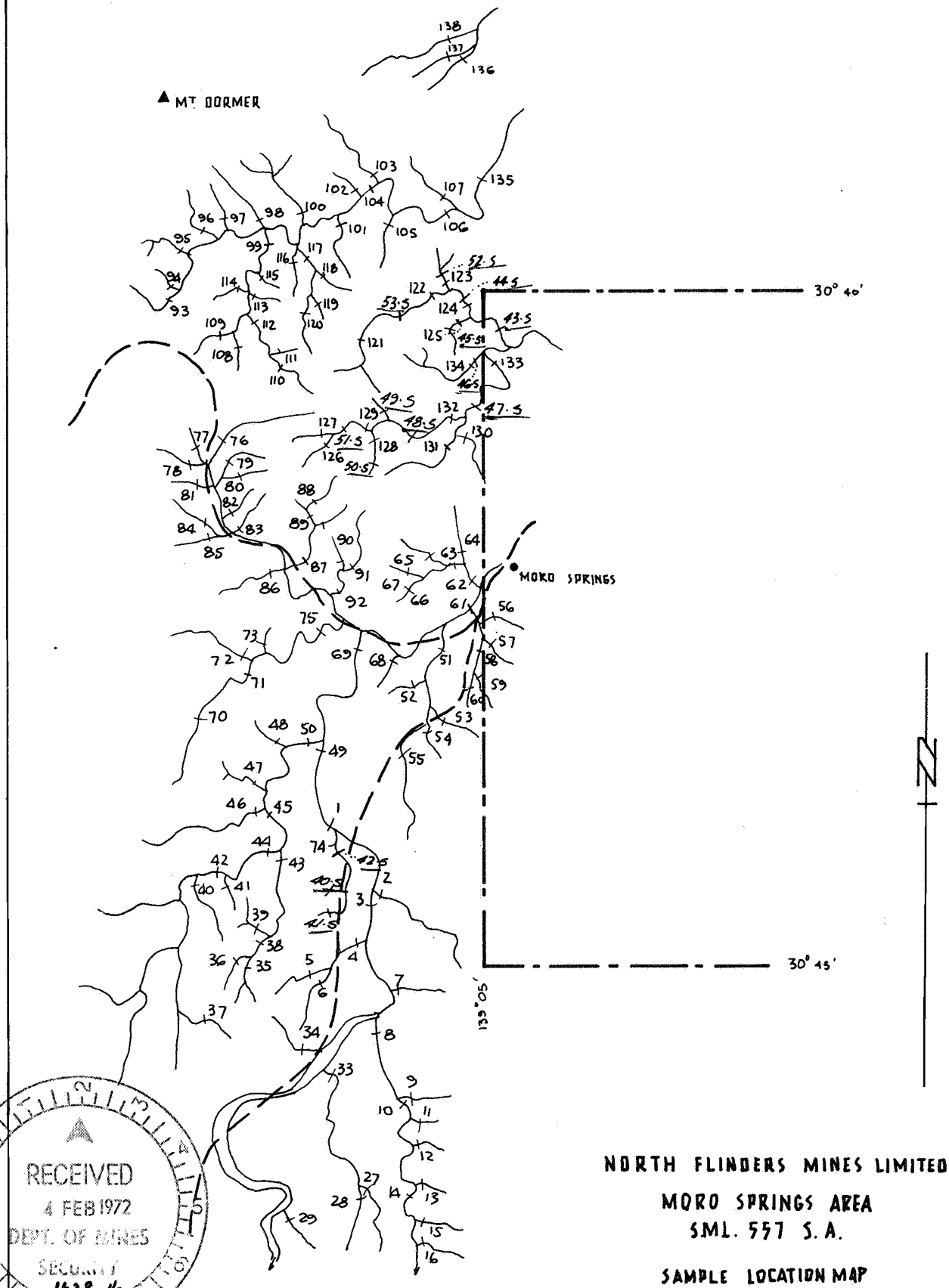
200 — Results in ppm unless otherwise stated. Detection limits in brackets

Sample No.	15378
A1	
o (5)	5
i (5)	10
r (20)	20
(10)	10
(50)	x
Mo (3)	x
Mn (10)	
Ta (100)	
Nb (20)	x
Be (1)	x
Th (100)	
Pt (10)	
Pd (10)	
Os (10)	
Ir (2)	
Rh (2)	
Ru (2)	
A2	
Cu (0.5)	
Pb (1)	10
Zn (20)	20
Sn (1)	1
Cd (3)	x
Bi (1)	80
Ag (0.1)	0.1
Au (3)	x
Ga (1)	

Sample No.	15378
A2 Contd.	
Ge (1)	
As (50)	x
Sb (30)	x
A3	
Te (20)	
Tl (1)	
P (100)	
A4	
Na (50)	
Li (1)	
A5	
K (5)	
Rb (10)	
Cs (30)	
A6	
Ba (50)	
Sr (10)	
Y (10)	
La (100)	
Ce (300)	
Nd (300)	
Pr (100)	
Ti (100)	
Er (100)	
Sc (50)	
Eu (50)	

esults are semi-quantitative. Elements apparently present in concentrations of economic interest should be re termine

A = 1 (1x17) = 17 — X = Not detected at limit quoted



50 - Mc PHAR CREW SAMPLE

50·5 - S.J. CARTHEW SAMPLE

NORTH FLINDERS MINES LIMITED

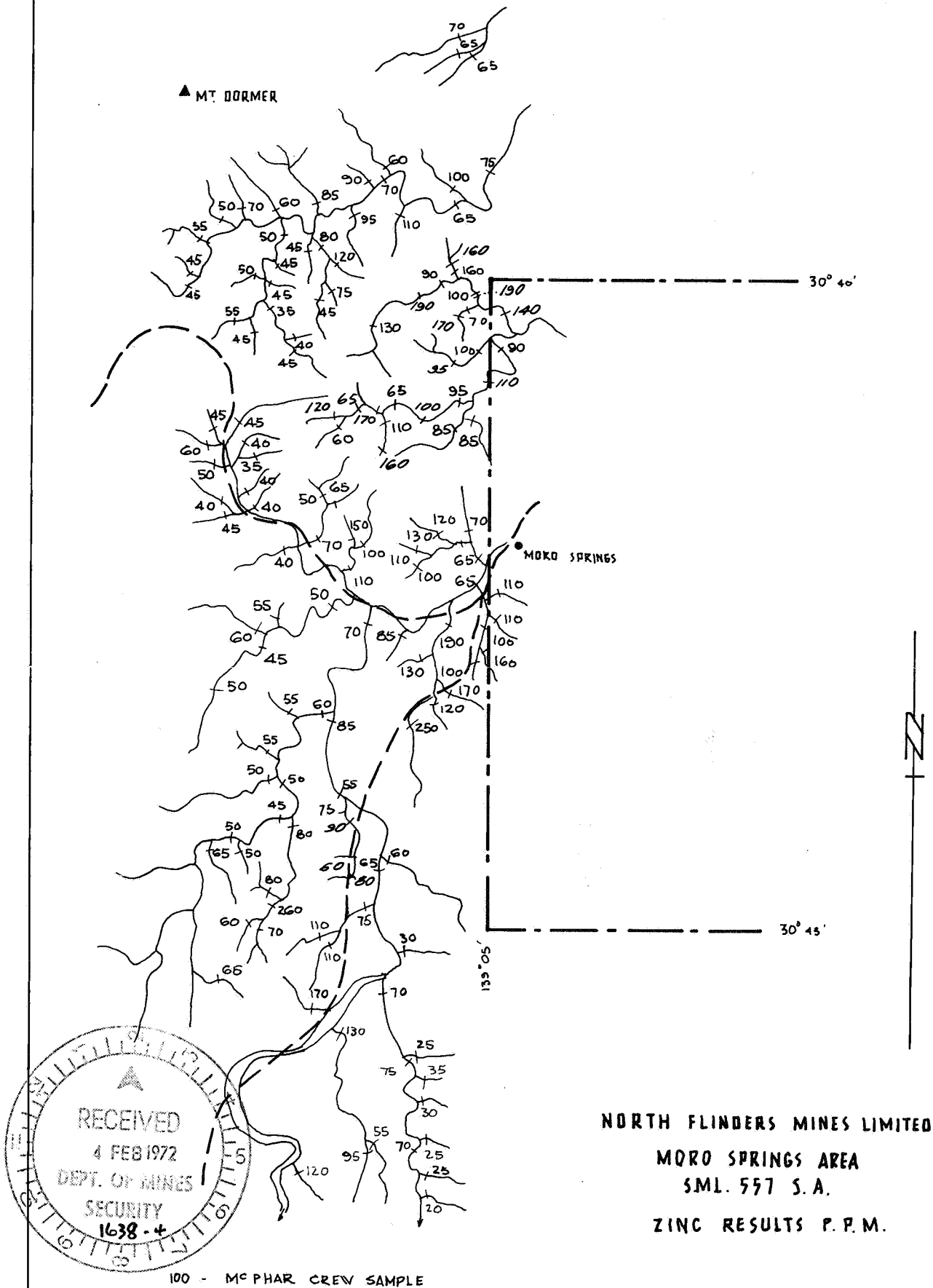
MORO SPRINGS AREA

S.M.L. 557 S.A.

SAMPLE LOCATION MAP

SCALE:- 60 CHAINS EQUALS 1 INCH

DWG 557 - 32



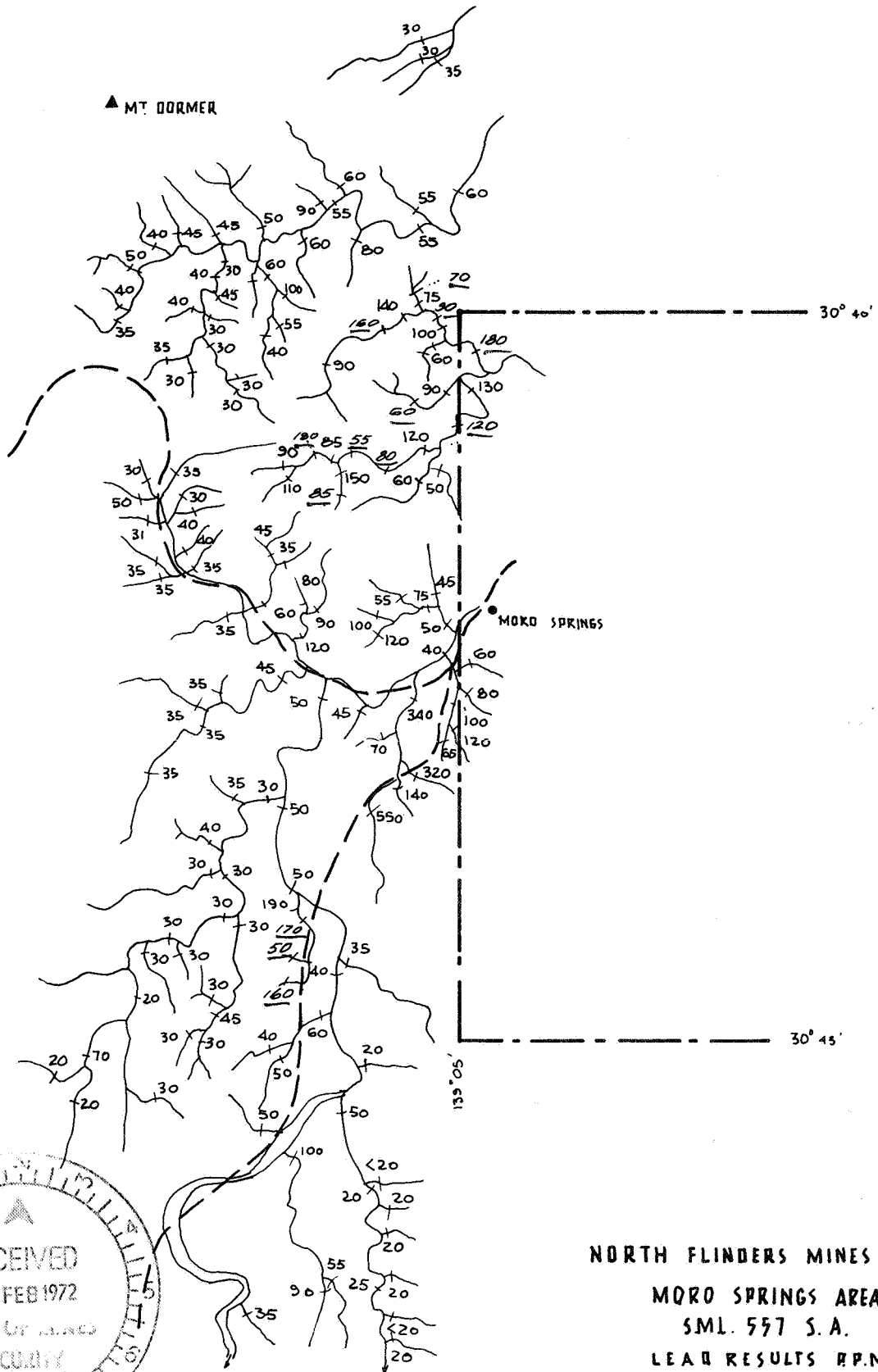
100 - Mc PHAR CREW SAMPLE
100 - S.J. CARTHEW SAMPLE

NORTH FLINDERS MINES LIMITED

MORO SPRINGS AREA
SML. 557 S.A.

ZINC RESULTS P.P.M.

SCALE:- 60 CHAINS EQUALS 1 INCH



50 - McPHAR CREW SAMPLE

50 - S.J. CARTHEW SAMPLE

NORTH FLINDERS MINES LIMITED

MORO SPRINGS AREA

SML. 557 S.A.

LEAD RESULTS P.P.M.

SCALE:- 60 CHAINS EQUALS 1 INCH

DWG. 557-34

McPHAR GEOPHYSICS PTY. LTD.

TELEPHONE 72 2133

50-52 MARY STREET, UNLEY, SOUTH AUSTRALIA
POSTAL ADDRESS: P.O. BOX 42, UNLEY, SOUTH AUSTRALIA 5061

CABLE
"PHARGEO" ADELAIDE
TELEX
"PHARGEO" AA82623

19th July, 1971

MINERALOGICAL REPORT NO. 630

by Dr.A.W.G.Whittle

TO: Mr. B. Wilson,
North Flinders Mining Co.,
25 Greenhill Road,
WAYVILLE.S.A. 5034

YOUR REFERENCE: Your order no. 3051

MATERIAL: Gossan

IDENTIFICATION: Patawarta Gossan

WORK REQUESTED: Detailed mineralogical investigation

SAMPLES AND SECTIONS: To be returned to you

McPHAR GEOPHYSICS PTY. LTD.

D. H. McColl

.....

for A.W.G. Whittle
Consultant for
McPhar Geophysics Pty. Ltd.

The specimen is a highly cellular quartz-rich rock with minimal limonite staining, and with a ragged brecciated appearance.

This appears in thin section as a stressed and brecciated aggregate of subhedral quartz in which a distinct lineation is visible. Among the quartz there are irregular patches of microcrystalline limonite; leached cavities which are lined by thin layers of colloform limonite, with or without microcrystalline jarosite, and smithsonite; and randomly-sited patches of microcrystalline jarosite, and of smithsonite, each of which has no direct relationship to indigenous boxwork limonite. These randomly-sited jarosite and smithsonite aggregates are 0.1-0.2 mm. in size, generally located amongst the quartz, and are indicative of limited movement of oxysalts within the gossan.

Positive evidence of the presence of pyrite and sphalerite was established in the polished section. Protected, unoxidised relics of these two minerals, exist as grains of 0.01-0.1 mm. size within quartz throughout most of the gossan. The zinc mineral is pure sphalerite with little or no solid solution FeS, hence the minimal limonite in the gossan.

In certain areas there are closely associated rhombic goethite boxworks, 1-2 mm. in size, from calcite; and elongate wavy sub-parallel walled goethite boxworks with acute angled partitions and copious microspherulitic "pin-point" goethite, 0.75 x 0.25 - 1.25 x 1.00 mm. in size, from sphalerite.

In nearby areas there are elongate clusters of leached open isometric pyrite cells which are associated with euhedral quartz, and with protected relics of pyrite.

The sample is therefore a true gossan which represents a stressed, brecciated and oxidised quartz-calcite-pyrite-sphalerite lode formation.

McPHAR GEOPHYSICS PTY. LTD.

31°15'

138°52'

138°55'

31°19'

Third Plain Creek

WILKAWILLINA GORGE

North Flinders Mines N. L.

WILKAWILLINA GORGE AREA
PT. S.M.L. 290
MODIFIED RIDGE AND SPUR SURVEY
SAMPLE LOCATION MAP

DRN:- I.B. | DATE:- 28·9·71 | SCALE:- 1000 feet to 1 inch (approx.)

ENV 1638(III)-1

III-1

DWG. G.C. 3215A

McPHAR GEOPHYSICS PTY. LTD.

138°52'

138°55'

31°15'

Third Plain Creek

WILKAWILLINA GORGE

A

B

C

D

138°55'

31°19'

Zn by AAS for ... ppm for Four on 0.25 gm sample of minus 80 mesh

ENV 1638(III)-2

III -2

North Flinders Mines N.L.

WILKAWILLINA GORGE AREA

PT. S.M.L. 290

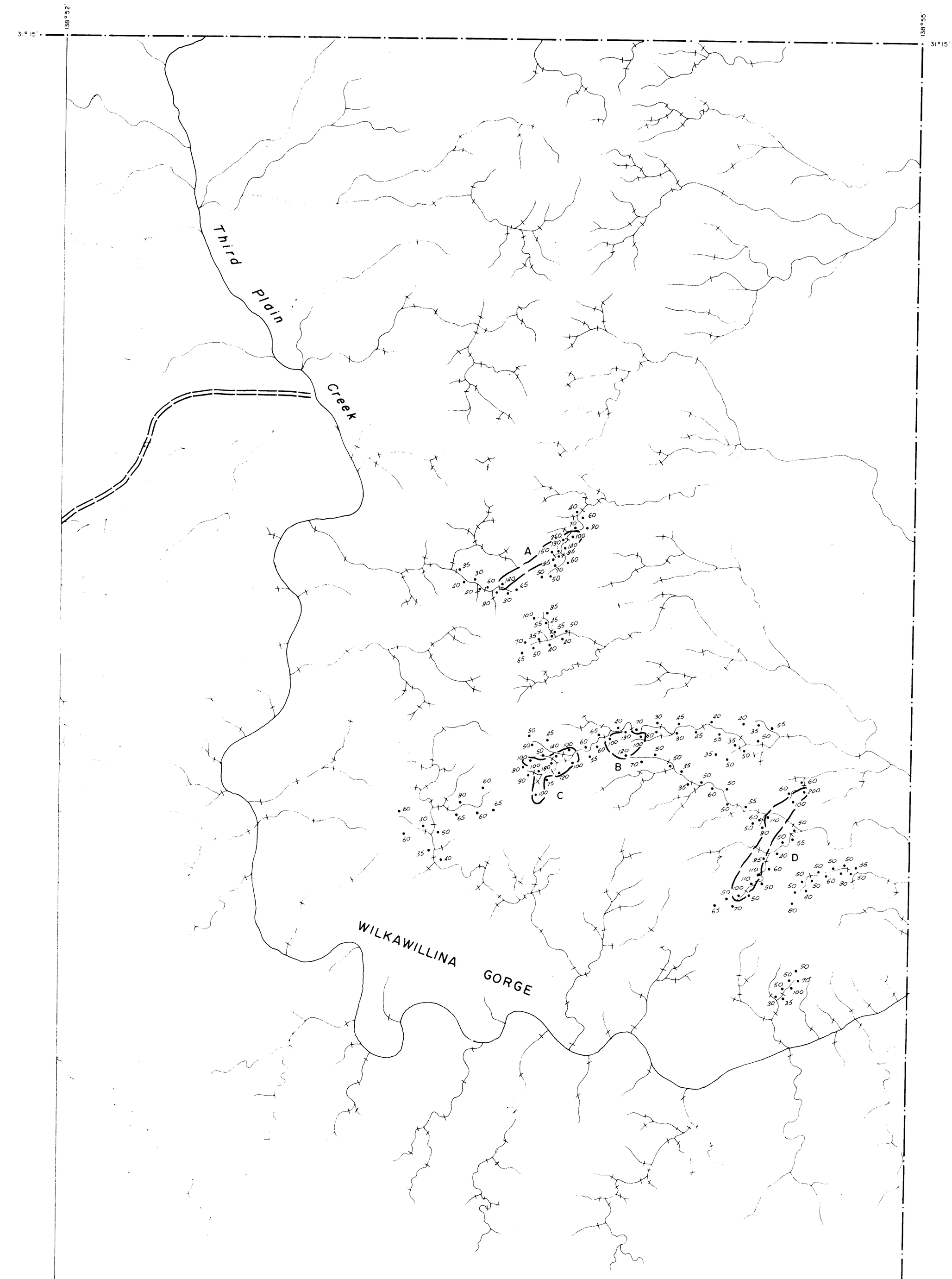
MODIFIED RIDGE AND SPUR SURVEY.

ZINC RESULTS p.p.m.

DRN:- 1 B	DATE:- 28 8 71	SCALE:- 1000 feet to 1 inch (approx.)

DWG: G.C. 3217A

McPHAR GEOPHYSICS PTY. LTD.



Pb by AAS following conc $HClO_4$ leach for 1 hour on 0.25 gm sample of minus 80 mesh

ENV 1638 (III) – 3

NFM	North Flinders Mines N. L.
	WILKAWILLINA GORGE AREA
	PT. S.M.L. 290
	MODIFIED RIDGE AND SPUR SURVEY
	LEAD RESULTS p.p.m

RECEIVED 1 NOV 1971 DEPT. OF MINES SECURITY 1638 -3

DRN:- 1 B	DATE:- 28 9 71	SCALE:- 1000 feet to 1 inch (approx)

III – 3

DWG: G C. 3216A

McPHAR GEOPHYSICS PTY. LTD.

138°52'
138°55'
31°15'
31°19'

Third Plain Creek

WILKAWILLINA GORGE

84 S(i)
318 S(i)
318 S(ii)
245 S(i)
251 S(i)
259 S(i)
231 S(ii)
233 S(ii)
229 S(i)
219 S(i)
223 S(ii)
224 S(ii)
139 S (iii)
139 S (ii)
139 S(i)
129 S (ii)
129 S(i)
147 S (iii)
147 S (i)
147 S (ii)

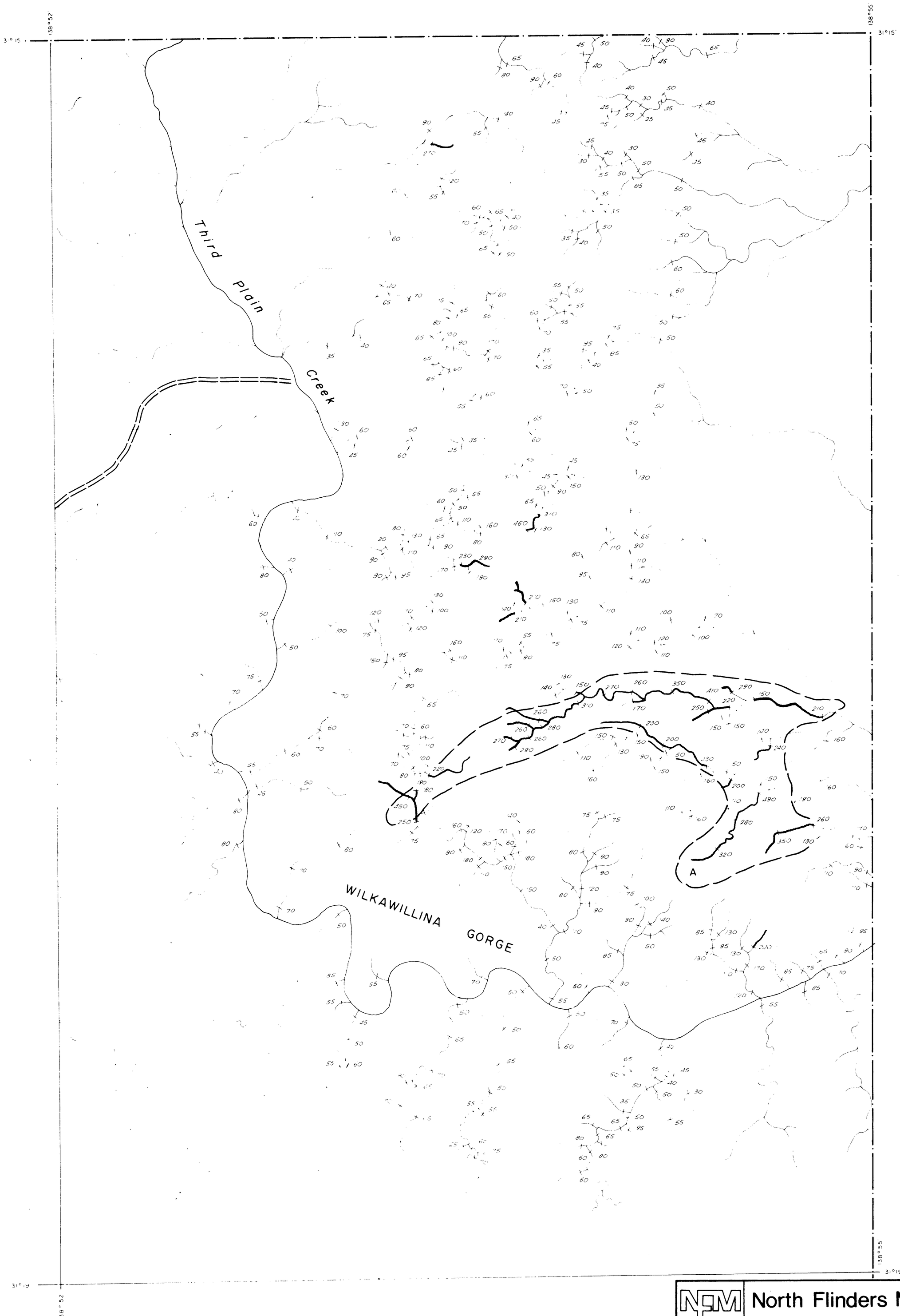
NFM	North Flinders Mines N. L.	
WILKAWILLINA GORGE AREA		
PT. S.M.L. 290		
ROCK CHIP SAMPLE LOCATIONS		
DRN:- I B	DATE:- 28 9 71	SCALE:- 1000 feet to 1 inch (approx.)

ENV 1638(III)-4

III -4

DWG. G C. 3214 A

McPHAR GEOPHYSICS PTY. LTD.



Zn, by AAS following conc $HClO_4$ leach for 1 hour on 0.25 gm sample of minus 80 mesh

ENV 1638(III)-5

North Flinders Mines N. L.

WILKAWILLINA GORGE AREA

PT. S.M.L. 557

DETAILED STREAM SEDIMENT SURVEY.

ZINC RESULTS p.p.m

DRN:-	DATE:-	SCALE:-
I B	26 8 71	1000 feet to 1 inch (approx)

ttt -5

DWG : G.C.3204 A

McPHAR GEOPHYSICS PTY. LTD.

138°52'

138°55'

31°15'

Third Plain Creek

A

B

C

WILKAWILLINA GORGE

31°19'

Pb, by AAS following cold HCl/H2O2 leach [illegible] -80 mesh

ENV 1638(III)-6

North Flinders Mines N.L.		
WILKAWILLINA GORGE AREA		
PT. S.M.L. 557		
DETAILED STREAM SEDIMENT SURVEY.		
LEAD RESULTS p.p.m.		
DRN:- I B	DATE:- 26 8 71	SCALE:- 1000 feet to 1 inch (approx)

RECEIVED
1 NOV 1971
DEPT. OF MINES
SECURITY
1638 -3

III - 6

DWG: G.C. 3203 A

McPHAR GEOPHYSICS PTY. LTD.

138°52'

138°55'

31°15'

31°19'

Third Plain Creek

WILKAWILLINA GORGE

Cu, by AAS following conc $HClO_4$ leach for 1 hour on 0.25 gm sample of minus 80 mesh

ENV 1638(III)-7

North Flinders Mines N.L.

WILKAWILLINA GORGE AREA

PT. S.M.L. 557

DETAILED STREAM SEDIMENT SURVEY.

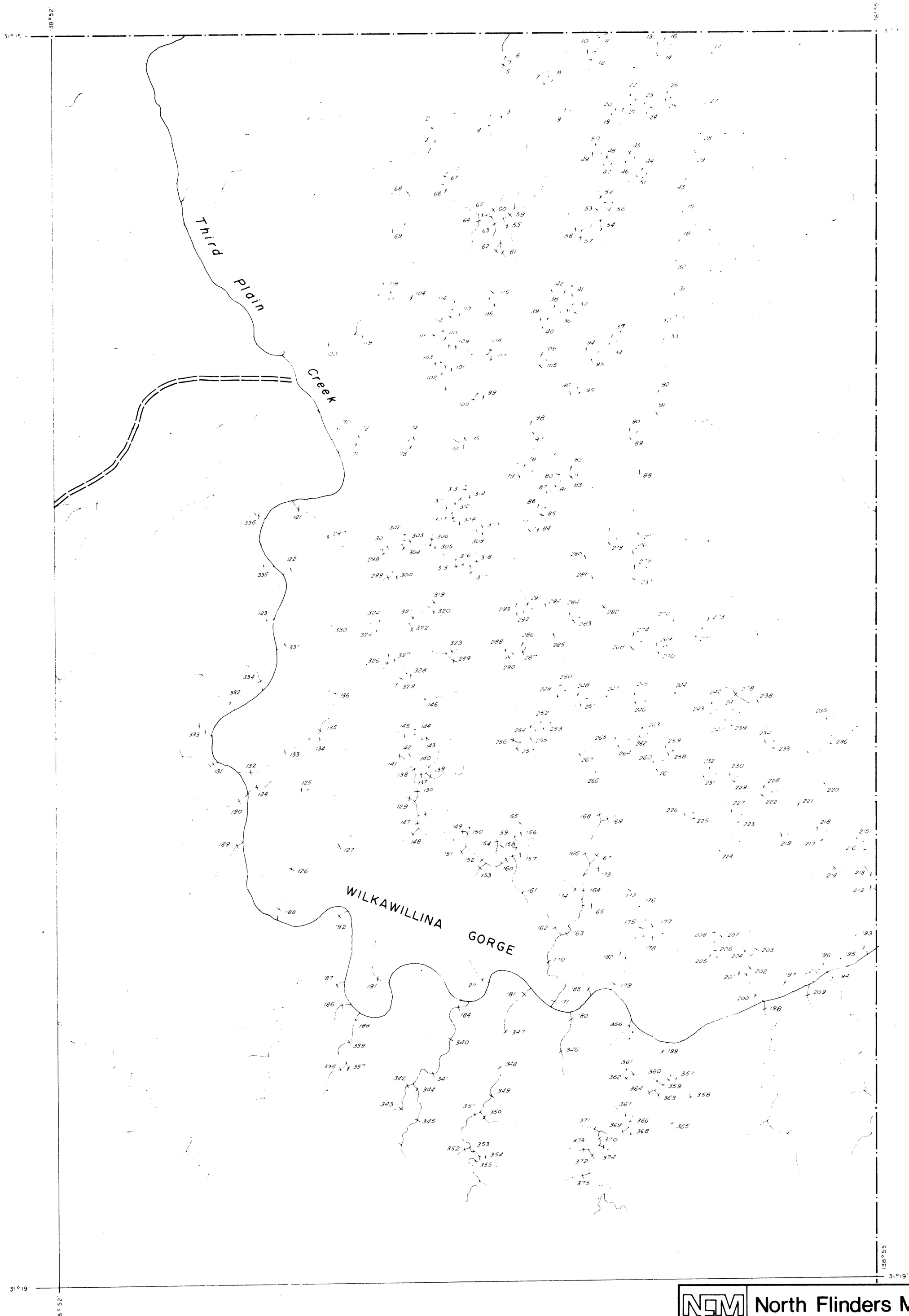
COPPER RESULTS p.p.m

DRN:- I B | DATE:- 26 - 8 - 71 | SCALE:- 1000 feet to 1 inch (approx)

III -7

DWG :G.C. 3202 A

McPHAR GEOPHYSICS PTY. LTD.



NFM	North Flinders Mines N. L.

WILKAWILLINA GORGE AREA

PT. S.M.L. 557

DETAILED STREAM SEDIMENT SURVEY

SAMPLE LOCATION MAP

DRN:-	DATE:-	SCALE:-
1 B	26 8 71	1000 feet to 1 inch (approx)

No 352 = 900352 etc.

ENV 1638(III) - 8

III - 8

DWG : G.C. 3201 A

McPHAR GEOPHYSICS PTY. LTD.

138°30'
30°47'
138°46'
30°47'
138°29'
30°50'
138°41'
30°52'
138°24'
30°55'
NUCCALEENA JOINT VENTURE AREA
BELTANA
CADNIA
1 MILE SHEETS
NILPENA R.S.
31°00' COPLEY 4 MILE
PARACHILNA SHEETS
PARACHILNA
BLINMAN
WARIOOTA MINE
Cu
Ned Well
Lyndar Well
MOOLOOLOO H.S.
LADY GOWMAN MINE
PATAWARTA HILL 331'6
MT LUCIUS
Cu
Ag
QUEEN MINE
ARROWIE MINE
ORATUNGA H.S.
Wheal Butler Cu
ANGO MINE Cu
WELLINGTON
Mt Mary Mine Cu
138°38'
138°39'
31°07'
31°08'
138°24'
138°46'
31°05'

North Flinders Mines N. L.

NILPENA AREA

S.M.L-292

MINE AND OCCURRENCE LOCATIONS

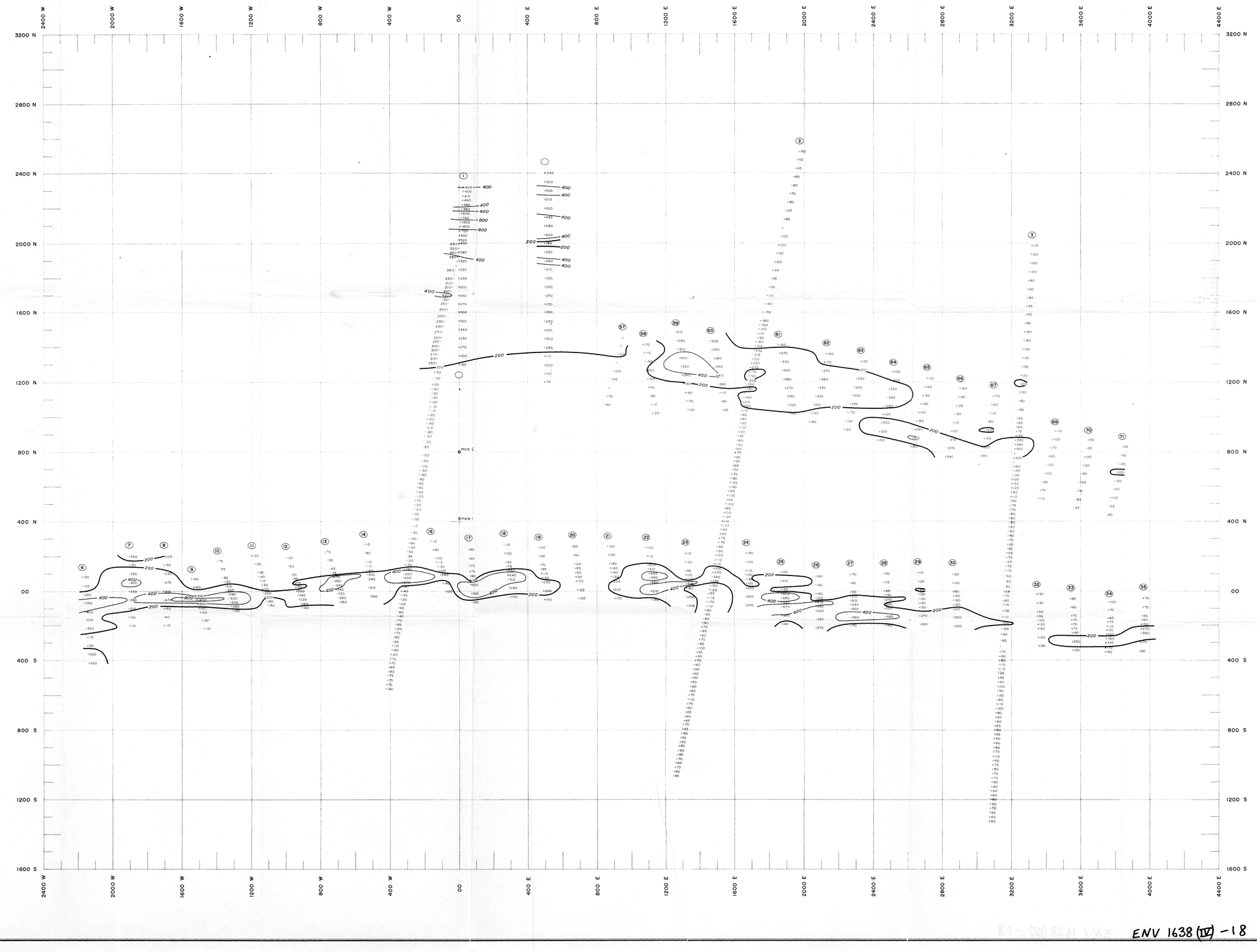
RECEIVED
1 NOV 1971
DEPT. OF MINES
SECURITY
1638-9

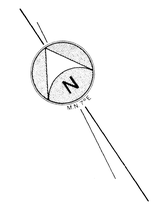
DRN:- R.D.M. | DATE:- 29-3-71 | SCALE:- 60 chains = 1 inch

ENV 1638(III)-9

III-9

DWG: G.C. 4138A





NOTES ON SAMPLING & ANALYSIS

LINES 1-35 SAMPLED AT 6" DEPTH.

ALL OTHER SAMPLES AS NEAR TO BEDROCK AS POSSIBLE

SAMPLES SIEVED TO 80 FRACTION

ANALYSIS BY McPHAR GEOPHYSICS PTY. LTD.

BY AAS ON .25gm SAMPLE FOLLOWING CONC. HCl:H$_2$O LEACH FOR ONE HOUR

SCALE

200 100 0 200 400 600 800 1000

FEET

NFM North Flinders Mines N. L.

PATAWARTA

ZINC PROSPECT

SML 557

GEOCHEMICAL SOIL SURVEY

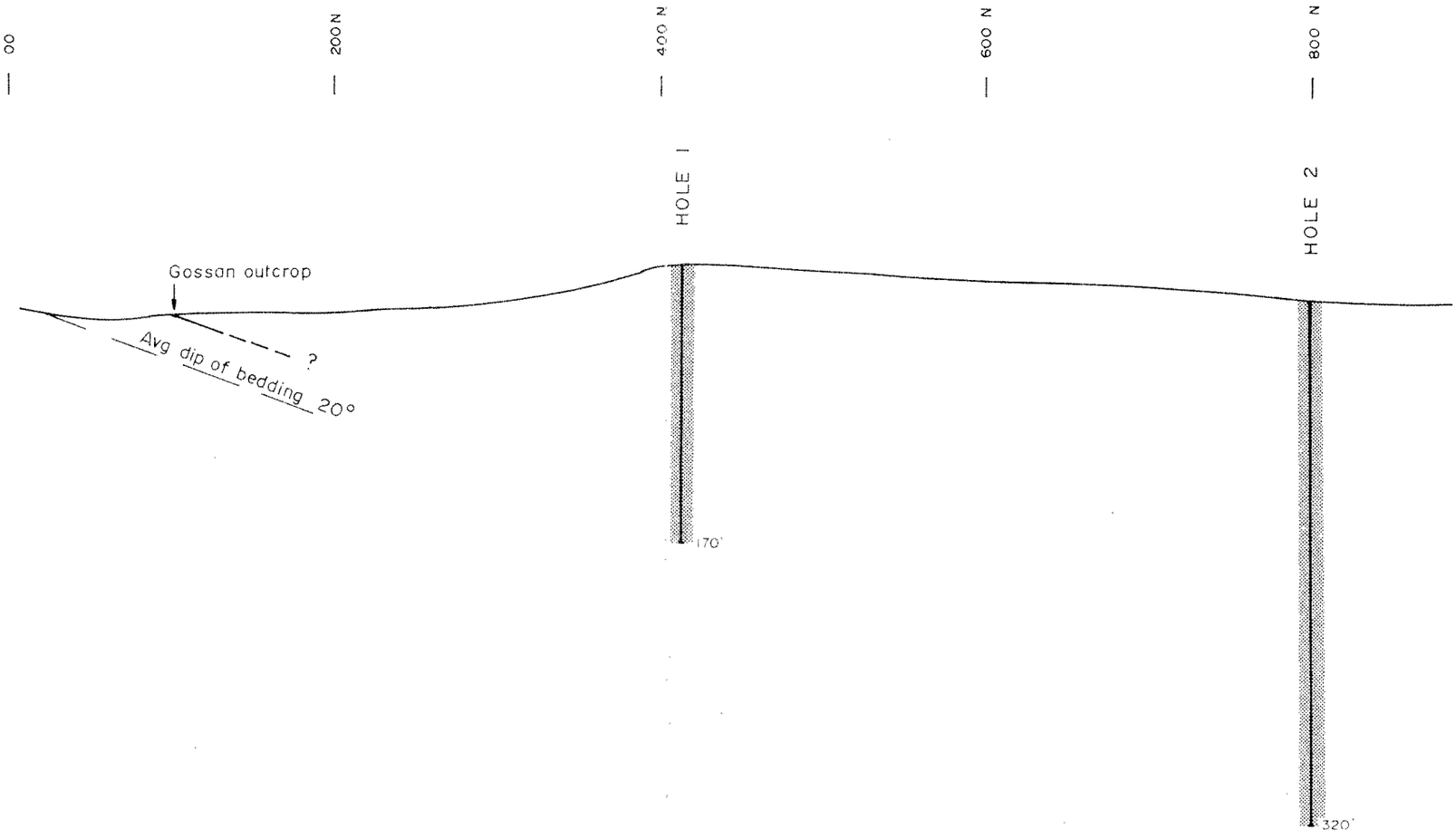
SHOWING

Zn RESULTS- P.P.M.

DRN:- R.G.	DATE:- OCT. 1971	SCALE:- 1" rep. 200'

DWG. 557-15

0200



PYRITIC SILTSTONE

100 50 0 100 200

SCALE IN FEET

NFM North Flinders Mines N. L.

PATAWARTA

ZINC PROSPECT

SML 557

SECTION 00

GEOLOGY BY R.E. READ

DRN:- M.C.C.	DATE:- FEB 72	SCALE:- 1 INCH REPS 100 FEET

DWG 557-35