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## SML 256

## LAKE DUTTON

## PROGRESS REPORTS TO LICENCE EXPIRY/RENEWAL FOR THE PERIOD 1/10/1968 TO 30/9/1970

Submitted by
Noranda Australia Ltd
1970



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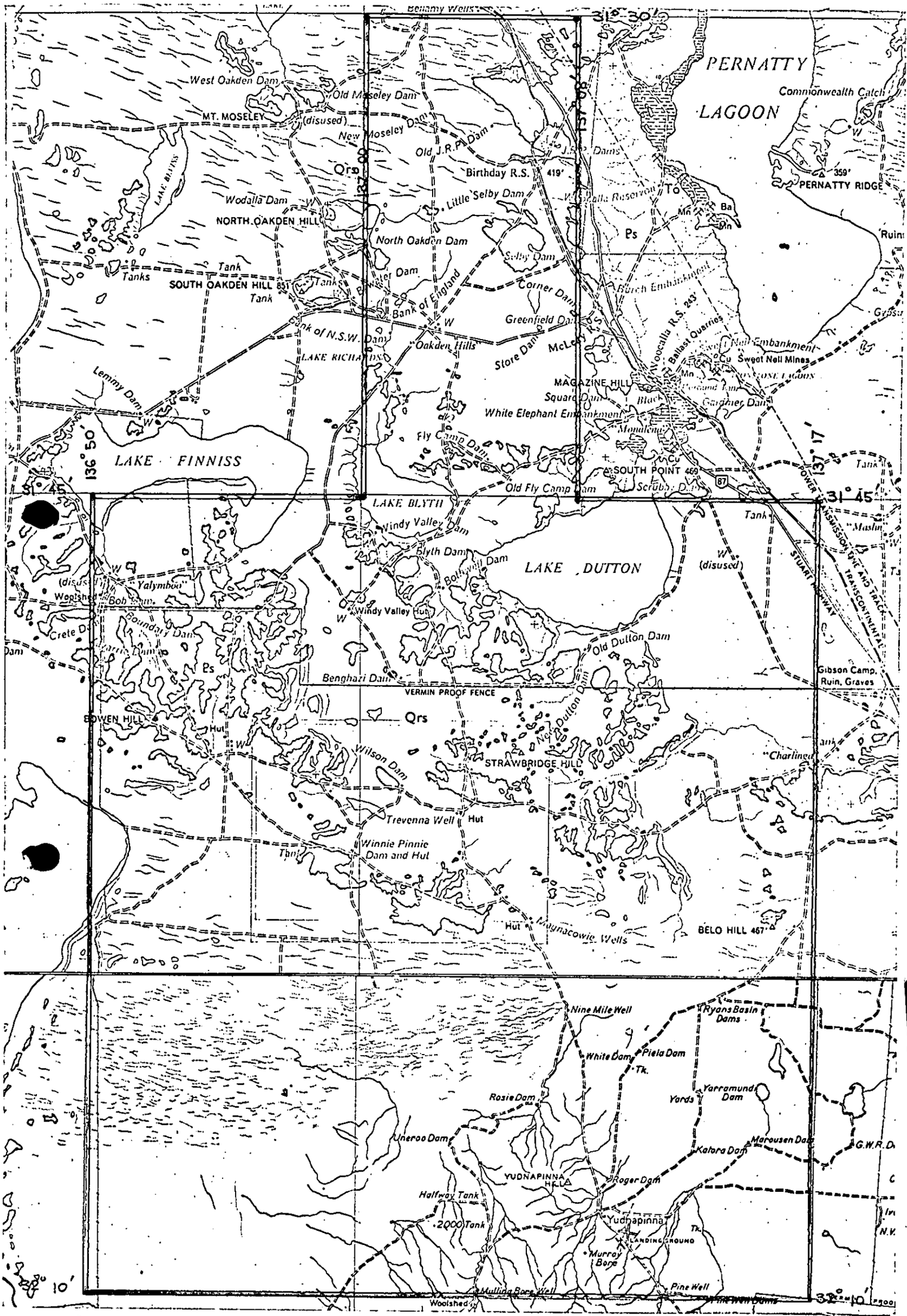
Government of South Australia
Primary Industries and Resources SA




SCALE 1: 250,000

NORANDA AUSTRALIA PTY. LTD. S.M.L. 256

DM. 61/68

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TENEMENT SML 256

TENEMENT HOLDER: Noranda Australia Ltd.

REPORTS:

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THOMAS, A., 1969
Progress repprt, Special mining lease No. 256
Lake Dutton, South Australia. Report No. 110
(includes logs, assays) (pgs.3-17)

Plans:

(see report No. 147, Appleyard, 1970)

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REPORTS:

THOMAS, A., 1969 Progress report, Special Mining Lease No. 256, Lake Dutton, South Australia. Report No. 131 (Pgs. 18-25)
(No Plans) (Includes petrography)

THOMAS, A. 1970 Special Mining Lease Lease No. 256, Lake Sutton South Australia Report for 6 months ended April 1, 1970 Report No. 137 (pgs. 26-59)

Plate 1 Location Map (In text) (pg. 30)

Plate 2 Geochemical results W.P. 20 (1043(1)-1)

Plate 3 Interpretation Geological and Geophysical Plan showing recommend Exploration Targets, (1043(1)-2)

REPORTS:

APPLEYARD, G.R. 1970
Special Mining Lease No. 256 Lake Dutton Area, South Australia. Report for Six Months ended.

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# PROGRESS REPORT

## SPECIAL MINING LEASE NO. 256

## LAKE DUTTON, SOUTH AUSTRALIA

ENV 1043

Report No. 110 March 1969

by

A. THOMAS

Melbourne, Australia

# SUMMARY


## Objectives

Following up the recommendations made by D. Tonkin in Noranda Australia Limited Report No. 103, anomalous geochemical lead values were confirmed in two localities.

## Conclusions

1. Drilling was carried out in 1968, at the southern locality known as the Winnie Pinnie-Trevenna Area, and an extensive area of black clay and shale was found containing geochemically anomalous lead and possibly anomalous zinc.

2. The mineralisation consists of sparse primary lead and zinc sulphides in a stratiform zone within sediments correlated with the Woocalla Dolomite Formation.

3. It appears that sediments of this type could be extensively developed under relatively shallow cover in an area at least 20 miles long and as many miles wide.

4. The grades of mineralisation are not interesting enough to warrant extensive geophysical surveys required to test the area on a regional scale.

## Recommendations

1. The anomaly at Greenfields Dam should be tested by a programme of approximately 10 rotary holes totalling 1500 feet.

2. Geological investigation should be made to search for shale outcrop in the intervening country between Greenfields Dam and Trevenna — two weeks should be sufficient.

3. If any success were obtained at Greenfields Dam, the drill while leaving the area should be used to drill a maximum of five stratigraphic holes up to 300 feet deep in order to locate and sample the Woocalla Dolomite horizon at four to five-mile intervals southward towards Trevenna.

4. Literature search should be initiated to determine whether any ore deposits in this type of environment have been described. Two weeks should suffice to examine references at an appropriate University Library.

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## LIST OF PLATES

(In Pocket)

| | | |
|---|---|---|
| Plate No. 1 | Special Mining Lease No. 256 - Lake Dutton - Geological Map | This plan is the same as plate 4 of report no. 147 |
| Plate No. 2 | Winnie Pinnie-Trevenna Area - Surface Plan | This plan is the same as Plate 5 of report no. 147 |
| Plate No. 3 | Winnie Pinnie-Trevenna Area - Sub-Surface Plan & Longitudinal Section | This plan is the same as plate 6 of report no 147 |

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# NORANDA AUSTRALIA LIMITED

## SPECIAL MINING LEASE NO. 256 - LAKE DUTTON, SOUTH AUSTRALIA

## Progress Report to March 31, 1969

## 1. INTRODUCTION

### 1.1 Special Mining Lease No. 256

Special Mining Lease No. 256, of 900 square miles to the west and south-west of Pernatty Lagoon, was granted to Noranda Australia Limited from October 1, 1968. One of the conditions of tenure is that a full technical report should be submitted at the conclusion of each six months. This report covers the period of six months ended March 31, 1969.

### 1.2 Background

Study of the area commenced in 1967, when exploration was pursued in an area of 2,700 square miles held under Special Mining Lease No. 152. This work originated as a regional extension of investigations at the Mt. Gunson copper deposit in which Noranda was then actively engaged. The investigations were carried out by D. Tonkin, whose findings were recorded in Noranda Report No. 103, January 1968.

Tonkin drew attention to a number of specific localities, three of which were designated priority number one targets for further exploration. Two of the priority number one targets were designated on the basis of rock geochemistry, one the Oakden Hills-Birthday Siding area, the other described as the Winnie Pinnie Dam-Trevenna Area.

### 1.3 Preliminary Investigations

In July and August 1968 a programme of follow-up geochemical sampling was carried out, to check and if possible amplify the favourable indications obtained by Tonkin in the Oakden Hills-Birthday Siding and the Winnie Pinnie Dam-Trevenna areas. In the first area 56 samples were collected and 70 samples in the second. Each sample consisted of a composite of chips taken from rock outcrop collected in duplicate over as wide a locality as possible (up to 1,000 square feet). One set of samples was analysed by McPhar Geophysics Pty. Ltd., the other by AMDEL.

As this work was carried out before the issue of the current Special Mining Lease No. 256, detailed plans showing these sample results are not submitted with this report. In general, confirmation was not obtained of anomalous copper values within Whyalla Sandstone and Pandurra Formation. Both sets of samples, however, confirmed anomalous lead values in shales from bore hole cuttings at two localities. The first was in the spoil of an old well at Greenfield Dam in the Oakden Hills-Birthday Siding area. The well is located one mile west of the McLeay siding on the Commonwealth Railway Line. The second locality was the Winnie Pinnie-Trevenna area, where the cuttings from three bore holes contained anomalous lead values in dark grey shale.

The first locality is situated very close to the western boundary of Special Mining Lease No. 139A, held by Austminex Pty. Ltd. The second locality is in an entirely virgin area to the south-west. This second area was therefore considered the more suitable to carry out an initial programme of about ten percussion drill holes.

In view of the interesting results obtained the programme was extended to 30 holes.

## 2. GEOLOGY

### 2.1 Regional Geology

The area has been mapped by the South Australian Department of Mines, most of it being recorded on the Torrens 1:250,000 S.A. Geological Atlas Series H53-16 Zone 5, the remainder mapped in preparation of the Port Augusta 1:250,000 Geological Map. The particular areas of interest were outlined in Noranda Report No. 103, on Plate 2.

The regional stratigraphy has more recently been described by B.P. Thomson and J.E. Johnson in the Quarterly Geological Notes of the Geological Survey of South Australia, No. 25 of January 1968.

The district consists of a shelf area in which rocks of the Adelaide System are represented by four major formations:

| | | |
|---|---|---|
| (1) | Tent Hill Formation | - Marinoan Age |
| (2) | Woocalla Dolomite | - Torrensian (?) Age |
| (3) | Pandurra Formation | - early Torrensian or Willouran Age |
| (4) | Roopena Volcanics | - Willouran Age. |

A major disconformity occurs between (1) and (3), the Woocalla Dolomite being present only in restricted areas. This disconformity is of economic interest as the locus of copper mineralisation at Mt. Gunson. The rocks are near horizontal in the shelf area, dipping to the east as the Torrens Hinge Line and Adelaide Geosyncline are approached.

The Woocalla Dolomite is prominent along the western shore of Pernatty Lagoon, where it overlies the Pandurra Formation.

At the Sweet Nell Mine near Woocalla the dolomite is underlain by a few feet of cupriferous shale, and shales have been observed in the Woocalla Dolomite sequence at several localities such as in the Woomera and Beda bores. The Whyalla Sandstone is the basal member of the Tent Hill Formation and is a very distinctive rock, generally light coloured with a texture distinguished by small spherical quartz grains and often containing abundant lithic material. The Pandurra Formation by contrast, is characteristically dark reddish sandstone, containing less rounded and more diversely sized quartz grains. Both formations were clearly identifiable in the drill holes at Winnie Pinnie, and the intervening black clays and dark grey shales are therefore correlated with the Woocalla Dolomite sequence.

## 2.2 Geology - Winnie Pinnie-Trevenna Area

The area consists of low hills interspersed with flat sandy plains. There are several dry salt lakes of small size. The major portion of the area drilled is covered by a light cover of mulga and myall trees.

As shown by the sections, the rocks are divisible into a surface veneer of Cainozoic sediments consisting of gravels, sand or clay overlying bedrock containing one or more of the three Adelaidean formations. These comprise the Whyalla Sandstone, the black clays and shales considered equivalent to the Woocalla Dolomite, and the Pandurra Formation. The area tested lies on the southern flank of a basement uplift in which the Pandurra Formation outcrops. In general the low hills are composed of Whyalla Sandstone which has, at the west end of the area, been removed by erosion, so that the Cainozoic sediments are found adjacent to different members of the bedrock formations according to their location on the pre-Cainozoic erosion surface.

The rock types are described as follows:-

### 2.2.1 Overburden

The flat to slightly underlaying surface of the area is covered with sand. The grain size varies between fine wind blown sand and gravel. Humus is poorly developed and finely distributed in the upper three feet. The soil is a carbonate type with C profile. Gypsum and travertine are common. The average depth of the topsoil is 15 feet, but depths up to 40 have been noted.

### 2.2.2 Bedrock

(a) The Whyalla Sandstone

The Whyalla Sandstone member belongs to the Tent Hill Formation. It is a lithic sandstone consisting of fine to medium size quartz grains; the chemical cement is lime and the mechanical cement is silt and clay. Also, different coloured layers are common. Evidence of both rapid and slow sedimentations is revealed by sharp contacts between fine and coarse grained beds and gravel layers. The rock is distinguished particularly by the spherical shape of its quartz grains. Thickness of this sandstone varies between 0 and 120 feet, with the average 50 feet.

(b) Clay and Shale Members

Below the Whyalla Sandstone are clays and shales. There are two different types of clays. The upper members are variously coloured, buff, greenish yellow, white, reddish and chocolate. The lower members are made up of a series of black clays and shales. The width is variable and the formation absent from the section in some holes. The black clay and shale members contain the mineralisation.

(c) The Pandurra Formation

This is the lowest unit and consists of well-rounded, medium size reddish quartz grains, with a silica cement.

## 2.3 Mineralisation

Mineralisation was seen only in the black clay and shale member. It consists of galena, sphalerite and pyrite; the galena was observed as extremely fine disseminations. Pyrite is irregularly distributed in the black clay and shale; a trace of pyrite was found in the top part of the Pandurra Formation, but where penetrated deeply this rock was quite unmineralised.

## 3. DRILLING PROGRAMME AND RESULTS

### 3.1 Drill Programme at Winnie Pinnie-Trevenna Area

Drilling commenced on October 4, 1968, and was carried out in two periods - until October 18 and again from December 2 until 14. In all, 30 holes were drilled totalling 3,187 feet. The contractor, W. O' Neill, Mineral Probe Drillers Pty. Ltd., employed an Ingersoll Rand P133 track-mounted air drill, and the holes were drilled using a combination of percussion and auger techniques. Drilling conditions were difficult, and core recoveries extremely variable. In many of the drill holes water was encountered at depths below 70 feet, so that samples had to be collected either as a sludge or as damp auger cuttings, lifted to surface and peeled off the auger flight. Under these conditions it is inevitable that some contamination of samples has taken place, but it is not possible to estimate the precise degree. The techniques used were successful in obtaining much valuable information, but the difficulties encountered in penetrating the clay beds constitute a special problem characteristic of the locality. These conditions have to be borne in mind when assessing the results. It is considered, however, that there is a certain consistency about the values obtained, and there is no reason to doubt that these are representative of the material recovered.

### 3.2 Assay Results

The assay results obtained are recorded on the accompanying sub-surface plan (Plate 3). The highest individual geochemical analyses were 6,400 p.p.m. and 6,200 p.p.m. Lead in holes Nos. WP16 and WP17, but in view of the overall drilling conditions the bulk averages are considered more relevant. At the western end of the area tested, drilling indicated a zone one mile long by half a mile wide which contains an average thickness of 20 to 30 feet of dark clay, averaging 0.2 per cent Lead and 0.3 per cent Zinc, ranging from 40 to 135 feet depth from surface.

In the centre of the area drilled, another zone some two miles long by half a mile wide contains an average thickness of 20 to 30 feet of dark clay averaging about 0.1 per cent Lead and 0.1 per cent Zinc ranging in depth from surface of 30 to 100 feet.

At the eastern end of the area drilled, the dark coloured shales and clays are deeper and only two holes, WP25 and WP26, succeeded in penetrating to the Pandurra Formation. Some sulphides were seen but geochemical bulk values were low. The testing here was unsatisfactory and the result inconclusive.

Most of the better grade sections of clay averaged about 7 p.p.m. silver; one value of 320 p.p.m. silver (quite uncharacteristic of the general run) was obtained in WP 7 outside either of the two mineralised zones.

3.3 Significance of Results

In assessing the results it seems possible that these two large areas of high geochemical content may arise either by presence of primary metallic minerals or by the adsorption of secondary metallic minerals on to collectors in the form of Manganese, Iron Oxides or even clays. It has been recognised that the Woocalla Dolomite Formation is a source of Manganese, and residual weathered concentrations have been exploited on a commercial scale around Pernatty Lagoon. For this reason Manganese was analysed for all samples and the results are plotted on the sections. The general level of Manganese in the sections high in Lead and Zinc is of the order of the combined Lead, Zinc value; large concentrations of Manganese are rare and no distinct correlation is evident between variations in Manganese and those in Lead and Zinc.

On the other hand, some sparse sulphides consisting of galena, sphalerite and pyrite were recognised in the drill cuttings from time to time, and the tendency was observed for the better values to occur in much the same zone in all the holes, viz. the upper part of the black clays.

This supports an interpretation of the results as a stratiform zone of high primary geochemical content.

Hawkes and Webb (Geochemical Exploration - Appendix) list average metal content of Black Shales as 20 - 400 p.p.m. Lead, Zinc 100 - 1,000 p.p.m., Silver 5 - 50 p.p.m. Manganese is given an average range of from 500 to 3,000 p.p.m. in igneous and sedimentary rocks generally (no special figure available for black shales).

Using these figures as a standard, it appears that the western zone contains lead values from $2\frac{1}{2}$ to 10 times normal, and zinc values from normal to three times normal.

The eastern zone contains lead values from $2\frac{1}{2}$ to 8 times normal, and zinc values from normal to twice normal.

Silver values are in general normal for this class of sediment.

Manganese values are also at a normal level.

The drilling results are, therefore, interpreted as indicating an extensive sedimentary area geochemically anomalous for lead and possibly for zinc.

## 3.4 Discussion on Sulphide Genesis

The Pandurra surface suffered erosion with the formation of depressions in which black clay and shale sedimentation took place. These clays and shales were originally "blackwaters" rich in organisms. The organic material was produced in oxygen-rich water, found only in shallow water or in the upper part of deep waters. The base metal sulphides contained in these sediments are believed to be a product of the reaction between ionised metals in solution and sulphur. The ionised metals were transported by the "blackwater" and the sulphur was derived from the death and accumulation of protein organisms, or from hydrogen sulphide, produced by bacteria. The reaction between protein sulphur or hydrogen sulphide and such ionised metal as Pb, Zn, Cu, Ag, Mn, took place in oxygen-free depths. The end stage of this process was the beginning of the Whyalla sedimentation. As this process varied, both laterally and vertically in time and space, sulphide thickness and extent are extremely variable. Best intersections made in the drill holes probably represent thicker basins or portions of basins of accumulation.

## 3.5 Structure of Area

Study of the shape of the underlying erosion surface of the Pandurra Formation, as revealed by the drill holes, indicates that the zones of clay with high geochemical content are aligned with depressions in this surface. By contrast the shales over the more elevated portions of this surface tend to be sandy

and greyer in colour, and relatively deficient geochemically in lead and zinc. This is shown by the isopachs drawn on the sub-surface plan, Plate 3.

3.6 Further Exploration

The drill results at the Winnie Pinnie-Trevenna Area have indicated that there is in this district a sedimentary formation carrying sparse base metal sulphides of lead and zinc, which appear to favour the darker and more carbonaceous shales and muds. The formation is correlated with the Woocalla Dolomite Formation and anomalous lead values are known to be present in two localities 20 miles apart.

This would open up an interesting area for investigation if the favourable rocks were accessible for inspection. However, it appears that little can be seen in outcrop because the shales have been eroded deeply and covered by more recent sands, clays and gravels; for example, no outcrop has been seen in the Winnie Pinnie-Trevenna Area. A very large part of the region, particularly in the west of the lease, is covered by dunes of wind-blown sand and the drainage pattern elsewhere consists of minor channels draining into salt lakes. Soil and drainage geochemistry are inapplicable. Rock geochemistry has been tried, but the results have not been particularly helpful; the only anomalous results from which this programme was derived consisting of sampled water bore cuttings.

The favourable shales and clays occupy more or less horizontal strata, probably overlain in most of the area by a shallow thickness of Whyalla Sandstone. The three main rock units - sandstone above, shale and clay, sandstone below - may have sufficiently contrasting velocities to be distinguished by a seismic method. If found to be applicable, this method could facilitate the location of basin structures in the top erosion surface of the Pandurra Formation which are considered to be the most favourable loci for accumulation of black shale and thus metal sulphides.

If this could be done, the next step would be to survey such target areas by the Induced Potential method to find the location of sulphide concentrations.

Regional exploration of the area as a whole must therefore lean heavily on geophysics. Before this type of programme

could be embarked upon it is considered more encouragement is needed in the shape of some tangible indications that economic grades of lead and zinc could be present.

The results at Winnie Pinnie are too close to the minimal to get really excited about. The possibility cannot be entirely discounted that they represent rather exceptional fluctuations in a metal background for these types of sediments.

There is not a great deal that geological mapping can do to add to the picture. Detailed observations of bedding attitudes in the Whyalla Sandstone will not necessarily throw any light on the shape of the underlying shales or the disconformable Pandurra Sandstone.

## 4. CONCLUSION AND RECOMMENDATIONS

The presence of sparse lead and zinc has been demonstrated in a stratiform setting within shale equivalents of the Woocalla Dolomite Formation. One of two localities known to be characterised by anomalous lead and zinc has been tested reasonably extensively without any indication of economic values.

On the results achieved to date a regional exploration programme of the area which would perforce lean heavily on geophysics, and be expensive to carry out, is not warranted.

However, the tonnage potential of the anomalous zones at Winnie Pinnie-Trevenna are such that it is considered that the Greenfields Dam anomaly should not be left untested.

A programme of 1,500 feet of rotary drilling would be most suitable, comprising approximately ten 150-foot holes spaced at about half-mile intervals parallel to the disconformity. A truck-mounted rotary drill like the Mayhew should be tried.

Some geological investigation should be made to check whether any shale outcrop can be found in the intervening country, particularly around the bluff and breakaways surrounding Lake Blyth, Lake Dutton and other smaller unnamed salt lakes.

With any encouragement from the Greenfields Dam drilling, the drilling of four or five stratigraphic holes to depths of, say, 300 feet, would be worth considering to obtain a section through the Woocalla Dolomite Formation spaced every four to five miles south towards Winnie Pinnie-Trevenna. This could be done while the rig is in the area.

Without greater encouragement from the drilling results it is difficult to see that this district offers prospects of any early discovery of mineralisation of economic importance.

N.B. This report incorporates the drill holes logged by A.C. Dunlop (Holes WP 1 to WP 14) and those logged by L. Szoke (Holes WP15 to WP 30).

I am also indebted to L. Szoke for his description of rock types and discussion on sulphide genesis.

A. Thomas,
Staff Geologist.

March 31, 1969

ISLAND LAGOON

LAKE MACFARLANE

137°00'E

31°45'S

32°00'S

Pernatty Lagoon

BIRTHDAY

ANOMALOUS LEAD, ZINC

Greenfield Dam

McLEAY

Oakden Hills Hs

PROPOSED DRILL THIS AREA

Sweet Neil Copper Mine

WOOCALLA

LAKE FINNISS

LAKE BLYTH

LAKE DUTTON

TRANSCONTINENTAL RAILWAY

Trevenna Q.S.

WINNIE PINNIE—TREVENNA AREA

Devonne Mineral Bore

Beda Bore

Yadnopinna Hs

LEGEND

| | | |
|---|---|---|
| A | | Mainly sand or soil |
| B | | Gravels, sands, clays |
| C | | Whyalla sandstone |
| D | | Woocalla dolomite |
| E | | Woocalla dolomite – shale equivalent |
| g | | Pandurra sandstone |
| × | | Proposed drill site |
| ×? | | Possible drill site (stratigraphic) |



PLATE 4

Plate 4 of report no 147
Plate 1 of report no. 110

# NORANDA AUSTRALIA LTD.

LAKE DUTTON S.M.L. 256

SOUTH AUSTRALIA

## GEOLOGICAL MAP

SCALE

| | | |
|---|---|---|
| DATE: 28 March 1969 | GEOLOGY: A THOMAS | DRAWN: N.S. |
| APPROVED: T.A.R | DRAWING No. 308/C/201 | |

ENV 1043(1)-2

137°00'E.

31°54'S.

WP24 −30 100'

WP12 11-25 75-4

Lake

WP13 −40 115'

WP23 14.5 180°

WP11 −5 120'

WINNIE PINNIE Dam

WP10 −10 150'

WP22 +12·5 100'

WP9 −15 50'

WP19 00' 100'

WP5 +2·5 150'

WP7 00 90'

WP8 −10 150'

WP16 −10 60'

WP20 +25 150'

WP21 +21·5 100'

WP4 +16 84'

Track

Abandoned Holes
WP1 80'
WP2 30'
WP3 50'

WP6 00 96'

WP17 +19 150'

WP18 +17·5 70'

WP19 +37·5 117'

To Hoxton and Tuttleponds H.S.

DATUM

TREVENNA O.S.

6°30'

Magnetic

Dam south of Trevenna O.S.

Lake

WP25 −33 200'

WP26 −33·5 193'

WP14 −40 68'

WP27 −10 93'

WP28 −5 50'

Track

To Trevenna H.S.

WP30 −30 129'

WP29 −17 114'

Lake

Legend

WP27 Drill Hole
−10 Reduced level of collar Relative to datum
93' Depth

DATUM COLLAR WP6

Cross sections

137°00'E.

ENV 1043(1)-7

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1043

Plate 5 of report no 147
Plate 2 of report no 110

PLATE 5

# NORANDA AUSTRALIA LTD.

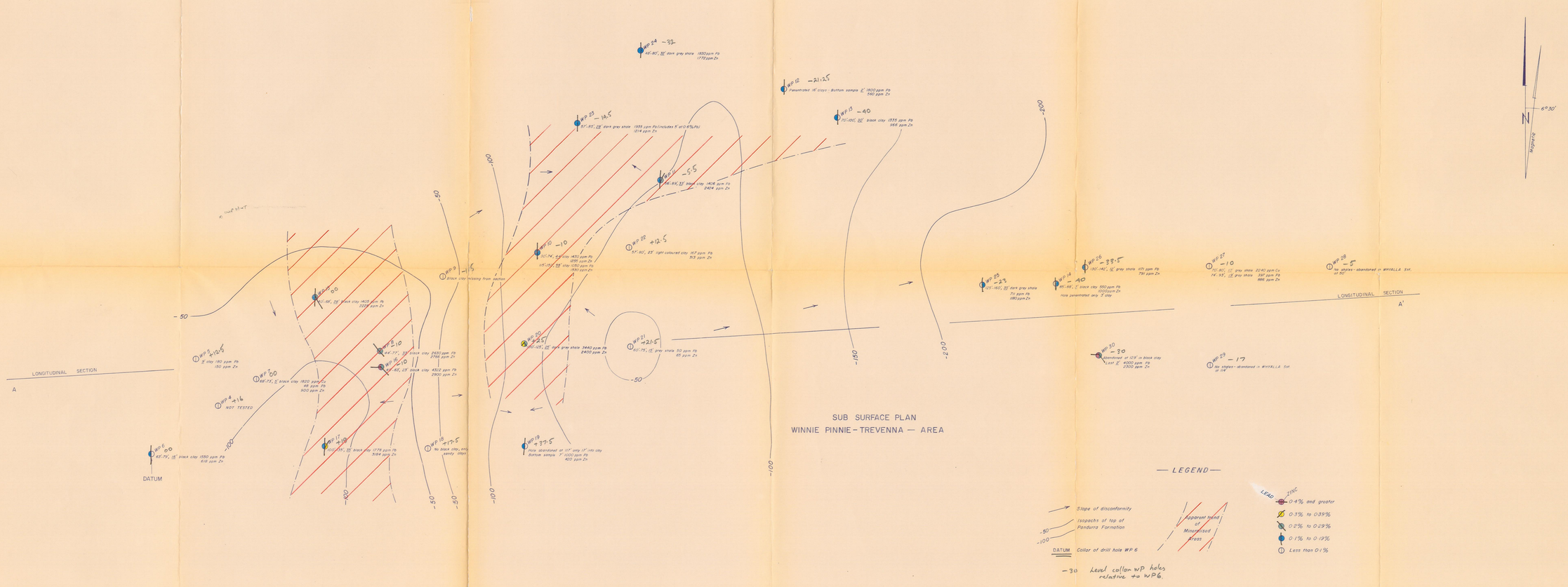
LAKE DUTTON SML 256
South Australia

## SURFACE PLAN

WINNIE PINNIE – TREVENNA AREA
Showing
DRILL HOLES

SCALE
1 inch = 1000 500 0 1000 2000 FEET

| | | |
|---|---|---|
| DATE: 28 MARCH 1969 | GEOLOGY: A. THOMAS | DRAWN: G.C. |
| APPROVED: T.A.R. | DRAWING No. 308/C/202 | |




SUB SURFACE PLAN
WINNIE PINNIE – TREVENNA — AREA

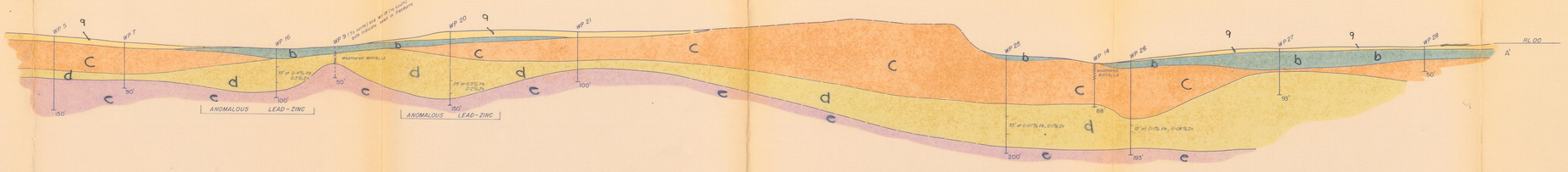
— LEGEND —

- Slope of disconformity
- Isopachs of top of Pandurra Formation
- Apparent trend of Mineralised Areas
- DATUM Collar of drill hole WP 6
- -30 Level collar WP holes relative to WP6

LEAD – ZINC
- 0·4% and greater
- 0·3% to 0·39%
- 0·2% to 0·29%
- 0·1% to 0·19%
- (1) Less than 0·1%

SUB SURFACE PLAN

LONGITUDINAL SECTION A-A'




LONGITUDINAL SECTION A—A' LOOKING NORTH

SCALE NOTE: Horizontal 1 inch = 1000 feet
Vertical 1 inch = 100 feet

— LEGEND —

- q Sand
- b Gravels
- c Whyalla sandstone
- d Woocalla dolomite (shales and clays)
- e Pandurra sandstone



Plate 6 of report no 147
Plate 3 of report no. 110

PLATE 6

**NORANDA AUSTRALIA LTD.**

LAKE DUTTON S.M.L. 256
South Australia

**SUB SURFACE PLAN**
WINNIE PINNIE – TREVENNA AREA SHOWING DRILLING RESULTS
**LONG SECTION A—A'**
SCALE
1000 500 0 1000 2000
FEET

| | | |
|---|---|---|
| DATE: 28th Mar. 1969 | GEOLOGY: A. Thomas | DRAWN: N.S. |
| APPROVED: T.A.R. | DRAWING No. 308-C-203 | |

ENV 1043(1)-6

NORANDA AUSTRALIA LIMITED

# DRILL RECORD

EMV 1043-II-1

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | 5 | 7 | 20 | 4201 | | | | | | Pink sandstone angular grains. | | | | | 0' - 80' |
| 5 | 10 | 5 | 30 | 88 | 4202 | | | | | | Pink sandstone with white clay pellets. | | | | | 0' - 50' |
| 10 | 15 | 5 | 15 | 44 | 4203 | | | | | | " " " " " " . Fe round grains. | | | | | Probably Tertiary Gravels. |
| 15 | 20 | 5 | 27 | 80 | 4204 | | | | | | Pink sandstone rounded wind blown grains rec. Whyalla sandstone. | | | | | |
| 20 | 25 | 5 | 11½ | 34 | 42 05 | | | | | | " " c darker Fe rounded grains - chips recognised as Whyalla sandstone. | | | | | Driller comments cavernous ground losing air in Hole. Hole 2.7/8" diam. Fairly long delay blowing through. |
| 25 | 30 | 5 | 16 | 47 | 4206 | | | | | | | | | | | |
| 30 | 35 | 5 | 17½ | 57 | 4207 | | | | | | Whyalla sandstone - Pink. c White clay pellets, and rounded Fe small pebbles. | | | | | |
| 35 | 40 | 5 | 28 | 82 | 4208 | | | | | | Whyalla sandstone - Pink. c Darker Fe pebbles. | | | | | |
| 40 | 45 | 5 | 37 | 109 | 4209 | | | | | | Friable fine grained White Whyalla sandstone c abundant impurities Fe stnd. pebbles and chips of Grey chert. | | | | | |
| 45 | 50 | 5 | 40 | 118 | 4210 | | | | | | Pink sandstone with rounded grains - some brown clay present from 45' | | | | | |
| 50 | 55 | 5 | 3 | 10 | 4211 | | | | | | At 50' brown clay pouring into hole. Cuttings are very fine grained Pink sandstone with rounded White pellets. | | | | | |
| 55 | 60 | 5 | - | | 4212 | | | | | | Fine pellets of clay being blown out of hole. No recovery of sample. | | | | | |
| 60 | 65 | 5 | - | | 4213 | | | | | | No Recovery - fine pellets of clay being thrown out. | | | | | |
| 65 | 70 | 5 | - | | 4214 | | | | | | " " " " " " " " | | | | | |
| 70 | 75 | 5 | - | | 4215 | | | | | | " " (Some pellets of Grey-Black clay. | | | | | |
| 75 | 80 | 5 | - | | 4216 | | | | | | " " (Thrown up). | | | | | |
| | | | | | | | | | | | Stopped Hole at 80' depth. | | | | | |



Drilled by B. O'Neill Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started October 4, 1968 Date Completed October 4, 1968 Logged by A. Thomas Sampled By R. Lennon Record Completed

No. of Hole WP-1. Location Lake Dutton, S.A. Depth of Hole 80' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-3 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 | 10 | 50 | | 4217 | | | | | | Cg boulder gravel at surface. Pale coloured sandstone (small round siliceous grains) with Pink argillaceous matrix - and some Fe stained fragments. Suspect - Gravel with clay matrix and various fragments mostly Whyalla sandstone. | | | | | 0' - 30' Relatively Hard. |
| 10 | 20 | 10 | 70 | | 4218 | | | | | | Pale coloured sandy clay with variety rock chips, some Fe stained some slightly rounded. Lighter coloured matrix. | | | | | Softer - Hole tending cave. |
| 20 | 30 | 10 | 50 | | 4219 | | | | | | Pale coloured argillaceous gravel? with some rounded pebbles and fragments of lithic sandstone. White clay pellets and light coloured clay matrix - gravel. | | | | | |
| | | | | | | | | | | | Hole abandoned at 30 ft. Large cavity at 10 ft. - Bottom of Hole filling - preventing deeper penetration. | | | | | |

Drilled by B. O'Neill Type of Drilling Air track Hole Size % Recovery Surveyed by Instrument Used

Date Started October 6, 1968 Date Completed October 6, 1968 Logged by A. Thomas Sampled By R. Lennon Record Completed

No. of Hole WP-2. Location Lake Dutton, S.A. Depth of Hole 30' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-II-4

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 30 | | | | | | | | | | Drilled through without recovery of cuttings. | | | | | 0' - 50' |
| 30 | 40 | 10 | 32 | | 4220 | | | | | | Pink argillaceous material - with fine round pebbles and a few Fe stained pebbles. | | | | | 0' - 40' Probably gravels. |
| | | | | | | | | | | | Drilled 0 - 20'. with 4" Bit. | | | | | |
| | | | | | | | | | | | 20 - 50' Drilled with 3½" shaver Bit. | | | | | |
| 40 | 50 | 10 | 24 | | 4221 | | | | | | From 40 - 50' Only recovered core material from higher in hole. No clay recovered. Sample taken. | | | | | |
| | | | | | | | | | | | Clay would not come to surface, despite use of shaver Bit. | | | | | |
| | | | | | | | | | | | Hole abandoned at 50'. | | | | | |

Drilled by B. O'Neill Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started October 6, 1968 Date Completed October 6, 1968 Logged by A. Thomas Sampled By R. Lennon Record Completed

No. of Hole WP-3. Location Lake Dutton, S.A. Depth of Hole 50' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-5 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 84'. |
| 0 | 10 | - | 27 | | 4222 | | | | | | Fragments of Grey Cherty or Travertine material in fine grained sandy variagated groundmass (Gravel). | | | | | Diam Hole 0'-80' |
| 10 | 20 | 10 | 38 | | 4223 | | | | | | Bulk of sample - spherical granules of quarts, but a number of fragments of gravel indicate transition in this section. | | | | | 3" ( 2.7/8" Bit). Reamed out with 4" Bit. |
| 20 | 30 | 10 | 42 | | 4224 | | | | | | | | | | | Casing from 0'-40' |
| 30 | 40 | 10 | 45 | | 4225 | | | | | | | | | | | |
| 40 | 50 | 10 | 40 | | 4226 | | | | | | Whyalla sandstone - light coloured - fine grained near spherical grains. | | | | | |
| 50 | 60 | 10 | 40 | | 4227 | | | | | | Whyalla sandstone - fine grained spherical grains - a few lithic fragments. | | | | | Recommenced 7/10/68 at 60'. |
| 60 | 70 | 10 | 63 | | 4228 | | | | | | Whyalla sandstone - contains fragments of Fe stained Lithic material, also faint trace of Fe or manganese [illegible] very fine grained in panned core. | | | | | |
| 70 | 80 | 10 | 46 | | 4229 | | | | | | Whyalla sandstone - fairly typical Brown slightly argillaceous matrix. | | | | | |
| 80 | 84 | 4 | - | | Sample | | | | | | Hole stopped at 84'. Cuttings not coming up - bottom of hole and sides caving. Couplings jamming in casing. | | | | | 10' of casing lost down hole. |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started October 6, 1968. Date Completed October 7, 1968. Logged by A. Thomas. Sampled By R. Lennon Record Completed

No. of Hole WP-4. Location Lake Dutton, S.A. Depth of Hole 84' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-II 6

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 150' |
| 0 | 10 | | | | | | | | | | Sand. (Not Sampled). Chips from base - Whyalla sandstone. | | | | | Casing 0-10'. |
| 10 | 20 | 10 | 24 | | 4230 | | | | | | Whyalla sandstone - fine grained sandstone - even spherical grains with few slightly larger Lithic and Fe coloured fragments. (Not hard rock - but hammer used on drill). | | | | | |
| 20 | 30 | 10 | 29 | | 4231 | | | | | | (Hammer not used). Whyalla sandstone typical with trace Mn in dish - very fine. | | | | | |
| 30 | 40 | 10 | 44 | | 4232 | | | | | | (Hammer in use from 35'). Whyalla sandstone typical. | | | | | |
| 40 | 50 | 10 | 19 | | 4233 | | | | | | Hammer in use. Whyalla sandstone typical. Slightly darker colour due to 40% Pink Quartz grains and also presence Fe stained Lithic | | | | | |
| 50 | 60 | 10 | 32 | | 4234 | | | | | | Hammer in use. Whyalla sandstone as above. Several larger Fe stained lithic fragments - number fine grained White lithics - 40% pink quarts grains. | | | | | |
| 60 | 69 | 9 | | | 4235 | 130 | 170 | 40 | 25 | | Whyalla sandstone, [illegible] number White lithic fragments and appreciable content (2-3%) of fine grained dark material. Not heavy Mn or carbonaceous. | | | | | |
| 69 | 80 | 11 | | | 4236 | | | | | | Drill unable penetrate beyond 69'. Cuttings jamming between Coupling and Casing. | | | | | |
| | | | | | | | | | | | 8.10.68. Attempted deepen hole - Cutting clay - some earthy-Red, Brown, some fissile Brown. Rods jamming. Decided to investigate Auger flights. | | | | | |
| 69 | 72 | 3 | 15 Damp | | 4237 | 180 | 140 | 150 | 40 | | Brown clay tending Grey Brown - damp in fine grained globules and some flaky shale-like pieces. Lesser Brown earthy fragments. Colouration tending to Black at base of Section. No mineralisation seen. | | | | | Resumed 10/10/68. Using Auger Flights on base of rods. |
| 72 | 78 | 6 | 19 Damp | | 4238 | 120 | 180 | 150 | 30 | | Black clay - mainly blown up in globular pellets. | | | | | |
| 78 | 84 | 6 | 34 Dry | | 4239 | | | | | | Pandurra Formation - Red sandstone & chips blue Quartz and fair quantity Lithic material. | | | | | |
| 84 | 90 | 6 | 34 | | 4240 | | | | | | Pandurra Formation. | | | | | Very hard boring. |
| 90 | 95 | 5 | 23½ | | 4241 | | | | | | Pink and White sandstone grains distinctly elongated and of a fair range in size. Few chips of Bluish Quartz. Probably Pandurra formation. | | | | | |
| 95 | 100 | 5 | 31 | | 4242 | | | | | | Pink and White sandstone as above. Pandurra formation. | | | | | " " " |
| 100 | 110 | 10 | 53 | | 4243 | | | | | | Same rock - Pandurra formation. Few isolated grains Pyrite. | | | | | " " " |
| 110 | 120 | 10 | 52 | | 4244 | | | | | | As above. | | | | | |
| 120 | 130 | 10 | 52 | | 4245 | | | | | | Same Pink and White sandstone. No vestige of Sulphides. | | | | | " " " |
| 130 | 140 | 10 | 47 | | 4246 | | | | | | Pandurra formation - as above. | | | | | |
| 140 | 150 | 10 | 6 | | 4247 | | | | | | Pandurra formation - as above. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started October 7, 1968. Date Completed October 10, 1968. Logged by A. Thomas. Sampled By R. Lennon. Record Completed

No. of Hole WP-5. Location Lake Dutton, S.A. Depth of Hole 150' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-7 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Bearing | Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 96' |
| 0 | 5 | 5 | 20 | | | | | | | | Gravel - variable silicified fragments. | | | | | 5' Case. |
| 5 | 10 | 5 | 20 | | 4248 | | | | | | Gravel - "Silcrete". | | | | | Ground caving used mud to stabilise hole. |
| 10 | 20 | 10 | 27 | | 4249 | | | | | | - | | | | | |
| 20 | 30 | 10 | Nil | | - | | | | | | Gravel. | | | | | |
| 30 | 40 | 10 | 78 | | 4251 | | | | | | Gravel and minor clay fraction. | | | | | |
| 40 | 45 | 5 | 16 | | 4252 | | | | | | No recovery. | | | | | Auger flight in use from 45 ft. |
| 45 | 48 | 3 | - | | | | | | | | Clay contaminated with Red soil from base of collar. | | | | | |
| 48 | 49 | 1 | ¼ | | 4253 | 30 | 70 | 95 | 25 | | As above. | | | | | |
| 49 | 53 | 4 | 2⅜ | | 4254 | 45 | 590 | 50 | 30 | | Clay - Buff - minor gravel fragments. | | | | | |
| 53 | 58 | 5 | 2½ | | 4255 | 55 | 1200 | 65 | 20 | | As above. | | | | | |
| 58 | 63 | 5 | 3 | | 4256 | 45 | 800 | 55 | 30 | | Clay - Buff - minor Black. | | | | | Resumed 11/10/68 at 68'. |
| 63 | 68 | 5 | 15 | | 4257 | 240 | 1300 | 180 | 30 | | Clay - Buff - Black contaminated with gravel. | | | | | |
| 68 | 73 | 5 | 7½ | | 4258 | 370 | 1400 | 160 | 95 | 10 | Black clay. | | | | | |
| 73 | 76 | 3 | 11 | | 4259 | 1200 | 1800 | 980 | 120 | 30 | Black and Grey clay. | | | | | Set extra 10' Casing |
| 76 | 78 | 2 | 14 | | 4260 | 3400 | 1900 | 2200 | 90 | 300 | Black clay. | | | | | |
| 78 | 79 | 1 | 3 | | 4261 | 1000 | 1900 | 840 | 100 | 40 | Black mud - Quarts grains and Sulphides. (Pyrite) 2-3% | | | | | |
| 79 | 88 | 9 | Wet | | 4262 | 440 | 590 | 600 | 40 | | Last 2 ft. probably suggestive Pandurra F. | | | | | |
| 88 | 90 | 2 | Wet | | 4263 | 260 | 510 | 200 | 50 | 10 | Soft rock. | | | | | |
| 90 | 96 | 6 | - | | | | | | | | Black mud - Quarts grains with minor Pyrite (1%). | | | | | Cutting's accumulating in clay. |
| | | | | | | | | | | | No Recovery - hard rock boring - Wet mud above. Pandurra. | | | | | |
| | | | | | | | | | | | END OF HOLE AT 96'. | | | | | Unable penetrate further into Pandurra F. |

Drilled by B. O'Neill. Type of Drilling Percussion Hole Size % Recovery Surveyed by Instrument Used

Date Started October 10, 1968. Date Completed October 11, 1968. (12.15 pm.) Logged by Dunlop-Patterson Sampled By R. Lennon Record Completed

No. of Hole WP-6. Location Lake Dutton, S.A. Depth of Hole 96' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-8 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 90' |
| 0 | 10 | | | | | | | | | | Sand. | | | | | 10' Casing. |
| 10 | 15 | 5 | | | 4264 | | | | | | Whyalla sandstone. | | | | | |
| 15 | 20 | 5 | | | 4265 | | | | | | Whyalla sandstone. | | | | | |
| 20 | 25 | 5 | 24 | | 4266 | | | | | | Whyalla sandstone. | | | | | |
| 25 | 30 | 5 | 16 | | 4267 | | | | | | Whyalla sandstone. Pink and White some Grey lithic material. | | | | | |
| 30 | 40 | 10 | 27 | | 4268 | | | | | | As above. | | | | | |
| 40 | 45 | 5 | 11 | | 4269 | | | | | | Whyalla sandstone. | | | | | |
| 45 | 48 | 3 | 5 | | 4270 | | | | | | " " | | | | | |
| 48 | 50 | 2 | 8 | | 4271 | | | | | | " " | | | | | |
| 50 | 60 | 10 | 42 | | 4272 | | | | | | " " | | | | | |
| 60 | 63 | 3 | 5 | | 4273 | | | | | | " " - Pink quartz and White clay fraction. | | | | | Auger Flight. |
| 63 | 68 | 5 | 11 | | 4274 | 25 | < 20 | 20 | 170 | < 2 | Sandy clay - Khaki. | | | | | " " |
| 68 | 73 | 5 | 14 | | 4275 | 2000 | 290 | 900 | 320 | 10 | Black clay with minor Pyrite - Foreign? | | | | | " " |
| 73 | 74 | 1 | Wet | | 4276 | 950 | 400 | 720 | 300 | | Black clay (Hard rock at 74' with a little $H2_0$ made overnight). | | | | | Resumed 7 a.m. 12/10/68. @ 73'. |
| 74 | 80 | 6 | Wet | | 4277 | 650 | 190 | 720 | 350 | | Bored in hard rock recogn. by chips As Pandurra F. Hole wet but not wet enough to blow out adequate sample. Sample contaminated by Black clay from above 80'. | | | | | Percussion Bit resumed. |
| 80 | 85 | 5 | Wet | | 4278 | 1500 | 200 | 1100 | 360 | | Pandurra Fm. - Elongated Pink and White quartz grains; with a few large pieces of Pyrite. Contaminated by shaly fragments. | | | | | |
| 85 | 90 | 5 | Wet | | 4279 | 1100 | 200 | 900 | 550 | | Pandurra Fm. - As above, with several coarse grains Pyrite, and heavily contaminated with Black shaly clay. | | | | | |
| | | | | | | | | | | | Considered Pyrite probably ex-Black clay - No sign of Fine grained Pyrite. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started October, 11, 1968. Date Completed October 12, 1968. Logged by Dunlop-Patterson Sampled By R. Lennon Record Completed

(2.15 p.m. Struck clay 3 p.m.)

No. of Hole WP-7. Location Lake Dutton, S.A. Depth of Hole 90' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-9 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Cu | Pb | Zn | Mn | Ag | | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6 | | | | | | | | | | | Sand. | | | | | 0' - 120' 6" casing |
| 6 | 10 | 4 | 16 | | 4280 | | | | | | | Whyalla sandstone and surface sand. | | | | | |
| 10 | 20 | 10 | 31 | | 4281 | | | | | | | Whyalla sandstone. | | | | | |
| 20 | 30 | 10 | 37 | | 4282 | | | | | | | Whyalla sandstone and White clay fraction. | | | | | |
| 30 | 35 | 5 | 12 | | 4283 | | | | | | Zinc Recheck | As above and minor Black grains. | | | | | |
| 35 | 38 | 3 | 8½ | | 4284 | 120 | 190 | 560 | 90 | | | Grey-Red and Brown clay. | | | | | Auger at 35'. |
| 38 | 40 | 2 | 10 | | 4285 | 1300 | 120 | 250 | 200 | | | Black clay. | | | | | |
| 40 | 44 | 4 | 15 | | 4286 | 950 | 210 | 300 | 240 | | | As above. | | | | | |
| 44 | 48 | 4 | 11 | | 4287 | 700 | 880 | ~~410~~ | 180 | | 400 | As above. | | | | | Auger Broken |
| 48 | 51 | 3 | 14 | | 4288 | 200 | 6300 | 7000 | 180 | | 1600 | As above. | | | | | |
| 51 | 54 | 3 | 17 | | 4289 | 340 | 3300 | 1000 | 250 | | 1000 | As above. | | | | | Resumed 13th. |
| 54 | 56 | 2 | 14 | | 4290 | 200 | 3400 | | 270 | | 3000 | As above. | | | | | |
| 56 | 57 | 1 | 6 | | 4291 | 140 | 3100 | | 270 | | 4600 | As above. Auger into hard rock? | | | | | |
| 57 | 60 | 3 | 15 | | 4292 | 90 | 2900 | | 360 | | 4500 | Black clay. | | | | | |
| 60 | 62 | 2 | 8 | | 4293 | 140 | 3200 | | 720 | | 5100 | Black clay with a few shale (Black, banded) fragments near base. | | | | | |
| 62 | 64 | 2 | 7 | | 4294 | 80 | 1600 | | 8500 | | 3900 | Black clay with Grey shale fragments. | | | | | |
| 64 | 66 | 2 | 13 | | 4295 | 60 | 2700 | | 4500 | | 3500 | Black clay with abundant Grey and minor Black shale fragments. | | | | | |
| 66 | 68 | 2 | Wet | | 4296 | 90 | 5300 | | 9600 | | 3000 | As above with trace of Galena ( < 1%) | | | | | Auger. |
| 68 | 70 | 2 | Wet | | 4297 | 280 | 1600 | 1100 | 9600 | | 1100 | Black clay with shale fragments. Minor Pyrite ( 1%) in fragments. | | | | | |
| 70 | 72 | 2 | Wet | | 4298 | 800 | 1000 | | 4800 | | 1100 | Black clay with shale fragments. Trace Pyrite. | | | | | |
| 72 | 74 | 2 | Wet | | 4299 | 430 | 1100 | | 4000 | | 1200 | As above. | | | | | |
| 74 | 76 | 2 | Wet | | 4300 | 280 | 880 | 1760 | 4400 | 5 | 1500 | Black clay with shale fragments. | | | | | |
| 76 | 77 | 1 | Wet | | 4301 | 460 | 1100 | | 6400 | | 2700 | As above. | | | | | |
| 77 | 80 | 3 | Wet | | 4302 | 260 | 680 | 760 | 8800 | | 760 | Shale fragments with minor Dolomite. | | | | | Percussion. |
| 80 | 85 | 5 | Wet | | 4303 | 160 | 890 | 600 | 3000 | | 600 | Abundant Quartz grains - rounded and angular - Pandurra Formation? | | | | | |
| 85 | 90 | 5 | Wet | | 4304 | 0.01 | 0.11 | 0.04 | 0.20 | 3 | | Pandurra Quartzite. Fine tail Sulphides - dark with shiny reflective surface - could be Galena - 0.5% Galena ) 2.5% Pyrite ) | | | | | Percussion " |
| 90 | 95 | 5 | Wet | | 4305 | <0.01 | 0.08 | 0.04 | 0.12 | < 2 | | As above about 0.2% Galena - 1% Pyrite. | | | | | |
| 95 | 100 | 5 | Wet | | 4306 | <0.01 | 0.12 | 0.03 | 0.09 | < 2 | | Pandurra Quarts. Fine tail Sulphide - 0.5% Galena - 1.0% Pyrite. | | | | | |
| 100 | 105 | 5 | Wet | | 4307 | 0.01 | 0.12 | 0.04 | 0.13 | 2 | | As above. | | | | | |
| 105 | 110 | 5 | Wet | | 4308 | <0.01 | 0.08 | 0.04 | 0.08 | 2 | | As above. | | | | | |
| 110 | 115 | 5 | Wet | | 4309 | | | | | | | As above. | | | | | |
| 115 | 120 | 5 | Wet | | 4310 | | | | | | | As above. | | | | | End day - 12/10/68 |

Drilled by B. O'Neill. Type of Drilling Percussion Hole Size % Recovery Surveyed by Instrument Used

Date Started October 12, 1968. Date Completed October 14, 1968. (8.10 a.m.) Logged by Dunlop-Patterson Sampled By R. Lennon Record Completed

No. of Hole WP-8. Location Lake Dutton, S.A. Depth of Hole 120' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-10 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 50' |
| 0 | 10 | 10 | - | | | | | | | | Sand and clay. | | | | | 10' Case. |
| 10 | 20 | 10 | 33 | | 4311 | | | | | | White and Buff clay. | | | | | |
| 20 | 25 | 5 | 20 | | 4312 | | | | | | As above. | | | | | |
| 25 | 30 | 5 | 23 | | 4313 | | | | | | Pandurra formation - No mineralisation. | | | | | |
| 30 | 35 | 5 | 28 | | 4314 | | | | | | As above. | | | | | |
| 35 | 40 | 5 | 17 | | 4315 | | | | | | As above and Yellow clay. | | | | | |
| 40 | 45 | 5 | 15 | | 4316 | | | | | | Pandurra - minor Yellow clay. | | | | | |
| 45 | 50 | 5 | 17 | | 4317 | | | | | | As above. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill. Type of Drilling Percussion Hole Size % Recovery Surveyed by Instrument Used

Date Started October 14, 1968. (8.20 a.m.) Date Completed October 14, 1968. (9.20 a.m.) Logged by Patterson, Dunlop. Sampled By R. Lennon Record Completed

No. of Hole WP-9. Location Lake Dutton, S.A. Depth of Hole 50' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

10443-11 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 150'. 10" Case |
| 0 | 10 | - | - | | | | | | | | Sand and clay. | | | | | |
| 10 | 15 | 5 | 7 | | 4318 | | | | | | Sand and clay. | | | | | |
| 15 | 20 | 5 | 14 | | 4319 | | | | | | Red and Yellow clay. | | | | | |
| 20 | 25 | 5 | 16 | | 4320 | | | | | | White clay. | | | | | |
| 25 | 30 | 5 | 11 | | 4321 | | | | | | White and Buff clay. | | | | | |
| 30 | 35 | 5 | 14 | | 4322 | 90 | 1500 | 50 | 20 | | Pale Purple clay. | | | | | Auger 30' to 50'. |
| 35 | 40 | 5 | 25 | | 4323 | 140 | 2800 | 100 | 60 | | As above. | | | | | |
| 40 | 45 | 5 | 12 | | 4324 | 210 | 2400 | 230 | 75 | | Brown clay. | | | | | |
| 45 | 48 | 3 | 4½ | | 4326 | 950 | 1500 | 1300 | 100 | 20 | Black and Brown clay and very fine Sulphide 1%. (Including Pyrite and Galena?) | | | | | |
| 48 | 50 | 2 | 3 | | 4327 | 380 | 1300 | 1800 | 430 | 15 | Black and Brown clay - trace Pyrite, Galena. | | | | | |
| 50 | 55 | 5 | 16 | | 4328 | 40 | 1100 | 2400 | 2000 | 5 | Black clay, Pyrite and Galena (2%). | | | | | Put on Bit |
| 55 | 60 | 5 | | | 4329 | 40 | 1100 | 2600 | 1500 | 5 | As above. | | | | | 50' to 70'. |
| 60 | 65 | 5 | 17 | | 4330 | 50 | 940 | 1200 | 1800 | 5 | As above. (1%). | | | | | |
| 65 | 70 | 5 | 14 | | 4331 | 45 | 640 | 1200 | 950 | < 2 | As above. (1%). | | | | | |
| 70 | 73 | 3 | Wet | | 4332 | 140 | 810 | 2200 | 1500 | 5 | Black clay - minor Pyrite, trace Galena. | | | | | Auger 70' to 98'. |
| 73 | 74 | 1 | Wet | | 4333 | 220 | 1000 | 2200 | 1200 | < 2 | As above. | | | | | |
| 74 | 85 | 11 | Wet | | 4334 | 55 | 450 | 880 | 2000 | 2 | As above. | | | | | |
| 85 | 90 | 5 | Wet | | 4335 | 35 | 320 | 840 | 3300 | 5 | As above. | | | | | |
| 90 | 93 | 3 | Wet | | 4336 | 45 | 280 | 330 | 2400 | < 2 | Black clay - Pyrite (2%). | | | | | |
| 93 | 98 | 5 | Wet | | 4337 | 55 | 480 | 320 | 2200 | 2 | Consolidated Black clay - Pyrite and Galena, Sulphides 1%. | | | | | |
| 98 | 104 | 6 | Wet | | 4338 | 50 | 510 | 1000 | 2600 | 2 | Black shales - minor Pyrite, trace Galena. | | | | | Bit 98' to 130'. |
| 104 | 110 | 6 | Wet | | 4339 | 50 | 490 | 900 | 2400 | 2 | As above. | | | | | |
| 110 | 115 | 5 | Wet | | 4340 | 40 | 440 | 400 | 1800 | 5 | As above. Sulphides very fine (3%). | | | | | |
| 115 | 120 | 5 | Wet | | 4341 | 60 | 450 | 1200 | 3400 | 5 | As above. Trace Sulphide. | | | | | |
| 120 | 125 | 5 | Wet | | 4342 | 50 | 710 | 1800 | 2600 | 2 | As above. Trace Sulphide. | | | | | |
| 125 | 130 | 5 | Wet | | 4343 | 55 | 720 | 2000 | 2800 | 5 | As above. Trace Pyrite and Galena. | | | | | |
| 130 | 135 | 5 | Wet | | 4344 | 50 | 2600 | 1400 | 3400 | 30 | Black and Grey shale (Dolomitic?) trace Sulphide. | | | | | Bit 130' to 150'. |
| 135 | 140 | 5 | Wet | | 4345 | 600 | 1200 | 1300 | 4500 | 5 | Black shale and Yellow clay fraction - Galena and Pyrite, Sulphide 4%. | | | | | |
| 140 | 145 | 5 | Wet | | 4346 | 380 | 1000 | 1400 | 5000 | < 2 | Black shale some Quartz (origin?) Sulphide 3% Pyrite, Galena. | | | | | |
| 145 | 150 | 5 | Wet | | 4347 | 220 | 690 | 1600 | 3600 | 5 | Pandurra formation - Sulphide 5% - Pyrite-Galena. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by E. O'Neill. Type of Drilling Percussion Hole Size % Recovery Surveyed by Instrument Used

Date Started October 14, 1968. Date Completed October 15, 1968. Logged by Dunlop-Patterson. Sampled By Lennon. Record Completed

No. of Hole WP-10. Location Lake Dutton, S.A. Depth of Hole 150' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-12 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 120'. 10' Casing. |
| 0 | 10 | - | - | | | | | | | | Sand. | | | | | |
| 10 | 15 | 5 | 25 | | 4348 | | | | | | White clay with minor White sandstone - Whyalla sandstone. | | | | | |
| 15 | 20 | 5 | 3 | | 4349 | | | | | | Whyalla sandstone and White clay. | | | | | Auger from 15' to 56' |
| 20 | 24 | 4 | 5 | | 4350 | | | | | | Grey - White clay. No Sulphide mineralisation observed. | | | | | |
| 24 | 26 | 2 | 9 | | 4351 | | | | | | As above. | | | | | |
| 26 | 28 | 2 | 10 | | 4352 | | | | | | As above. | | | | | |
| 28 | 31 | 3 | 6 | | 4353 | | | | | | As above. | | | | | |
| 31 | 34 | 3 | 15 | | 4354 | | | | | | As above. | | | | | |
| 34 | 37 | 3 | 8 | | 4355 | | | | | | As above with abundant Gypsum. | | | | | |
| 37 | 40 | 3 | 12 | | 4356 | | | | | | Grey clay with minor Yellow clay. | | | | | |
| 40 | 43 | 3 | 7 | | 4357 | | | | | | As above. | | | | | |
| 43 | 46 | 3 | 8 | | 4358 | | | | | | Light Khaki clay. | | | | | |
| 46 | 49 | 3 | 8 | | 4359 | | | | | | Khaki and Orange-Brown clay. No Sulphide mineralisation. | | | | | |
| 49 | 52 | 3 | 14 | | 4360 | | | | | | As above. | | | | | |
| 52 | 53 | 1 | 5 | | 4361 | | | | | | Khaki with minor Black clay. No Sulphides observed. | | | | | |
| 53 | 56 | 3 | 11 | | 4362 | | | | | | Khaki and Black clay. Minor Sulphides (Pyrite & Galena) in Black clay. | | | | | |
| 56 | 60 | 4 | 15 | | 4363 | 50 | 1000 | 2400 | 510 | 10 | Black shale chips. Trace Sulphides (including Galena). | | | | | Bit from 56' to 65'. |
| 60 | 65 | 5 | 14 | | 4364 | 45 | 1100 | 3000 | 1400 | 10 | Black shale chips. No Sulphides observed. | | | | | |
| 65 | 66 | 1 | 4 | | 4365 | 200 | 1100 | 2200 | 2600 | | Black clay. Minor Sulphides (Pyrite and Galena). | | | | | Resumed 16/10/68. |
| 66 | 68 | 2 | 15 | | 4366 | 120 | 1100 | 2000 | 9600 | | As above. | | | | | Auger from 65 to 84' |
| 68 | 71 | 3 | Wet | | 4367 | 120 | 1300 | 5200 | 6000 | | Black shale chips and black clay. Sulphides 1% including Galena. | | | | | |
| 71 | 76 | 5 | Wet | | 4368 | 120 | 2900 | 3000 | 3600 | | Black clay with Pyrite and Galena 1-2%. | | | | | |
| 76 | 78 | 2 | Wet | | 4369 | 230 | 2800 | 2600 | 2800 | | As above. 1/2 - 1%. | | | | | |
| 78 | 84 | 6 | Wet | | 4370 | 320 | 1100 | 1400 | 3600 | | Black shale chips Sulphides 2-3%. (Pyrite and Galena) | | | | | |
| 84 | 89 | 5 | Wet | | 4371 | 270 | 600 | 1400 | 3800 | | Black shale and grey shale (Dolomite?), Sulphides 2-3%. | | | | | Bit from 84' to 120' |
| 89 | 95 | 5 | Wet | | 4372 | 120 | 440 | 480 | 7200 | | Dolomite, Galena, Pyrite, Sulphide < 1% | | | | | |
| 95 | 100 | 5 | Wet | | 4373 | 160 | 490 | 860 | 2600 | | Pandurra. Sulphide - Galena-Pyrite 5%. | | | | | |
| 100 | 105 | 5 | Wet | | 4374 | 130 | 380 | 480 | 200 | | As above. Sulphide 2-3% mainly Pyrite. | | | | | |
| 105 | 110 | 5 | Wet | | 4375 | 110 | 190 | 200 | 650 | | As above. Sulphide 5% mainly Pyrite. | | | | | |
| 110 | 115 | 5 | Wet | | 4376 | 70 | 230 | 310 | 470 | | As above. Sulphide 2-3% mainly Pyrite. | | | | | |
| 115 | 120 | 5 | Wet | | 4377 | 70 | 220 | 230 | 600 | | Pandurra minor Sulphides. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B.O'Neill. Type of Drilling Percussion Hole Size % Recovery Surveyed by Instrument Used

Date Started October 15, 1968. Date Completed October 16, 1968. Logged by Dunlop-Patterson Sampled By Lennon. Record Completed

No. of Hole WP-11. Location Lake Dutton, S.A. Depth of Hole 120' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-13 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 | | | | | | | | | | Dune sand and decomposed Whyalla sandstone. | | | | | 0'-76'6" 10' Case. |
| 10 | 20 | 10 | 7 | | 4377 | | | | | | Whyalla sandstone. | | | | | |
| 20 | 30 | 10 | 12 | | 4378 | | | | | | Whyalla sandstone and minor White clay. | | | | | |
| 30 | 34 | 4 | 5 | | 4379 | | | | | | White clay (sandy) | | | | | Auger from 30' to 72'. |
| 34 | 36 | 2 | 7 | | 4380 | | | | | | Whyalla sandstone - White clay. | | | | | |
| 36 | 38 | 2 | 10 | | 4381 | | | | | | As above with minor Black clay. | | | | | |
| 38 | 41 | 3 | 10 | | 4382 | | | | | | As above. | | | | | |
| 41 | 45 | 4 | 14 | | 4383 | | | | | | Quartz and White clay (Whyalla sandstone decomposed). | | | | | |
| 45 | 48 | 3 | 12 | | 4384 | | | | | | As above. | | | | | |
| 48 | 54 | 6 | 28 | | 4385 | | | | | | As above. | | | | | |
| 54 | 58 | 4 | 13 | | 4386 | | | | | | As above. | | | | | |
| 58 | 60 | 2 | 15 | | 4387 | | | | | | As above with minor Khaki and Orange clay. | | | | | |
| 60 | 63 | 3 | 5 | | 4388 | | | | | | Khaki and Black clay. (Decomposed Whyalla sandstone contamination) No Sulphides observed. | | | | | |
| 63 | 65 | 2 | 10 | | 4389 | 430 | 75 | 150 | 140 | | Black with minor Khaki clay (contaminated by Whyalla sandstone) 2-3% very fine grained Sulphides in black clay. | | | | | |
| 65 | 68 | 3 | 5 | | 4390 | 480 | 170 | 290 | 150 | | Contaminated Black clay. 2% fine Sulphides. | | | | | |
| 68 | 70 | 2 | 5 | | 4391 | 290 | 700 | 300 | 160 | | As above. 1% Sulphides (Including Galena). | | | | | |
| 70 | 72 | 2 | 14 | | 4392 | 160 | 1800 | 560 | 220 | | As above. Minor Sulphides in washings - few large (1 mm.) crystals of Galena. | | | | | |
| 72 | 76'6" | 4'6" | No Recovery. | | | | | | | | | | | | | Bit from 72' to 76'6" |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill. Type of Drilling Percussion. Hole Size % Recovery Surveyed by Instrument Used

Date Started October 16, 1968. Date Completed October 16, 1968. Logged by K. Patterson Sampled By Lennon. Record Completed

No. of Hole WP-12. Location Lake Dutton, S.A. Depth of Hole 76'6" Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-14 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0'-115' |
| 0 | 10 | 10 | | | | | | | | | White sand. | | | | | 10" Casing. |
| 10 | 20 | 10 | 23 | | 4393 | | | | | | Whyalla sandstone. | | | | | |
| 20 | 30 | 10 | 33 | | 4394 | | | | | | " " - Part clayey. | | | | | |
| 30 | 40 | 10 | 34 | | 4395 | | | | | | " " | | | | | |
| 40 | 43 | 3 | 7 | | 4396 | | | | | | " " and fine grained grey shale. | | | | | |
| 43 | 45 | 2 | 1 | | 4397 | 400 | 40 | 35 | 50 | | As above. No Sulphides. | | | | | Auger from |
| 45 | 50 | 5 | 12 | | 4398 | 110 | < 20 | 20 | 30 | | Grey sandy shale. Trace Sulphides (including Galena). | | | | | 43' to 45' |
| 50 | 55 | 5 | 9 | | 4399 | 35 | < 20 | 85 | 20 | | As above. | | | | | Bit 45-56. |
| 55 | 56 | 1 | 7 | | 4400 | 50 | 20 | 190 | 30 | | As above - minor Sulphides. | | | | | |
| 56 | 59 | 3 | 13 | | 4401 | 110 | 50 | 280 | 60 | | Black clay (contaminated with sandstone). Sulphides < 1%. | | | | | Auger from |
| 59 | 62 | 3 | Wet | | 4402 | 600 | 150 | 600 | 160 | | Black clay. Minor Sulphides. | | | | | 56-62'. |
| 62 | 70 | 8 | Wet | | 4403 | 290 | 900 | 450 | 380 | | Black clay. Sulphides 1% (including Galena) | | | | | |
| 70 | 75 | 5 | Wet | | 4404 | 190 | 1400 | 640 | 1200 | | Black shale, minor Dolomite, and Quartz grains - contamination. Sulphides < 1%. | | | | | |
| 75 | 78 | 3 | Wet | | 4405 | 450 | 1400 | 3200 | 1500 | | Black shale. Sulphides 1% (including Galena). | | | | | Auger from |
| 78 | 85 | 7 | Wet | | 4406 | 170 | 1500 | 1000 | 1100 | | As above. 1-2% - some large ( 2 m.m.) Galena crystals. | | | | | 75-78'. |
| 85 | 90 | 5 | Wet | | 4407 | 130 | 1600 | 840 | 2200 | | As above. 1% | | | | | Continued |
| 90 | 95 | 5 | Wet | | 4408 | 160 | 720 | 510 | 3200 | | Grey shales (Dolomite) Sulphides 1% (including Galena) No sulphide in shale chips. | | | | | 18/10/68. |
| 95 | 100 | 5 | Wet | | 4409 | 220 | 790 | 490 | 3600 | | As above with Sulphides. < 1 minor pink quartzite. | | | | | |
| 100 | 105 | 5 | Wet | | 4410 | 160 | 370 | 370 | 2400 | | Pink quartzite - Pandurra Formation, contamination from overlying shale. Trace of Sulphides. | | | | | |
| 105 | 110 | 5 | Wet | | 4411 | 120 | 330 | 260 | 1100 | | As above. Sulphides 1-2%. | | | | | |
| 110 | 115 | 5 | Wet | | 4412 | 110 | 280 | 160 | 500 | | As above. Trace Sulphide | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill. Type of Drilling Percussion. Hole Size % Recovery Surveyed by Instrument Used

Date Started October 17, 1968. Date Completed October 17, 1968. Logged by K.Patterson Sampled By Lennon Record Completed

No. of Hole WP-13. Location Lake Dutton, S.A. Depth of Hole 115' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-15 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 88' |
| 0 | 5 | | | | | | | | | | Sandy clay. | | | | | 15' Casing |
| 5 | 8 | 3 | 4 | | 4413 | | | | | | Weathered sandy (Rounded grains) clay. | | | | | Auger from 5' to 17' |
| 8 | 9 | 1 | 4 | | 4414 | | | | | | White clay (sandy). | | | | | |
| 9 | 11 | 2 | 5 | | 4415 | | | | | | As above. | | | | | |
| 11 | 14 | 3 | 11 | | 4416 | | | | | | White and grey clay (sandy). | | | | | |
| 14 | 17 | 3 | 10 | | 4417 | | | | | | Clayey sandstone. | | | | | |
| 17 | 20 | 3 | Wet | | 4418 | | | | | | As above with abundant Gypsum. | | | | | |
| 20 | 25 | 5 | Wet | | 4419 | | | | | | Clayey sand with minor dark Brown soil? (Unconsolidated) | | | | | |
| 25 | 30 | 5 | Wet | | 4420 | | | | | | As above. | | | | | |
| 30 | 35 | 5 | Wet | | 4421 | | | | | | Whyalla sandstone, minor White clay. | | | | | |
| 35 | 40 | 5 | Wet | | 4422 | | | | | | As above. | | | | | |
| 40 | 45 | 5 | Wet | | 4423 | | | | | | As above. | | | | | |
| 45 | 50 | 5 | Wet | | 4424 | | | | | | As above. | | | | | |
| 50 | 55 | 5 | Wet | | 4425 | | | | | | As above. | | | | | |
| 55 | 60 | 5 | Wet | | 4426 | | | | | | As above. | | | | | |
| 60 | 65 | 5 | Wet | | 4427) | 110 | < 2 | 70 | 130 | | As above, with a few Black Shale ? - Hard some part rounded (Chips). | | | | | |
| 65 | 70 | 5 | Wet | | 4428) | | | | | | As above - trace Sulphides. | | | | | |
| 70 | 75 | 5 | Wet | | 4429 | 85 | 40 | 90 | 55 | | As above - sandstone may be contamination? | | | | | |
| 75 | 80 | 5 | Wet | | 4430 | 170 | 20 | 35 | 30 | | As above. | | | | | |
| 80 | 85 | 5 | Wet | | 4431 | 50 | 30 | 70 | 35 | | Sandstone and Grey clay. | | | | | Auger from 80-85'. |
| 85 | 88 | 3 | FromBit | | 4432 | 100 | 550 | 1000 | 1400 | | Grey clay, minor Sulphides. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill. Type of Drilling Percussion Hole Size % Recovery Surveyed by Instrument Used

Date Started October 18, 1968. 10.30 a.m. Date Completed Logged by K. Patterson Sampled By Lennon Record Completed

No. of Hole WP-14. Location Lake Dutton. Depth of Hole 88' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-16 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 100'. |
| 0 | 6 | 6 | | | - | | | | | | Sand, travertinous rubble. | | | | | Casing 16' of 3'5" (0'-16') |
| 6 | 10 | 4 | 15 | | 4433 | | | | | | Gravels and fine sandy material and travertine. | | | | | |
| 10 | 16 | 6 | 65 | | 4434 | | | | | | Light coloured clay and gravels Qtz ≈2 m/m & travertine | | | | | |
| 16 | 20 | 4 | 25 | | 4435 | | | | | | See above. | | | | | |
| 20 | 25 | 5 | 30 | | 4436 | | | | | | Talcose white clay. | | | | | |
| 25 | 30 | 5 | 30 | | 4437 | | | | | | Greenish White clay and Talc! | | | | | |
| 30 | 35 | 5 | 50 | | 4438 | | | | | | Buff clay, less talc than above. | | | | | Augers used from 20' - 68'. |
| 35 | 38 | 3 ) | 50 | | 4439 | 130 | 900 | 150 | 40 | < 2 | Buff clay and some Limonite concretions - Chocolate coloured clay and goethite pebbles in small amounts. | | | | | |
| 38 | 40 | 2 ) | | | | | | | | | Buff clay and some Limonite concretions - | | | | | |
| 40 | 45 | 5 | 50 | | 4440 | 160 | 1500 | 200 | 65 | < 2 | Chocolate coloured clay and goethite pebbles in small amounts. | | | | | |
| 45 | 50 | 5 | Wet | | 4441 | 150 | 1600 | 500 | 970 | < 2 | Grey clay with fragments of Yellow, Brown, Violet clay. | | | | | |
| 50 | 55 | 5 | Wet | | 4442 | 230 | 760 | 3000 | 820 | < 2 | Dark greenish grey clay. | | | | | |
| 55 | 60 | 5 | Wet | | 4443 | 110 | 1100 | 4000 | 700 | 16 | Dark grey clay with dark black clay fragments and concretion limonite. | | | | | |
| 60 | 65 | 5 | Wet | | 4444 | 40 | 870 | 3100 | 7100 | 6 | As above! | | | | | |
| 65 | 68 | 3 | Wet | | 4445 | 45 | 3400 | 2800 | 3100 | 6 | As above! | | | | | |
| 68 | 71'5" | 3'5" | | | | | | | | | No core. | | | | | |
| 71'5" | 75'5" | 3'5" | Wet | | 4446 | 600 | 570 | 380 | 2600 | 5 | Black clay and Galena?! | | | | | 0.2 Pb? |
| 75'5" | 80 | 4'5" | Wet | | 4447 | 340 | 400 | 260 | 3300 | 5 | Black clay and Pyrite and Galena. | | | | | 0.1 Pb? |
| 80 | 85 | 5 | Wet | | 4448 | 240 | 250 | 340 | 3100 | < 2 | Black wet clay and Pandurra fragments (Quartz Sandstone) | | | | | |
| 85 | 90 | 5 | Wet | | 4449 | 160 | 590 | 340 | 1450 | < 2 | Pandurra formation, consist of Quartz sandstone and some Pyrite. | | | | | Contamination possible. |
| 90 | 95 | 5 | Wet | | 4450 | 180 | 190 | 290 | 1350 | < 2 | " " " " " " and minor Pyrite. | | | | | Check Au. |
| 95 | 100 | 5 | Wet | | 4451 | 150 | 350 | 380 | 1200 | < 2 | Pandurra but less Pyrite. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 2, 1968. Date Completed December 2, 1968. Logged by L. Szoke. Sampled By I. Miller Record Completed

No. of Hole WP-15. Location Lake Dutton, S.A. Depth of Hole 100' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

U 1043-17 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 100'. |
| 0 | 10 | | | | | | | | | | Top sand and soil. Red dust and sandy clay. | | | | | 4½" - 10' Casing. |
| 10 | 20 | 10 | | | 4452 | | | | | | Whyalla sandstone, fine to medium grains and $CaCO_3$ | | | | | |
| 20 | 29 | 9 | | | 4453 | | | | | | " " , quartz grains 89%, grain size: 0.5 m/m. to 2 m/m. | | | | | 30' 3'5" Casing. |
| 29 | 40 | 11 | | | 4454 | 300 | 240 | 340 | 110 | 5 | At 29' Buff clay, rest consists of dark Grey clay and Galena? | | | | | 0.07% Pb. |
| 40 | 45 | 5 | | | 4455 | 100 | 6400 | 3600 | 110 | 6 | Dark grey clay or black clay. Galena ! | | | | | 0.1% Pb. |
| 45 | 50 | 5 | | | 4456 | 130 | 4000 | 2400 | 125 | 7 | " " " | | | | | |
| 50 | 55 | 5 | | | 4457 | 95 | 3200 | 2800 | 125 | 6 | " " " | | | | | |
| 55 | 60 | 5 | | | 4458 | 140 | 4600 | 2800 | 120 | 6 | At 57'5" hard black clay and Galena! | | | | | 0.2 - 0.3 Pb. |
| 60 | 63 | 3 | | | 4459 | 200 | 2800 | 1900 | 560 | 6 | As above and minor Pyrite. | | | | | 0.1 - 0.2 Pb. |
| 63 | 66 | 3 | | | 4460 | 340 | 170 | 1000 | 3500 | 2 | Dark grey clay and Quarts sand. | | | | | |
| 66 | 70 | 4 | | | 4461 | 160 | 160 | 640 | 4150 | 5 | " " " | | | | | |
| 70 | 75 | 5 | | | 4462 | 220 | 440 | 820 | 2000 | < 2 | " " Quarts sandy clay. | | | | | |
| 75 | 80 | 5 | $H_2O$ | | 4463 | 150 | 500 | 720 | 560 | < 2 | Watery dark clay with fragments from Pandurra formation. | | | | | |
| 80 | 85 | 5 | " | | 4464 | | | | | | Pandurra formation, consists of Quarts grains with silicified cem. and Pyrite. | | | | | |
| 85 | 90 | 5 | " | | 4465 | | | | | | " " " " " " | | | | | |
| 90 | 95 | 5 | | | 4466 | | | | | | " " minor Pyrite. | | | | | |
| 95 | 100 | 5 | | | 4467 | | | | | | " " " " " " minor Pyrite. | | | | | Check Au. |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 3, 1968. Date Completed December 3, 1968 Logged by L. Szoke Sampled By I. Miller Record Completed

No. of Hole WP-16. Location Lake Dutton, S.A. Depth of Hole 100'. Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-18 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 | | | | | | | | | | Top soil - Reddish sandy soil. | | | | | |
| 10 | 20 | 6 | 70 | 90 | 4480 | | | | | | Whyalla sandstone - White, consists of well rounded Quartz grains and clay. | | | | | 0' - 150'. |
| 20 | 30 | 10 | 55 | 90 | 4481 | | | | | | Whyalla sandstone - " " " " " " grains and clay. | | | | | |
| 30 | 33 | 3 | 22 | 70 | 4482 | | | | | | Whyalla sandstone - " " " " " " grains and clay. | | | | | |
| 33 | 37'5" | 4'5 | 15 | 50 | 4483 | | | | | | Whyalla sandstone - Greenish with clay/sample contaminated by old clay from Hole No. 16. | | | | | |
| 37'5" | 45 | 7'5 | 25 | ? | 4484 | | | | | | Whyalla sandstone. | | | | | |
| 45 | 50 | 5 | 16 | | 4485 | | | | | | " " grain are very fine and to 1½ m/m. | | | | | |
| 50 | 60 | 10 | 28 | | 4486 | | | | | | " " different grains - vein to 1½ m/m. and different coloured layers. | | | | | 10'5" 43' 3'5" |
| 60 | 70 | 10 | 25 | | 4487 | | | | | | Whyalla sandstone " " " " different coloured layers. | | | | | |
| 70 | 75 | 5 | 11 | | 4488 | | | | | | Whyalla sandstone " " " " different coloured layers. | | | | | |
| 75 | 80 | 5 | Wet | | 4499 | | | | | | $H_2O$ from top has been poured into the hole, Black clay and Sand. | | | | | |
| 80 | 90 | 10 | Wet | | 4500 | 75 | 60 | 150 | 120 | < 2 | " " " " " " " " " " " " " " | | | | | Auger |
| 90 | 95 | 5 | Wet | | 4501 | 55 | 80 | 160 | 360 | < 2 | Black clay started 93'. | | | | | 45' A. |
| 95 | 98 | 3 | Wet | | 4502 | 340 | 300 | 420 | 740 | 6 | Black clay. | | | | | |
| 98 | 100 | 2 | Wet | | 4503 | 300 | 650 | 410 | 940 | 5 | Wet dark Grey clay and sand in small amount. | | | | | 55' P. |
| 100 | 105 | 5 | Wet | | 4504 | 120 | 6200 | 4000 | 1400 | 8 | Dark grey clay, silicified zone between 103-104'5" with Sphalerite? Galena and Pyrite. | | | | | |
| 105 | 108'5" | 3'5 | Wet | | 4505 | 60 | 1500 | 4800 | 2100 | 6 | Dark grey clay and some Quartz material and shales. | | | | | |
| 108'5" | 115 | 7'5 | Wet | | 4506 | 120 | 1000 | 2600 | 1100 | 2 | Dark clay and Quarts grains and Black shales and silicified layers | | | | | |
| 115 | 120 | 5 | Wet | | 4507 | 60 | 1200 | 5400 | 1900 | 5 | Dark clay and shale fragments. Galena ! | | | | | |
| 120 | 130 | 10 | Wet | | 4508 | 80 | 950 | 2200 | 1600 | 6 | Black clay with shale fragments and some silicified fragments. | | | | | |
| 130 | 135 | 5 | Wet | | 4509 | 60 | 800 | 1500 | 1350 | 5 | " " " " " " " | | | | | 25' P. |
| 135 | 140 | 5 | Wet | | 4510 | | | | | | Pandurra fragments in Black clay started 138'5" (contamination possible. Pyrite present). | | | | | |
| 140 | 150 | 10 | Wet | | 4511 | | | | | | Pandurra formation - Sample contaminated by black clay. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Neill Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 4, 1968. Date Completed December 5, 1968. Logged by L. Szoke. Sampled By I. Miller Record Completed

No. of Hole WP-17. Location Lake Dutton, S.A. Depth of Hole 150' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-19 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | | | | | | | | | | Reddish sand and top soil - Lateritic. | | | | | 0' - 70'. |
| 5 | 20 | 15 | 90 | | 4512 | | | | | | Whyalla sandstone/White fine-grained at the top. A 10' Calichi ($CoCo_3$). | | | | | 5' 5". dia. to 40' 3,5" dia. Casing. |
| 20 | 30 | 10 | 75 | | 4513 | | | | | | " | | | | | |
| 30 | 40 | 10 | 71 | | 4514 | | | | | | " | | | | | 10' 3.5" dia. |
| 40 | 50 | 10 | 81 | | 4515 | 20 | 20 | 220 | 20 | < 2 | " At 50' more clay and coarse grained material~~isation~~ of Quartz. | | | | | |
| 50 | 57 | 7 | 20 | | 4516 | 20 | 35 | 45 | 45 | < 2 | Coarse grained clayey sandstone grains to 3 m/m. dia. | | | | | |
| 57 | 62 | 5 | 45 | | 4517 | | | | | | White clay and sand 1 : 1 | | | | | 12' Auger. |
| 62 | 70 | 8 | Wet | | 4518 | | | | | | Pandurra formation started at 63' (White clay and Pandurra). | | | | | 8' P. Bit. |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 5, 1968. Date Completed December 6, 1968. Logged by L. Szoke. Sampled By I. Miller. Record Completed

No. of Hole WP-18. Location Lake Dutton, S.A. Depth of Hole 70' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-20 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 117'. |
| 0 | 5 | | | | | | | | | | 3' Reddish sand and soil 2' Gravel. | | | | | 5' 5" dia. |
| 5 | 10 | 5 | 45 | | 4519 | | | | | | Whyalla sandstone - White. | | | | | Casing and Pick Bit. |
| 10 | 20 | 10 | 75 | | 4520 | | | | | | " | | | | | |
| 20 | 30 | 10 | 69 | | 4521 | | | | | | " | | | | | |
| 30 | 40 | 10 | 82 | | 4522 | | | | | | " | | | | | |
| 40 | 50 | 10 | 75 | | 4523 | | | | | | " | | | | | |
| 50 | 60 | 10 | 85 | | 4524 | | | | | | " | | | | | |
| 60 | 70 | 10 | 75 | | 4525 | | | | | | " | | | | | |
| 70 | 80 | 10 | 80 | | 4526 | | | | | | " and Reddish colour. | | | | | |
| 80 | 90 | 10 | 81 | | 4527 | | | | | | Dark Grey Whyalla. | | | | | |
| 90 | 100 | 10 | 85 | | 4528 | | | | | | " " " sandstone | | | | | |
| 100 | 110 | 10 | 51 | | 4529 | 260 | 180 | 300 | 50 | < 2 | Dark Grey Whyalla Quartz/and Black shale and Pyrite | | | | | |
| 110 | 117 | 7 | 14 | | 4530 | 460 | 1000 | 420 | 2000 | 6 | " " | | | | | Hole fallen In. |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 6, 1968. Date Completed December 6, 1968. Logged by L. Szoke. Sampled By I. Miller. Record Completed

No. of Hole WP-19. Location Lake Dutton, S.A. Depth of Hole 117' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-21 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Reddish sand and soil. | | | | | 5' - 150' |
| 5 | 10 | 5 | 30 | | 4531 | | | | | | Secondary zone, Gravel and sand. | | | | | 5" P. 5'5" C. Per 4". |
| 10 | 20 | 10 | 70 | | 4532 | | | | | | Whyalla sandstone at 23', Red to 25'. | | | | | P. 4" |
| 20 | 30 | 10 | 85 | | 4533 | | | | | | Whyalla sandstone. | | | | | P. 4". |
| 30 | 40 | 10 | 80 | | 4534 | | | | | | White, Brown, Chocolate, White, Whyalla. | | | | | |
| 40 | 50 | 10 | 45 | | 4535 | | | | | | Whyalla sandstone different colours and fragments from Pandurra. | | | | | P. 4". |
| 50 | 60 | 10 | 38 | | 4536 | | | | | | " " and Grey shale. | | | | | P. 3". |
| 60 | 70 | 10 | 35 | | 4537 | | | | | | " " " " " | | | | | P. 3". |
| 70 | 80 | 10 | 36 | | 4538 | | | | | | " " " " " | | | | | P. 3". |
| 80 | 87 | 7 | 42 | | 4539 | | | | | | Whyalla. | | | | | P. 3". |
| 87 | 95 | 8 | 12 | | 4540 | 560 | 280 | 420 | 2000 | 6 | Dark Grey shale. | | | | | |
| 95 | 100 | 5 | 15 | | 4541 | 300 | 4000 | 960 | 2250 | 7 | Black shale. Galena ! | | | | | |
| 100 | 105 | 5 | 20 | | 4542 | 90 | 4400 | 4800 | 2450 | 6 | " " | | | | | |
| 105 | 110 | 5 | 12 | | 4543 | 70 | 3900 | 3200 | 2300 | 6 | " " | | | | | |
| 110 | 115 | 5 | 15 | | 4544 | 70 | 3800 | 2400 | 3150 | 6 | " " | | | | | |
| 115 | 120 | 5 | 20 | | 4545 | 240 | 1100 | 640 | 3150 | 6 | " " Pyrite and Galena. | | | | | |
| 120 | 125 | 5 | 23 | | 4546 | 280 | 450 | 400 | 5200 | < 2 | " light coloured clay. Pyrite and Galena. | | | | | |
| 125 | 130 | 5 | 23 | | 4547 | 190 | 400 | 370 | 1250 | < 2 | Light grey shale and Quarts. | | | | | |
| 130 | 135 | 5 | 22 | | 4548 | 70 | 240 | 200 | 590 | < 2 | Shale and Pandurra fragments. | | | | | |
| 135 | 140 | 5 | 17 | | 4549 | | | | | | Pandurra formation?! | | | | | |
| 140 | 145 | 5 | | | 4550 | | | | | | " " | | | | | |
| 145 | 150 | 5 | | | 4551 | | | | | | " " | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track. Hole Size % Recovery Surveyed by Instrument Used

Date Started December 7, 1968. Date Completed December 7, 1968. Logged by L. Szoke. Sampled By I. Miller Record Completed

No. of Hole WP20 Location Lake Dutton, S.A. Depth of Hole 150' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-22 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 0' - 100'. |
| 0 | 5 | | | | | | | | | | Reddish soil - sand. | | | | | 5" P. |
| 5 | 10 | 5 | 22 | | 4552 | | | | | | " " and Gypsum. | | | | | 4" P. |
| 10 | 20 | 10 | 75 | | 4553 | | | | | | Whyalla sandstone - White. | | | | | |
| 20 | 30 | 10 | 80 | | 4554 | | | | | | " " " | | | | | |
| 30 | 40 | 10 | 82 | | 4555 | | | | | | " more clay present. | | | | | 3" P. |
| 40 | 50 | 10 | 79 | | 4556 | | | | | | " different colours. | | | | | |
| 50 | 60 | 10 | 72 | | 4557 | | | | | | " - very fine sandstone and Grey Shale - dark. | | | | | |
| 60 | 69 | 9 | 70 | | 4558 | 15 | 25 | 50 | 830 | < 2 | " - coarse grained. | | | | | |
| 69 | 75 | 6 | 21 | | 4559 | 30 | 90 | 80 | 3700 | < 2 | Dark Grey Shale. | | | | | |
| 75 | 80 | 5 | 18 | | 4560 | 20 | 30 | 55 | 460 | < 2 | Pandurra formation. | | | | | |
| 80 | 90 | 10 | 35 | | 4561 | | | | | | " " | | | | | |
| 90 | 100 | 10 | 48 | | 4562 | | | | | | " " | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 7, 1968. Date Completed December 7, 1968. Logged by L. Szoke. Sampled By I. Miller. Record Completed

No. of Hole WP-21. Location Lake Dutton, S.A. Depth of Hole 100' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-23 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Bearing | Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Whyalla sandstone. | | | | | 5" P. 0' - 100'. |
| 5 | 10 | 5 | 23 | | 4564 | | | | | | " " - White. | | | | | 4" P. |
| 10 | 20 | 10 | 75 | | 4565 | | | | | | " | | | | | |
| 20 | 30 | 10 | 80 | | 4566 | | | | | | " | | | | | |
| 30 | 40 | 10 | 75 | | 4567 | | | | | | " | | | | | |
| 40 | 50 | 10 | 78 | | 4568 | | | | | | " | | | | | |
| 50 | 57 | 7 | 75 | | 4569 | | | | | | " coloured fine grained. | | | | | 3" P. |
| 57 | 62 | 5 | 50 | | 4570 | 140 | 220 | 130 | 50 | 2 | Greenish-Yellow Buff clay and Black clay. | | | | | Auger. |
| 62 | 69 | 7 | 45 | | 4571 | 380 | 140 | 300 | 130 | 10 | Black clay and Black shale with Manganese? or Chalcocite? and Pyrite. | | | | | |
| 69 | 73 | 4 | 43 | | 4572 | 400 | 250 | 640 | 500 | 5 | Dark grey shale to Black shale. | | | | | |
| 73 | 80 | 7 | 60 | | 4573 | 90 | 110 | 270 | 6300 | < 2 | Light colour - grey shale. | | | | | 3" P. |
| 80 | 90 | 10 | 55 | | 4574 | | | | | | Light shale and Pandurra fragments. No mineralisation. | | | | | |
| 90 | 100 | 10 | 38 | | 4575 | | | | | | Pandurra formation. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 7, 1968. Date Completed December 7, 1968. Logged by L. Szoke Sampled By I. Miller. Record Completed

No. of Hole WP-22. Location Lake Dutton, S.A. Depth of Hole 100' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-24 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | | | | | | | | | | Reddish top sand and soil. | | | | | 0' - 122'. |
| | | | | | | | | | | | | | | | | 5" P. |
| | | | | | | | | | | | | | | | | 4" P. |
| 5 | 10 | 5 | 35 | | 4576 | | | | | | Whyalla sandstone - White. | | | | | |
| 10 | 20 | 10 | 80 | | 4577 | | | | | | " " " | | | | | |
| 20 | 30 | 10 | 79 | | 4578 | | | | | | " " " | | | | | |
| 30 | 40 | 10 | 69 | | 4579 | | | | | | " " " coarse-grained Quartz sand. | | | | | |
| 40 | 45 | 5 | 15 | | 4580 | | | | | | White clay and sandstone. Grains from very fine to 2 mm. dia. | | | | | 3" P. |
| 45 | 50 | 5 | | | 4581 | | | | | | Buff clay and Brown clay and sand. | | | | | 3" P. |
| 47 | 52 | 5 | | | 4582 | | | | | | Clay - Brown and Grey coloured. | | | | | Augers. |
| 52 | 57 | 5 | | | 4583 | 180 | 360 | 70 | 60 | 5 | Dark grey clay. | | | | | " |
| 57 | 62 | 5 | | | 4584 | 1200 | 6000 | 160 | 120 | 10 | " " " Galena? | | | | | " |
| 62 | 65 | 3 | | | 4585 | 140 | 2000 | 900 | 70 | 5 | " " " | | | | | 3" P. & A. |
| 65 | 70 | 5 | | | 4586 | 40 | 940 | 1100 | 1100 | 5 | Dark grey Shale. | | | | | 3" P. |
| 70 | 75 | 5 | | | 4587 | 30 | 800 | 1000 | 1400 | 5 | " " " | | | | | 3" P. |
| 75 | 80 | 5 | | | 4588 | 30 | 1000 | 1000 | 1300 | 5 | " " " | | | | | 3" P. |
| 80 | 85 | 5 | | | 4589 | 35 | 900 | 3000 | 1200 | 2 | " " " | | | | | 3" P. |
| 85 | 90 | 5 | | | 4590 | 35 | 700 | 700 | 1200 | 2 | " " " | | | | | 3" P. |
| 90 | 95 | 5 | | | 4591 | 30 | 250 | 350 | 1700 | < 2 | " " " | | | | | 3" P. |
| 95 | 100 | 5 | | | 4592 | 30 | 280 | 230 | 1600 | < 2 | " " " | | | | | 3" P. |
| 100 | 105 | 5 | | | 4593 | 30 | 190 | 200 | 1800 | < 2 | " " " | | | | | 3" P. |
| 105 | 110 | 5 | | | 4594 | 30 | 220 | 650 | 1700 | < 2 | " " " | | | | | 3" P. |
| 110 | 115 | 5 | | | 4595 | 30 | 260 | 650 | 2000 | < 2 | " " " | | | | | 3" P. |
| 115 | 120 | 5 | | | 4596 | 35 | 260 | 430 | 1800 | 2 | " " " | | | | | 3" P. |
| 120 | 122 | 2 | | | 4597 | 30 | 420 | 470 | 1600 | < 2 | " " " | | | | | 3" P. |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 8, 1968. Date Completed December 10, 1968. Logged by L. Szoke Sampled By R. Glastonbury & I.Miller. Record Completed

No. of Hole WP-23. Location Lake Dutton, S.A. Depth of Hole 122' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-25 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 15 | 10 | 55 | | 4598 | | | | | | Red sand and soil. | | | | | 5" P. |
| 15 | 25 | 10 | 50 | | 4599 | | | | | | Gravel, sand, Gypsum, Travertine. | | | | | 4" P. |
| 25 | 36 | 11 | 45 | | 4600 | | | | | | At 18' Whyalla sandstone. White to 26', clay from 26'. | | | | | " " |
| 36 | 42 | 6 | 40 | | 4601 | | | | | | Clay - White-Grey colour. Buff clay and White clay, Fe layers. | | | | | Auger 3". |
| 42 | 48 | 6 | 42 | | 4602 | | | | | | Clay - Buff and Yellow Brown colour. | | | | | |
| 48 | 55 | 7 | | | 4603 | 850 | 2200 | 1100 | 150 | 20 | Clay - Buff and Greenish Yellow clay and White, Purple, Brown, Grey-Green layers. | | | | | |
| 55 | 65 | 5 | Wet | | 4604 | 45 | 750 | 2400 | 1800 | 5 | Clay - dark Grey and some mineralisation. Galena? | | | | | |
| 65 | 70 | 5 | Dry | | 4605 | 30 | 930 | 3400 | 2800 | 5 | Clay and dark Grey Shale. | | | | | |
| 70 | 75 | 5 | 40/50 | | 4606 | 50 | 3500 | 1200 | 2400 | 5 | Dark grey Shale. | | | | | 3" P. |
| 75 | 80 | 5 | 30/40 | | 4607 | 260 | 2700 | 400 | 3600 | 5 | " " " | | | | | |
| 80 | 85 | 5 | 40 | | 4608 | 340 | 140 | 150 | 3600 | 2 | " " " | | | | | |
| 85 | 90 | 5 | 35 | | 4609 | 220 | 390 | 300 | 10000 | 5 | " " " | | | | | |
| 90 | 95 | 5 | 30 | | 4610 | | | | | | " " " " and Silicified material, Pyrite and Galena? | | | | | |
| 95 | 100 | 5 | 30 | | 4611 | | | | | | " " " " " siltstones and Pandurra fragments. | | | | | |
| | | | | | | | | | | | Pandurra formation. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 10, 1968. Date Completed December 10, 1968. Logged by L. Szoke. Sampled By I. Miller & R. Glastonbury. Record Completed

No. of Hole WP-24. Location Lake Dutton, S.A. Depth of Hole 100' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-26 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | | | | | | | | | | | Sand and Gravel. | | | | | 0' to 200'. |
| 5 | 15 | 10 | 70 | | 4612 | | | | | | | Whyalla sandstone - White. | | | | | 5" P. |
| 15 | 25 | 10 | 68 | | 4613 | | | | | | | " " - White, from 22' dark Grey sandstone. | | | | | 4" P. |
| 25 | 35 | 10 | 72 | | 4614 | | | | | | | " " - Grey-Brown sandstone. | | | | | |
| 35 | 45 | 10 | 40 | | 4615 | | | | | | | " " - fine-grained grey sandstone. (Hard) | | | | | 3" P. |
| 45 | 55 | 10 | 52 | | 4616 | | | | | | | " " " " " | | | | | |
| 55 | 65 | 10 | 45 | | 4617 | | | | | | | " " " " " | | | | | |
| 65 | 75 | 10 | 50 | | 4618 | | | | | | | " " " " " | | | | | |
| 75 | 85 | 10 | 45 | | 4619 | | | | | | | " " " " " | | | | | |
| 85 | 87 | 2 | | | 4620 | | | | | | | " " | | | | | |
| 87 | 95 | 7 | | | 4621 | | | | | | | Shale and dark-grey and white sandstone and Pandurra fragments and Pyrite. | | | | | 87' - 150' Auger. |
| 95 | 100 | 5 | | | 4622 | | | | | | | At 98'5" Shale and sandstone. | | | | | |
| 100 | 105 | 5 | | | 4623 | | | | | | | Dark grey Shale. | | | | | |
| 105 | 107 | 2 | 2 | | 4624 | | | | | | | " " | | | | | |
| 107 | 108'5" | 1'5" | | | 4625 | 460 | 160 | 440 | 1300 | 5 | | Clay - dark Grey and Shale. | | | | | |
| 108'5" | 117 | 18'5" | Wet | | 4626 | 220 | 1400 | 700 | 1500 | 5 | | Dark grey Shale. | | | | | |
| 117 | 125 | 7 | | | 4627 | 90 | 430 | 420 | 820 | 2 | Au | Hard grey Shale (Sample difficult to bring up !) | | | | | |
| 125 | 130 | 5 | | | 4628 | 60 | 930 | 1500 | 1600 | 5 | <0.5 | Dark grey to Black clay and silicified Shale and Galena? Pyrite? | | | | | Check Au. |
| 130 | 135 | 5 | | | 4629 | 70 | 1600 | 2000 | 2000 | 5 | | Dark grey clay and black Shale. | | | | | |
| 135 | 140 | 5 | | | 4630 | 60 | 730 | 1000 | 1200 | 2 | | Dark grey clay " " " | | | | | |
| 140 | 150 | 10 | | | 4631 | 45 | 480 | 1350 | 1800 | 2 | <0.5 | Shale, silicified with Pyrite and black clay. | | | | | Check Au. |
| 150 | 160 | 10 | | | 4632 | 40 | 380 | 1200 | 1600 | 2 | <0.5 | Silicified Shale " " | | | | | " " . 3" P. |
| 160 | 170 | 10 | | | 4633 | 45 | 420 | 900 | 1700 | 2 | | " " | | | | | |
| 170 | 180 | 10 | | | 4634 | 40 | 360 | 680 | 1600 | 2 | | " " No min. has been seen. | | | | | |
| 180 | 190 | 10 | | | 4635 | 90 | 820 | 900 | 2500 | 2 | | " " | | | | | |
| 190 | 200 | 10 | | | 4636 | | | | | | | Pandurra at 194'. | | | | | |
| | | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by D. O'Niell Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 10, 1968. Date Completed December 11, 1968. Logged by L. Szoke. Sampled By I. Miller & R. Glastonbury. Record Completed

No. of Hole WP-25. Location Lake Dutton, S.A. Depth of Hole 200' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043 - 27 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9 | | | | | | | | | | Ter. Soil, Reddish sand at 9' clay Brown coloured and Gravel. | | | | | 0' - 193'. 4° P. |
| 5 | 15 | 10 | 41 | | 4637 | | | | | | Brown and White clay and Reddish sand. At 16' Whyalla. | | | | | |
| 15 | 25 | 10 | 28 | | 4638 | | | | | | Whyalla sandstone - White, watery. | | | | | |
| 25 | 35 | 10 | | | 4639 | | | | | | As above. | | | | | |
| 35 | 45 | 10 | | | 4640 | | | | | | " " | | | | | |
| 45 | 58 | 13 | | | 4641 | | | | | | " " | | | | | |
| 58 | 80 | 22 | | | 4642 | | | | | | " " | | | | | 3° P. |
| 80 | 90 | 10 | | | 4643 | | | | | | " " and Grey sandstone. | | | | | |
| 90 | 100 | 10 | | | 4644 | | | | | | " " | | | | | |
| 100 | 110 | 10 | | | 4645 | | | | | | " " | | | | | |
| 110 | 120 | 10 | | | 4646 | | | | | | " " " " shale at 119'. | | | | | |
| 120 | 125 | 5 | | | 4647 | 200 | 170 | 200 | 130 | 5 | Sandy - shale. | | | | | Auger. |
| 125 | 130 | 5 | | | 4648 | 200 | 780 | 480 | 370 | 5 | " " | | | | | |
| 130 | 135 | 5 | | | 4649 | 140 | 1300 | 470 | 510 | 5 | " " | | | | | |
| 135 | 140 | 5 | | | 4650 | 140 | 830 | 450 | 530 | < 2 | " " | | | | | |
| 140 | 142 | 2 | | | 4651 | 240 | 1700 | 2500 | 1700 | 5 | Dark Grey to Black shale and clay. | | | | | |
| 142 | 150 | 8 | | | 4652 | 90 | 720 | 450 | 760 | 5 | " " " " " " | | | | | |
| 150 | 155 | 5 | | | 4653 | 55 | 600 | 800 | 1000 | 5 | " " " " " " | | | | | 3° Bit. |
| 155 | 160 | 5 | | | 4654 | 40 | 430 | 200 | 920 | 2 | " " | | | | | |
| 160 | 165 | 5 | | | 4655 | 60 | 460 | 660 | 1200 | 5 | " " Pyrite! | | | | | 0.7 Pb. ? |
| 165 | 170 | 5 | | | 4656 | 50 | 420 | 650 | 1300 | < 2 | Pyrite and Galena. | | | | | |
| 170 | 175 | 5 | | | 4657 | 60 | 1000 | 700 | 1500 | 5 | | | | | | 0.5 Pb. ? |
| 175 | 180 | 5 | | | 4658 | 70 | 1000 | 500 | 1900 | 5 | | | | | | 0.7 Pb. ? |
| 180 | 185 | 5 | | | 4659 | 75 | 680 | 380 | 2500 | 2 | | | | | | |
| 185 | 190 | 5 | | | 4660 | 80 | 380 | 420 | 1800 | 2 | 185'- Pandurra . Silicified hard Shale and Q-S Shale. Pyrite Pandurra ? at 185'. | | | | | 1.0% Sulphide. |
| 190 | 193 | 3 | | | 4661 | | | | | | Pandurra formation. | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 11, 1968. Date Completed Logged by L. Szoke. Sampled By I. Miller & R. Glastonbury. Record Completed

No. of Hole WP-26. Location Lake Dutton, S.A. Depth of Hole 193' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-29 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | | | | No Sample | | | | | | Red sand and soil and some Gravel. | | | | | 0' - 93 ' |
| 5 | 15 | 10 | 30 | | 4662 | | | | | | Red sandy silt. | | | | | 5" P. |
| 15 | 25 | 10 | 28 | | 4663 | | | | | | Red sandy silt and clay, tertiary ! ? | | | | | 4" P. to 42'. |
| 25 | 35 | 10 | 39 | | 4664 | | | | | | Red silty sand and Reddish Clay. | | | | | |
| 35 | 45 | 10 | 30 | | 4665 | | | | | | At 42' $CaCo_3$ cemented fine sand and coarse sand (Whyalla). | | | | | |
| 42 | 50 | 8 | 15 | | 4666 | | | | | | White Clay from 42'. | | | | | Auger. |
| 50 | 55 | 5 | 28 | | 4667 | | | | | | White Clay and White sandy Clay. | | | | | |
| 55 | 57'5" | 2'5" | 25 | | 4668 | | | | | | Pinkish sandy Clay. | | | | | |
| 57'5" | 62'5" | 5 | 30 | | 4669 | | | | | | Different coloured clay layers, buff, brown, greenish, yellowish. | | | | | |
| 62'5" | 70'0" | 7'5" | 65 | | 4670 | 40 | 220 | 45 | 30 | < 2 | Different colour and black Clay. | | | | | |
| 70 | 74 | 4 | 30 | | 4671 | 2900 | 300 | 90 | 30 | 5 | Black Clay. Galena. | | | | | Galena 0.5 - 1 0.7 Pb. |
| 74 | 80 | 6 | 35 | | 4672 | 1800 | 360 | 1000 | 140 | 5 | " " and Galena. | | | | | |
| 80 | 83 | 3 | 12 | | 4673 | 600 | 240 | 900 | 560 | 5 | " " | | | | | |
| 83 | 90 | 7 | 20 | | 4674 | 90 | 430 | 800 | 1700 | 2 | Black Shale. Pyrite, Galena and (Chalcopyrite?) | | | | | 3" P. |
| 90 | 93 | 3 | | | 4675 | 170 | 550 | 850 | 1600 | 5 | Black clay soft. | | | | | Drill stopped. |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 12, 1968. Date Completed December 13, 1968. Logged by L. Szoke Sampled By I. Miller & R. Glastonbury Record Completed

No. of Hole WP-27. Location Lake Dutton, S.A. Depth of Hole 93' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-29 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | | | | | | | | | | Top soil, Reddish sand and red silt, Quarts. | | | | | 0' - 50'. |
| 5 | 14 | 9 | | | 4675 | 170 | 550 | 850 | 1600 | 5 | Top clay - Reddish sandy clay. | | | | | |
| 14 | 20 | 6 | | | 4676 | | | | | | | | | | | |
| 20 | 30 | 10 | | | 4677 | | | | | | Whyalla at 25'. White. | | | | | |
| 30 | 40 | 10 | 35 | | 4678 | | | | | | " different coloured layers. | | | | | |
| 40 | 50 | 10 | 22 | | 4679 | | | | | | " with Pandurra fragments. | | | | | |

Drilled by B. O'Niell Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 13, 1968. Date Completed December 13, 1968. Logged by L. Szoke. Sampled By I. Miller & R. Glastonbury. Record Completed

No. of Hole WP-28. Location Lake Dutton, S.A. Depth of Hole 50' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-30 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | | | | No Sample | | | | | | Top soil and Gravel etc. | | | | | 0' - 114'. |
| | | | | | | | | | | | " " | | | | | 0-7', 7' P. |
| 5 | 15 | 10 | 50 | | 4680 | | | | | | At 12'6" clay different colours and Red silt and sand, Travertine and Gypsum. | | | | | |
| 15 | 25 | 10 | 56 | | 4681 | | | | | | | | | | | |
| 25 | 35 | 10 | 58 | | 4682 | | | | | | At 33' Whyalla sandstone. | | | | | |
| 35 | 45 | 10 | 40 | | 4683 | | | | | | At 40' Whyalla - different grains and watery. | | | | | |
| 45 | 52 | 7 | 10 | | 4684 | | | | | | At 52' " - wet. | | | | | |
| 52 | 60 | 8 | 15 | | 4685 | | | | | | Whyalla sandstone. | | | | | |
| 60 | 65 | 5 | 17 | | 4686 | | | | | | " sandy White and Greenish clay. | | | | | A - 60 |
| 65 | 70 | 5 | 18 | | 4687 | | | | | | " " " " " " | | | | | |
| 70 | 73 | 3 | 16 | | 4688 | | | | | | " " " " " " | | | | | |
| 73 | 80 | 7 | Wet | | 4689 | | | | | | " " " " " " | | | | | |
| 80 | 90 | 10 | Wet | | 4690 | | | | | | " " " " " " | | | | | |
| 90 | 100 | 10 | Wet | | 4691 | | | | | | " " " " " " | | | | | |
| 100 | 110 | 10 | Wet | | 4692 | | | | | | " " " " " " | | | | | |
| 110 | 114 | 4 | | | | | | | | | | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 14, 1968. Date Completed December 14, 1968. Logged by L. Szoke Sampled By I. Miller & R. Glastonbury. Record Completed

No. of Hole WP-29. Location Lake Dutton, S.A. Depth of Hole 114' Co-ords.of Collar Bearing Inclination Vertical.

NORANDA AUSTRALIA LIMITED

1043-31 II

## DRILL RECORD

| From | To | Sample Length | Recovery Lbs. | Recovery % | Sample No. | Assays Cu | Pb | Zn | Mn | Ag | Geological Log | Angle to core | Survey Depth | Survey Bearing | Survey Inclination | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | | | | No Sample | | | | | | Top soil, Sand, Travertine, Gravel etc. to 9'. | | | | | 0' to 129'. |
| 5 | 15 | 10 | 78 | | 4692 | | | | | | From 9' Whyalla Sandstone. | | | | | |
| 15 | 25 | 10 | 72 | | 4693 | | | | | | " " " and at 23' lime cemented coarse-grained Whyalla. | | | | | |
| 25 | 35 | 10 | 50 | | 4694 | | | | | | From 9' Whyalla Sandstone. | | | | | |
| 35 | 41 | 6 | 25 | | 4695 | | | | | | " " " " watery. | | | | | |
| 41 | 50 | 9 | Wet | | 4696 | | | | | | " " " " " | | | | | |
| 50 | 62 | 12 | Wet | | 4697 | | | | | | " " " " " | | | | | |
| 62 | 68 | 6 | Wet | | 4698 | 350 | <20 | 65 | 40 | <2 | Shale at 62' - grey clay, sandy clay. | | | | | |
| 68 | 75 | 7 | Wet | | 4699 | | | | | | Grey Shale and Whyalla sandstone. | | | | | |
| 75 | 80 | 5 | | | | | | | | | At 80 ' probably clay ? ! | | | | | |
| 80 | 85 | 5 | | | 4701 | 40 | <20 | 60 | 30 | <2 | Dark grey clay and sand. | | | | | |
| 85 | 89 | 4 | | | 4702 | Unsatisfactory Sample. | | | | | " " sandy clay (No mineralisation has been seen). | | | | | |
| | | | | | | 20 | 40 | 60 | 40 | <2 | | | | | | |
| 89 | 95 | | | | | Unsatisfactory Sample. | | | | | | | | | | |
| 95 | 100 | | | | | | " | | " | | | | | | | |
| 100 | 110 | 10 | | | 4703 | | | | | | Whyalla Sandstone. | | | | | |
| 110 | 120 | 10 | | | 4704 | 220 | 140 | 440 | 180 | 5 | From 115' black Shale and clay. | | | | | |
| 120 | 127 | 7 | | | 4705 | 160 | 1400 | 680 | 420 | 5 | Sandy black Clay with large gravel. | | | | | |
| 127 | 129 | 2 | | | 4706 | 90 | 4000 | 2300 | 1500 | 5 | " " | | | | | |
| | | | | | | | | | | | Air track Hammer broken down ! | | | | | |
| | | | | | | | | | | | END OF HOLE. | | | | | |

Drilled by B. O'Niell. Type of Drilling Air Track Hole Size % Recovery Surveyed by Instrument Used

Date Started December 14, 1968. Date Completed December 15, 1968. Logged by L. Smoke. Sampled By I. Miller & R. Glastonbur. Record Completed

No. of Hole WP-30. Location Lake Dutton, S.A. Depth of Hole 129' Co-ords.of Collar Bearing Inclination Vertical.

ENV 1043.


018

PROGRESS REPORT

SPECIAL MINING LEASE NO. 256

LAKE DUTTON, SOUTH AUSTRALIA

Report No. 131 September, 1969

# NORANDA AUSTRALIA LIMITED

## SPECIAL MINING LEASE - NO. 256 - LAKE DUTTON

1. Introduction

Noranda Australia Limited was granted a Special Mining Lease over an area of 900 square miles for a period of two years commencing October 1, 1968. One of the conditions under which it was granted stipulated that Noranda Australia Limited would submit a report at the conclusion of each six months showing all work undertaken. This report is for the six months ended September 30, 1969.

2. Petrographic Report

Work during this period was confined to the completion of a petrographic examination of drill sludges from four of the non-core drill holes carried out in the Winnie Pinnie area in December, 1968. This study was made by Mr. I. R. Pontifex of McPhar Geophysics Pty. Ltd., Adelaide and a copy of this report is attached.

The four samples examined were selected as representatives of the many assay sections of the holes in which geochemically significant values were registered for lead and zinc. The relevant assays for the samples examined were as follows:-

| Sample No. | Hole | Depth Feet | Lead ppm | Zinc ppm | Copper ppm |
|---|---|---|---|---|---|
| 4445 | WP 15 | 65-68 | 3400 | 2800 | 45 |
| 4455 | WP 16 | 40-45 | 6400 | 3600 | 100 |
| 4505 | WP 17 | 105-108½ | 1500 | 4800 | 60 |
| 4541 | WP 20 | 95-100 | 4000 | 960 | 300 |

As described in the last six monthly report, these and the other holes are half a mile apart, so that the geochemical base metal values represent a very large extent of sediment.

..2..

Before embarking on further drill holes in the region, it was felt that the recorded observation of fine sulphides of lead and zinc in the drill logs should be confirmed by petrographic examination. This examination has confirmed that the base metal values are in fact due to the presence of minute quantities of lead, zinc and copper.

Mr. Pontifex has also observed an association of the lead, zinc and copper sulphides with carbonate material within the host rock.

for A. Thomas,
Staff Geologist.

LFB

16 SEP 1969

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021

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| 2 | T.A.R. | | |
| 1 | G.C.B. | | |
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## MINERALOGICAL REPORT NO. 61

by I.R. PONTIFEX 15th September, 1969.

TO: Mr A. Thomas,
Noranda Aust. Limited,
1 View Street,
PORT AUGUSTA S.A. 5700

Copy to: Mr G.C. Battey,
Noranda Aust. Limited,
7th Floor,
Royal Insurance Building,
440 Collins Street,
MELBOURNE VIC. 3000

Your Reference: Your Sample Record Sheet 31.7.69
Your Cost Code 408/c/-

Material: Sludge - drill cuttings from the Lake Dutton - Lake Macfarlane area, S.A.

Identification: 4445, 4455, 4505, 4541.

Work Requested: Mineralogical examination of representitive fractions of this material to identify minerals giving rise to anomalous amounts of Pb, Zn, Cu and Mn.

Sections: Retained for your possible further reference, available on request.

I.R. Pontifex
.....
(Signed)

EXAMINATION PROCEDURE

A sample taken at random from the black sludge - drill cutting material from each hole was panned and washed clean of the very fine black silt and mud.

Since the main interest of this study was in the identification of metallic minerals giving rise to anomalous amounts of Cu, Pb, Zn, Mn, the washed fraction of each was then panned, into a "fine" (sand size) relatively heavy fraction and a "coarse" (greater than sand, ranging up to fragments 8mm across) relatively lighter fraction. A polished section was prepared of each of these fractions. A thin section was prepared of each coarse, light fraction. In the fine fraction it was expected to simply identify the component metallic minerals. In the coarse fraction it was hoped to see the relationship of these minerals to the host rock fragments, and to identify the country rock type.

In case some metallic minerals of significance occurred in the silt or mud fraction which was originally washed from the samples, one section of this material was also prepared in polished section for examination.

RESULTS OF THE EXAMINATION

I. Conclusions

The anomalous geochemical values from these samples is due to primary sulphide minerals, sphalerite, galena and chalcopyrite. Pyrite is also common in relatively coarse 'free' grains, and as extremely fine, disseminated grains, some of which are spherical and framboidal. A manganese mineral, psilomelane was tentatively identified only in 4445. Chalcopyrite is in places altered to chalcocite and minor covellite.

These minerals occur mainly as free grains, average size about 0.3mm, however some grains, notably pyrite, measure up to 1mm across.

Chalcopyrite commonly contains scattered, fine grains of subhedral pyrite. The independent grains of pyrite generally consist of an aggregate of very fine euhedral to subhedral grains.

Minute grains of pyrite several microns in size, are also disseminated through fragments of the carbonate fragments. These are commonly framboidal. Individual fine grains of framboidal pyrite also occur in the section. Pyrite is the only mineral which shows this disseminated character in the host rock fragments to any significant degree.

The sphalerite grains have a pronounced pale yellow internal reflection indicating that it is essentially Fe free.

Scattered grains of psilomelane, of similar size to the sulphides, occur in this section. These are partially replaced by clouded alteration products which makes their positive identification difficult. They do not appear to form composite grains with the sulphides.

/cont'd .

The country rock fragments consist predominantly of carbonate with minor subrounded quartz grains.

The mode of occurrence, grain size etc., of these grains is described in detail below.

II. Descriptions

Sample 4445

(a) Thin Section of washed sample.

Most of the grains consist of cloudy, "dirty looking " carbonate, probably dolomite. Their average size is about 0.5mm. Accessory limonitised grains and minor-accessory quartz and dolomitic siltstone are also present. The section contains about 3% opaque grains, some of which consist of extremely finely divided opaque material densely clouding grains of ?carbonate.

(b) Polished section of washed sample : fine

The opaque minerals in this section and their approximate estimated abundance are:

| | |
|---|---|
| Galena | 2-3% |
| sphalerite | 1-2% |
| pyrite | 2-3% |
| chalcopyrite | 1% (perhaps <1%) |
| ?psilomelane | 1-2% |

(These abundances cannot be correlated directly with the geochemical analyses, since the samples examined in the polished sections have been washed, panned and differentiated into relative heavies, and lights.)

(c) Polished section of washed sample : coarse.

The same ore minerals as found in the fine fraction also occur in this coarse fraction. Again fine pyrite, including minute framboidal and rare spheroidal grains, is the most abundant mineral disseminated through the rock fragments. Galena and sphalerite form mostly free grains in this section, much the same size as in the "fine"; the amount of chalcopyrite in the sample is negligible. Galena is intimately associated with loose aggregates of pyrite in places.

Sample 4455

(a) Thin section of washed sample.

The component grains in this sample are essentially the same as in 4445. Quartz grains and black-clouded grains of carbonate are far more abundant. "Pure" carbonate grains form only about 5% of the section.

../3

Sample 4455

(b) Polished Section of washed sample : fine.

The ore minerals found in this section showing their approximate order of abundance are:

pyrite, sphalerite, galena, chalcopyrite.

Their total abundance is about 20-25% of this section. No manganese minerals were recognised. Several grains of probable chalcocite occur in the section.

These grains have essentially the same mode of occurrence as in 4445, except most of them, sphalerite in particular far more commonly form fine intergrowths with the country rock. This explains the abundance of carbonate containing disseminated opaques seen in thin section.

(c) Abundant free grains of ore minerals occur in this section. Average grains size is about 1mm. Some grains of corroded sphalerite measure up to 2.5mm across.

Pyrite and sphalerite are the most abundant ore minerals, in this section, with subordinate galena and minor chalcopyrite. No manganese minerals were recognised.

Sample 4505

(a) Thin section of washed sample.

The non opaque rock fragments in this section consist of about 2/3 carbonate grains, and 1/3 rounded to subrounded (but broken), quartz grains. The quartz has an average grain size of 0.3mm. This section contains a lower amount of opaques than the two described above, i.e. 3-5% of the section.

(b) Polished section of washed sample : fine.

Relatively fewer ore minerals occur in this section than those above. Sphalerite and then galena are the most abundant, scattered as free grains, In places they form composite grains. Their maximum size is 0.6mm.

Smaller free pyrite grains, are also common. Minute grains of pyrite, several microns across, are disseminated through most of the carbonate fragments.

Several free grains of chalcopyrite have minor galena associated with them. Also some fractured grains of chalcopyrite are altered sround their boundaries and along fractures to chalcocite and associated covellite.

/cont'd

Sample 4505

(c) Polished section of washed sample : coarse.

Only accessory free grains of sphalerite, pyrite and galena occur in this fraction. Most of the ore minerals consist of extremely fine pyrite, some spheroidal, disseminated through carbonate fragments.

(d) Polished section of fine black, mud-silt normally removed from the washed samples described above.

Extremely fine pyrite, average size 0.01mm. is the most abundant ore mineral in this fraction, forming about 10-15% of it. These grains are mainly anhedral; a lesser number are framboidal (i.e. aggregates of minute spheroidal grains producing a rasberry like aggregate), and rarely these grains are spheroidal.

Accessory, very fine sphalerite and galena are also present.

Sample 4541

(a) Thin section of washed sample.

This has about the same composition as 4541?. It consists mainly of clouded carbonate, accessory rounded quartz grains. Fine opaques occur in the carbonate. Virtually no free opaque grains are present.

(b) Polished section of washed sample : fine.

This contains the same ore minerals in the same mode of occurrence as 4445 above. Galena is the most abundant ore mineral. No definite manganese minerals were recognised.

(c) Polished section of washed sample : coarse.

This contains the same ore minerals, in the same mode of occurrence as in this fraction describe above.

IRP/BA

ENV: 1043

026

# SPECIAL MINING LEASE NO. 256

# LAKE DUTTON, SOUTH AUSTRALIA

## REPORT FOR 6 MONTHS ENDED APRIL 1, 1970.

Report No. 137. June, 1970.

BY

A. THOMAS
CHIEF GEOLOGIST - WESTERN

Perth, Western Australia.

027

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Page No.

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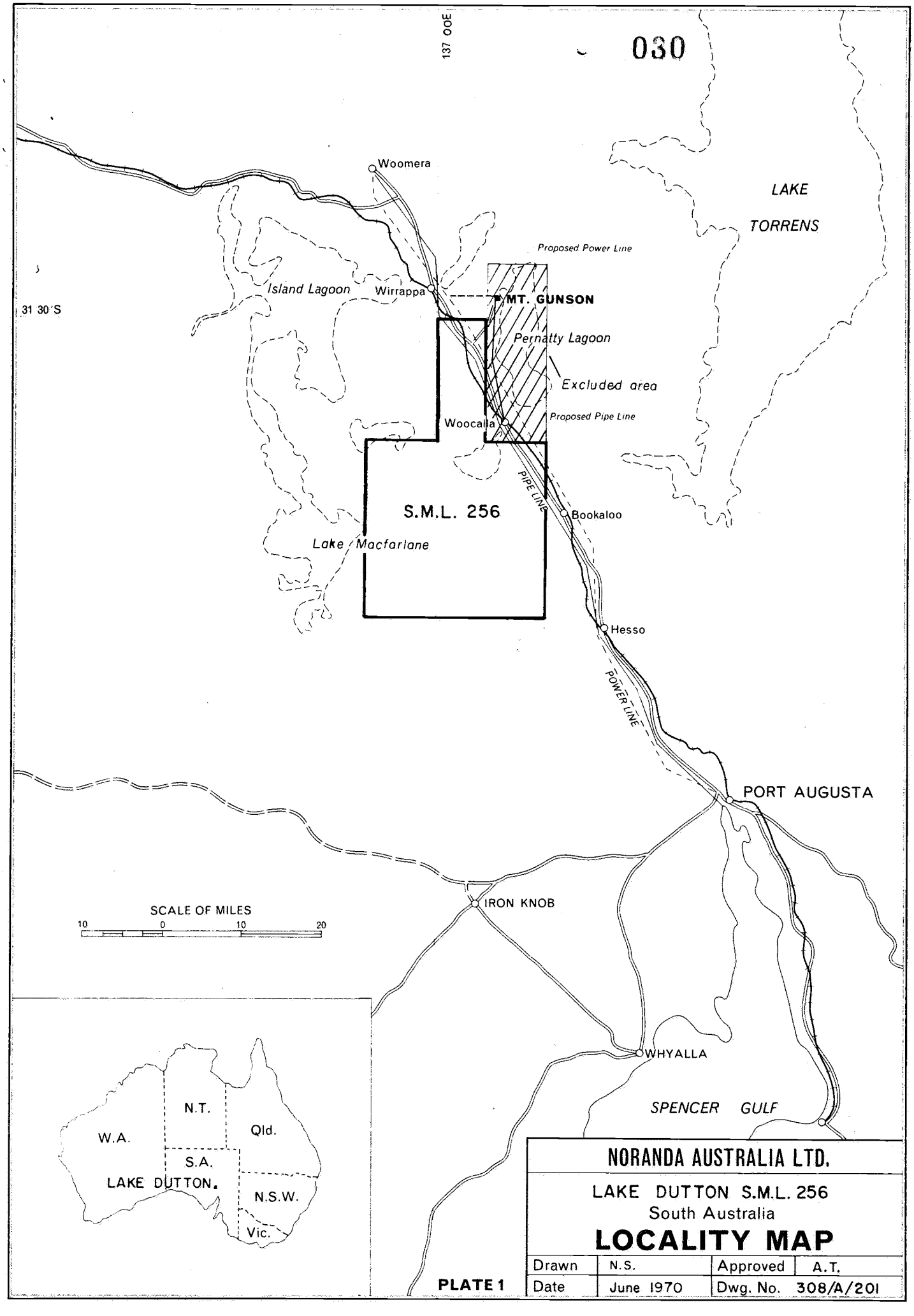
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Proposed Power Line
Island Lagoon
Wirrappa
MT. GUNSON
Pernatty Lagoon
Excluded area
Proposed Pipe Line
Woocalla
PIPE LINE
S.M.L. 256
Lake Macfarlane
Bookaloo
Hesso
POWER LINE
PORT AUGUSTA
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SPENCER GULF
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Qld.
S.A.
LAKE DUTTON.
N.S.W.
Vic.
NORANDA AUSTRALIA LTD.
LAKE DUTTON S.M.L. 256
South Australia
LOCALITY MAP
Drawn N.S. Approved A.T.
Date June 1970 Dwg. No. 308/A/201
PLATE 1

## 1. INTRODUCTION

Special Mining Lease No. 256 was granted to Noranda Australia Limited, for a period of two years from October 1, 1968. One of the conditions of the lease was that full technical reports should be submitted every six months, showing all work undertaken. This report covers the period of six months ending April 1.

## 2. ACTIVITY

A research study in considerable depth was carried out by Mr. and Mrs. A.C. Dunlop, geologists, during this period, and a copy of their report is submitted with this progress report. In compiling this report Mr. and Mrs. Dunlop acknowledged the assistance and informative discussions which they were able to have with Mr. R.K. Johns of the South Australian Mines Department, and other authorities.

## 3. RESUMÉ

Resumé of previous activity within Lake Dutton Special Mining Lease No. 256.
Work in the area was initiated by Noranda Australia Limited in 1967, when feasibility studies were being carried out in conjunction with Austminex Pty. Ltd., at the Mt. Gunson copper deposit. In the rather larger Lake Macfarlane Special Mining Lease, geological mapping, rock geochemistry, and magnetic re-interpretation were carried out. D. Tonkin's geological work led to the delineation of two anomalous areas, near the Birthday Siding Oakden Hills locality, and in the vicinity of the Winnie Pinnie Dam - Trevenna locality. Anomalous lead values were obtained from sampling old bore and well cuttings in both of these areas within dark shales and muds.

The Winnie Pinnie Dam area was tested by percussion drilling in October and December 1968, with results reported in Noranda Report No. 110 in January 1969. Two zones containing sparse lead and zinc sulphides in an apparently stratiform setting within dark clays and shales were outlined. Drill cuttings were examined by Mr. I. Pontifex of McPhar Geophysics, and a copy of his Report was submitted to the Mines Department in 1969. He confirmed the presence of fine pyrite, galena, sphalerite and chalcopyrite within the shales.

## 4. FURTHER INVESTIGATIONS

The dark clays and shales containing the sparse sulphides occur under cover of overlying sandstones of the Tent Hill Formation, covered in turn by extensive shallow deposits of sands, gravels, and clays. Except at one brief locality near the Greenfield Dam, the shales do not outcrop within the lease area, but are believed to be within relatively shallow depths from the surface over extensive areas. In fact, favourable conditions for repetition of the trace sulphides might well extend over 400 square miles, and the need has been to develop some ideas for narrowing down zones which might afford some hope of testing for focal points of enriched base metal sulphides, where economically significant grades may occur.

## 5. RESEARCH CONCLUSIONS

In their report Mr. and Mrs. Dunlop have shown that at the Winnie Pinnie Dam, the dark shales with fine sulphides show some analogies with the Kupperschiefer of Northern Europe, but that thicknesses of the shale are much greater, with apparently correspondingly lower grades of sulphide. As with the Kupperschiefer, there is some evidence of metal zoning vertically and horizontally, if say the Sweet Nell copper mine (off our lease) is regarded as a copper enriched zone of the same general syngenetic facies.

Solution of metals and transportation in saline groundwater from their source environment to points of reprecipitation and concentration in localities of structurally favourable brecciation and permeability may present a valid mechanism for ore concentration at Pernatty. The relatively high barium and fluorite geochemical background in the region again point to a certain analogy with the Mississipi Valley type ore deposits, the origin of which has been ascribed by some authorities to the influence of saline fluids.

## 6. RESEARCH RECOMMENDATIONS

Mr. and Mrs. Dunlop have recommended seismic refraction geophysical investigations with the purpose of delineating the sub surface structure within the Pandurra/Tent Hill disconformity, and drilling by rotary Mayhew or similar rig technique to test stratigraphy on a broad spacing pattern to detect possible lateral zoning of metals within the shales. They recommend shallow percussion drilling of possibly structurally favourable zones adjoining basement highs.

## 7. PROPOSED INVESTIGATIONS DURING THE NEXT SIX MONTH PERIOD.

An approach was made to Geophysical Services International (Sydney) and Compagnie Generale de Geophysique (Brisbane) for quotations for seismic refraction surveys. In view of the relatively high cost of this type of approach, it has been decided to carry out further drilling first, with the idea of obtaining more widely spread stratigraphic sections and possibly obtaining indications of lateral metal zoning, before reconsidering seismic refraction surveys as the technique could then be concentrated in the most favourable localities.

# RESEARCH REPORT

# SPECIAL MINING LEASE NO. 256

# LAKE DUTTON

# SOUTH AUSTRALIA

April, 1970

By

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## SUMMARY


1. All previous investigations of the Lake MacFarlane Pernatty Region have been co-ordinated.

2. Research has been conducted into pertinent literature on similar areas.

3. Ideas have been discussed with academic and research workers interested in the area.

4. A description is given of the possible origin of the mineral deposits.

5. A seismic geophysical programme has been proposed.

6. A proposed drilling programme of 4,800 feet has been outlined.

# 1. INTRODUCTION

## 1.1 Background and Work to Date

During an investigation of the Mt. Gunson copper deposit, by Noranda in 1967, a regional study was initiated with the object of discovering extensions or repetitions of this type of mineralisation, within Special Mining Lease No. 152, which covered 2,700 square miles. This work was carried out by D. Tonkin and recorded in Noranda Report 103, January 1968. In conjunction with Tonkin's work, a two stage interpretation of airborne magnetometer data was compiled by J. Webb and P. Woyzbun of Austral Exploration Services. This involved examination and interpretation of pertinent aeromagnetic contours and reduced profiles available from the South Australian Mines Department.

On the basis of rock geochemistry, from the limited outcrops present, Tonkin drew attention to two priority 1 areas; one in the Birthday Siding - Oakden Hills locality and the other in the Winnie Pinnie Dam - Trevanna locality. In July and August 1968, A. Thomas confirmed some of Tonkin's rock geochemistry from sampling old well cuttings in both of the priority areas. Anomalous lead values were obtained from dark shales and muds from four well sites.

Special Mining Lease No. 256 of 900 square miles was granted to Noranda Australia Limited on October 1, 1968. As the Birthday Siding - Oakden Hills anomalous area is very close to the border of Special Mining Lease No. 139a held by Austminex (now by C.S.R. - United Uranium), it was decided to first test the Winnie Pinnie Dam - Trevanna anomalous area. A percussion drilling programme of 3187 feet was thus undertaken to test this area using a Gardner Denver P133 track mounted air drill during October and December 1968. The results of this programme are recorded by A. Thomas in Noranda Report 110, January 1969. In this programme two zones containing sparse lead and zinc sulphides, in an apparently stratiform setting within dark clays and shales, were delineated. One zone is 20 - 30 feet thick and extends over an area 1 mile by half a mile, and averages 0.2% Pb and 0.3% Zn at depths ranging from 40 to 135 feet from the surface. The other zone is 20 to 30 feet thick and two miles by half a mile in area. It averages 0.1% Pb and 0.1% Zn at depths ranging from 30 to 100 feet from the surface.

In September 1969, samples of drill cuttings from this programme were examined by I. Pontifex of McPhar Geophysics. He observed fine pyrite, galena, sphalerite and chalcopyrite, and his findings are recorded in Mineralogical Report 61, (Appendix I).

## 1.2 Geology

### 1.2.1 Introduction and Setting

The Lake MacFarlane - Pernatty Lagoon Region has been mapped by the South Australian Mines Department on the Torrens and Port Augusta 1:250,000 geological sheets. Further observations on the stratigraphy have been made by B.P. Thomson and J.E. Johnson (1968). The current geological investigations draw heavily on the mapping and interpolation of D. Tonkin (1968).

The sediments in this area form part of the Stuart Stable Shelf, marginal to the Adelaide Geosyncline. The shelf sediments rest on the Gawler Platform - an Archean igneous and metamorphic complex. The transition from the Stuart Stable Shelf to the Adelaide Geosyncline proper, is marked by the Torrens Hinge Zone - a series of persistent north-north-west trending basement lineaments.

### 1.2.2 Stratigraphy

The discussion of the stratigraphy will be confined to the area lying within the current S.M.L. No. 256.

(a) The Pandurra Formation is the oldest rock group outcropping within the area. Examination of drill cuttings from the Beda Bore, suggest that the Pandurra Formation is underlain by a pyroxene basalt of the Roopena Volcanics, which have been assigned a Willouran Age. The Pandurra Formation is thought to be of late Willouran or early Torrensian Age. It is comprised of sandstones, grits and quartzites which show a characteristic red colouration. The Woomera No. 1 Bore passed through 500 feet of this Formation without bottoming.

(b) The Wocalla Dolomite disconformably overlies the Pandurra Formation. It consists of yellow, buff or grey massive and laminated dolomites, grey and black, laminated, dolomitic shales and black shales. At the top of this unit there is a sequence of buff, yellow and red clays. Near Mt. Gunson, the Wocalla Dolomite contains Collenia fossils, intraformational breccias and crenulated bedding with abrupt terminations, suggestive of a stromolite reef, (R.K. Johns 1967). Drilling in the Winnie Pinnie Dam area has indicated irregularities in the upper surface of the Pandurra Formation, in which finely laminated dolomites, shales and muds have been deposited. The Woomera No. 1 Bore passed through a 400 foot section of the Wocalla Dolomite, but in many areas the overlying Tent Hill Formation lies on the Pandurra. This may suggest black shale deposition in a restricted lagoonal environment, with marginal reef complexes about basement highs in the Pandurra land surface (corresponding to the Pernatty Culmination). The multicoloured clays and irregularities in the upper surface of the Wocalla Dolomite may indicate a transition to arid conditions and some erosion.

(c) The Tent Hill Formation disconformably overlies the Wocalla Dolomite and consists of the Whyalla Sandstone Member, the Tregolana Shale Member, the Corraberra Sandstone Member and the Simmens Quartzite Member. This account will only be concerned with the Whyalla Sandstone Member. The Tent Hill Formation is of Marinoan Age. The Whyalla Sandstone contains dominantly white and grey porous, cross-bedded sandstones, with some small carbonate lenses, (possibly equivalent to the Nuccaleena Formation - D. Tonkin (1968) ) and some thin gypseous bands - (J. McAndrew, pers comm. 1970). The white sandstones are made up of spherical quartz grains in a muddy matrix suggesting a wind blown origin. The Whyalla Sandstone attains a thickness of 300 feet in the Woomera No. 1 Bore.

(d) Tertiary and Recent accumulations cover much of this area. They take the form of remnants of siliceous duricrust of Tertiary Age, and recent sand dunes. The thickness of these deposits is generally less than 40 feet.

### 1.2.3 Structure

The sediments in this area have a generally sub-horizontal attitude. The disconformity between the Pandurra Formation and the Whyalla Sandstone is a major feature probably controlled by the Pernatty structural culmination. This culmination takes the form of a series of large inliers of Pandurra Formation extending north-south from Yudnapinna homestead to the northern end of Lake Windabout. This may represent a basement high and its configuration is probably controlled by block faulting, as indicated by the aeromagnetic data (Webb and Woyzbun 1967 (a) and (b) ). This block faulting and the erosional features in the Pandurra surface probably controlled the sedimentation of the Wocalla Dolomite.

## 1.3 Work Carried Out

Geological investigations in the area of S.M.L. 256 are hampered by an absence of outcrop and other geological features. Consequently further drilling programmes would be of a random nature, which can become particularly expensive in an area of this size. For this reason it was decided that a research programme should first be undertaken to outline any other possible means of exploration in the area.

This current investigation is aimed towards:

(a) Co-ordinating all previous investigations of the area.

(b) Conducting research into pertinent literature on similar areas.

(c) Discussing ideas with academic and research workers interested in the area.

(d) Recommending further exploration targets on the basis of the geological, geophysical and geochemical data gained above.

# 2. MINERALISATION, LITERATURE RESEARCH AND DISCUSSION

## 2.1 Mineralisation

### 2.1.1 Mt. Gunson - Primary

These copper deposits take the form of scattered, horizontal, more or less tabular bodies, elongated in an east-west direction. They contain malachite, chrysocolla, covellite, bornite and atacamite, disseminated as cement about quartz grains in the more friable sandstone (Whyalla Sandstone), along bedding and joint planes in the Pandurra Formation and along fractures and in irregular patches in the Wocalla Dolomite. All mineralisation is situated very close to the Pandurra Disconformity.

Comment and Speculation Tonkin 1968 suggests 5 possible controls for mineralisation at Mt. Gunson:

(a) The Pernatty Culmination

(b) The disconformable Whyalla-Pandurra contact.

(c) Proximity to the Wocalla Dolomite.

(d) Basement fractures.

(e) Basement uplifts.

He regards these controls as being important, whether the deposits represent copper solutions emanating from depth or a syngenetic concentration, or a deposition from ground water. Considering the controls outlined by Tonkin and other features of these deposits, deposition from copper bearing solutions is a possible origin. Mineralisation is localised along zones of high permeability (such as the Pandurra-Whyalla disconformity), and areas of increased jointing and fracturing in the Pandurra Formation. These mineralised, permeable zones are situated in a basement high (Pernatty Culmination) in a structurally passive environment towards which solutions might have migrated. McAndrew (pers. comm.) on the basis of minerographic work considers that the suite of oxidised minerals represent replacement of original sulphides.

## 2.1.2 Mt. Gunson - Secondary

$1\frac{1}{2}$ miles north of Mt. Gunson in the Gunyah Lake, an arm of Pernatty Lagoon, copper mineralisation exists in silts and sandstones on the lake floor, which has formed a small basin in the Pandurra Formation. The copper takes the form of atacamite, malachite and the sulphide djurleite (J. McAndrew - pers. comm.), cementing quartz grains and as small segregations in the Whyalla Sandstones. Towards the bottom of this unit the Whyalla sandstone contains numerous, angular fragments of the Pandurra quartzite. Less important mineralisation exists in joints and fractures in the Pandurra Formation.

Comment and Speculation McAndrew (pers. comm.) considers this important sulphide body to have possibly originated from copper bearing solutions derived from the leaching of copper from the primary deposits above the lake. These solutions flowed into the Gunyah Lake where circulation is poor, and copper was precipitated (in the porous Whyalla Sandstone on the lake floor), as sulphide from the reduction of sulphate rich lake brines by bacterial action. In this lagoon area the Wocalla Dolomite is absent.

## 2.1.3 Lead-Zinc Mineralisation

Drilling in the vicinity of Winnie Pinnie Dam and Trevanna outstation disclosed sparse galena, sphalerite, chalcopyrite and pyrite mineralisation in a stratiform setting, within poorly consolidated muds, clays and dolomitic shales of the Wocalla Dolomite. Comparing the geochemical results (from the drilling programme) with the average metal content of Black Shales (Hawkes and Webb, 1965), A. Thomas (1968) found that lead ranged from $2\frac{1}{2}$ - 10 times normal and zinc from normal to three times normal. This suggests definitely anomalous lead values and possibly anomalous zinc. All holes were analysed for manganese as well as copper, lead and zinc, but no relationship between manganese values and values for lead and zinc were apparent. Manganese values tend to increase through the shales and clays towards the Pandurra contact (Plate 2). There is a persistent tendency for weak copper enrichment towards the top and sometimes bottom of the zone of higher lead-zinc

values (Plate 2). Pontifex (1969), in a minerographic investigation of drill sludge recognised some spherical and framboidal forms of pyrite, particularly in pyrite which was disseminated in carbonate rich sediments. He also noted that chalcopyrite commonly contained fine grains of subhedral pyrite. Much of the galena and chalcopyrite, and some of the sphalerite occurs as free grains, suggesting that it occurs in the poorly consolidated muds and clays rather than in the more consolidated dolomites and black shales. No association between manganese minerals (psilomelane) and sulphides was observed. The area drilled is situated on the southern flank of basement rise in the Pandurra Formation, which forms the Pernatty Culmination. Two zones containing higher lead and zinc values trend north - south as shallow basins, flanking a swell in the Pandurra surface.

Comment and Speculation Copper mineralisation at the Sweet Nell Copper Mine occurs in a similar stratigraphic position to the lead-zinc-copper mineralisation in the Trevanna - Winnie Pinnie Dam area. At the Sweet Nell deposit, a cupriferous shale bed 4 feet thick underlies a grey-buff dolomite bed, at the base of the Wocalla Dolomite, and lying on red sandstones and quartzites of the Pandurra Formation. This shale contains high grade oxide copper ore, but only represents a small remnant outlier, on a large area of Pandurra Formation. It is situated on the Pernatty Culmination adjacent to a flexure in the Pandurra basement. The mineralisation at Sweet Nell indicates that mineralisation of higher grades may exist elsewhere within the shales and muds of the Wocalla Dolomite.

## 2.2 Literature Research

It was considered that if any zones of economic mineralisation existed in this environment - a literature research programme would be a possible approach to their location. In this search of the literature for descriptions and discussions of a similar environment to the Pernatty - Lake MacFarlane region, two broad semigenetic groupings appear. The first group

consists of those mineral deposits (copper-lead-zinc) with a possible syngenetic sedimentary origin and the second consists of those that possibly originated from solution activity. The boundaries between these groupings are gradational (thus inter-related) and controversial to say the least.

2.2.1 Syngenetic Grouping

First we will consider the syngenetic grouping. Black bituminous shales throughout the world show abnormally high metal contents. They form in stagnant non-oxygenated environments which favour the precipitation of sulphides.

A suitable but controversial example, (showing some characteristics similar to the Pernatty - Lake Mac-Farlane mineralisation) is the Kupferschifer of Northern Europe, which stretches from North Eastern England to the Low Countries, Germany and Poland. (This example has been chosen in preference to the syngenetic ores of (a) The Mt. Isa - MacArthur River type, which have closer volcanic associations suggesting an exhalative volcanic sedimentary origin; or (b) the Rhodesian Copper Belt, where copper mineralisation in shales and quartzites flanks barren Collenia reefs on basement highs). This Kupfer-schifer has been the subject of numerous investigations (mostly foreign language productions). Dunham (1964) gives a comprehensive review in English.

The Kupferschifer is a thin bituminous dolomitic shale formed in the Middle Permian Zechstein lagoon (basin). It is underlain by the Lower Permian red sandstone, conglomerate and shale of the Rotliegende, and over-lain by dolomitic limestones of the Zechsteinkalk, which is in turn overlain by a thick Permian evaporite sequence. Dunham (1964) suggests that the deposition of the Kupferschifer was merely the prelude to a pro-longed episode of cyclic evaporation. In the Mansfeld Basin the ore shale averages 22 cm. in thickness (about 9 inches), averaging 3% copper over an area of 140 square kilometers. The sulphides occur in as minute spheres (framboids and spheres of C.G. Love (1962) ) and as small lenses parallel to the bedding. The minerals are chalcocite, bornite, chalcopyrite, pyrite, argentite, sphalerite and galena.

Below are some examples of mineralisation in the Kupferschifer giving some idea of their extent and grade:

(a) Basins north and south of the Harz - 100 square miles of greater than 1% copper, 2,200 square miles of greater than 1% zinc with a comparable area of lead enrichment.

(b) The Marl Slate (English equivalent) - over 390 square km. averaging 1.3 metres thick (0 to 3.9 metres) and showing values of up to 3.1% zinc and 0.26% lead.

(c) Haasel and Groditz Basins - where the mineralised bed is 1.8 metres and 1.2 metres thick respectively but the copper grades are lower than at Mansfeld.

(d) Borndorf - where a copper marl averages 0.43% copper, and a lead marl up to 0.14% copper, 6.2% zinc and 0.14% lead, over a combined thickness of 4.5 metres.

(e) Examples of drilling at Spremburg - No. 13; 74 cm thick, 0.03 - 1.09% copper, 0.13 - 3.99% zinc, 0.13 - 3.6% lead with average combined base metal content of 3 - 4%. No. 3; reaches 4% zinc. No. 29; contains 3% zinc with 0.5% lead. No. 15; ranges from 0.3 - 2.8% copper.

(f) At Sieroszowice - mineralised bed is 2.25 m. thick and averages 1.4% copper.

(g) At Lubin - mineralised bed is 2.3 m. thick and averages 1.69% copper.

Considering examples (f) and (g), this combined area is 30 sq. km. and contains 6 million tons of contained copper metal.

Within the Kupferschifer and its equivalents, there are vertical zonations with a copper rich zone at the base of the shale. A lateral zonation has also been suggested, with copper rich facies closer to the shore line. There also appears to be a facies of lead and

zinc enrichment, e.g. in the Marl Slate, which shows low copper values. There is considerable controversy regarding the origin of the metal content, but there is an important occurrence of older, Hercinian mineralisation flanking the Zechstein lagoon. Dunham (1964) considers the following conditions necessary for the generation of this type of mineralisation:

(i) stagnant bottom conditions

(ii) very slow sedimentation

(iii) hydrothermal mineralisation in progress at many places below or within drainage of the lagoon.

H. Borchert (in Dunham 1964) conceded that primary concentrations of trace elements might develop into poor ores, as a facet of sedimentation in a black, bituminous, salinar, dolomitic facies.

2.2.1.1 Relationship to the Lake MacFarlane - Pernatty Region

Sedimentation of the Wocalla dolomite took place under not dissimilar conditions to that of the Kupferschifer, with the formation of finely laminated black dolomitic shales and muds, (suggestive of slow sedimentation) showing a transition to arid conditions with a probable weak evaporite stage, underlain by red beds of the Pandurra Formation. In the Wocalla Dolomite the mineralised sequences are much thicker than in the Zechstein, though the grades are lower. No literature has been located referring to the controls of grade and metal ratios under these conditions. Thus if we consider the mineralisation in the Winnie Pinnie - Trevanna area to be possibly syngenetic, then it is difficult to forecast where better grades might be encountered, if any exist. However, the preceding literature examination does suggest the possibility that this area may represent a lead-zinc facies, and that a copper rich facies, which may be of economic

interest, could exist within the Wocalla Dolomites. This view is supported by the existence of high grade copper mineralisation within a basal shale underlying the massive dolomite at the Sweet Nell Copper Mine. Consequently, it appears that the best method to test this suggestion would be to conduct a drilling programme of 6 broadly spaced dual purpose cored holes to test the stratigraphy and to indicate any variations in the copper content.

### 2.2.2 Solution Grouping

Secondly we will consider the solution activity grouping those deposits possibly originating from metal bearing solutions. Recent investigations have suggested that Na-Ca-Cl brines may form the basis of ore bearing fluids; (White, 1968; Jackson and Beales, 1967; Davidson, 1966). The basis for these conclusions has been derived from a study of:-

(a) Fluid inclusions, observed from many ore deposits, particularly the Mississippi Valley Lead-Zinc-Fluorite-Barite deposits and the Pine Point Lead-Zinc deposits of North West Territories, Canada. (Roedder, 1963, 1968; D.E. White, 1968). The fluid inclusions of ore and gangue minerals have been shown to have very saline chemical compositions and homogenisation investigations have suggested a low temperature origin.

(b) The Salton Sea Geothermal System. This occurs offshore from the Colorado River Delta of California, where drilling has discovered a very saline brine carrying extremely high heavy metal values (White, 1968).

(c) The Red Sea Geothermal System. In 1964, two subsurface pools of hot saline brine were discovered in the floor of the Red Sea. An investigation of recent sediments associated with these saline pools indicates that they carry very high levels of copper, lead and zinc.

D.E. White (1968) has suggested four possible mechanisms from which saline brines may originate:

(a) From magmatic activity - having a probable deuteric origin.

(b) From connate ocean waters, evolving into a saline brine through passage through a series of semi-permeable membranes, during diagenesis and compaction of unconsolidated sediments.

(c) From the leaching of evaporite deposits by dilute meteoric waters.

(d) From the concentration of dilute meteoric waters by passage through semi-permeable membranes.

Experimental data has suggested that transport of metals in chloride complexes in the presence of some sulphide is feasible and that any one of several mechanisms may cause precipitation of metal sulphides at favourable sites (D.E. White 1968, in a comprehensive review of pertinent literature). These mechanisms are:

(i) Minor sulphide present in the fluid may selectively precipitate certain metals as temperature decreases and pH increases.

(ii) Sulphate in the fluid is reduced to sulphide as organic material in the environment is oxidised by bacteria.

(iii) Sulphur may be released from sulphur bearing hydrocarbons.

(iv) Sulphide previously in the form of pyrite recombines to form a more stable sulphide.

(v) A metal bearing fluid may mix with a fluid rich in sulphide.

(vi) Large systems deficient in sulphide may evolve sulphide at low rates (not detected by analyses), sufficient to deposit sulphide in favourable parts of the system.

(vii) At temperatures above 300°C many fluids contain total S as $SO_2$ and $SO_3^{2-}$ and with decreasing temperature conversion to sulphide may occur.

The Mississippi Valley Type Lead-Zinc-Fluorite-Barite deposits may have originated from a saline ore fluid, as suggested by Jackson and Beales (1967) and White (1968). These deposits commonly show the following features - summarised by Ohle (1959) in Jackson and Beales (1967):-

(a) They occur in limestone and dolomite.

(b) They consist of bedded replacements and veins.

(c) Mineralogy is simple and precious metal content is low.

(d) There is a general absence of igneous rocks as potential sources of ore solutions.

(e) Ore bodies are most common in passive structural regions.

(f) Ore is frequently related to positive structural features including basement highs (e.g. Penines on granite basement domes), knobs, calcareous sand banks and algal reefs.

(g) Solution, activity, brecciation, slump, collapse and thinning are commonly in evidence.

(h) Ore occurs at shallow depths relative to the present surface.

In their discussion of the Pine Point Ore Body, Jackson and Beales (1967) consider that, in a marine basin metallic solutions are precipitated as sulphides or are adsorbed on and absorbed in accumulating sediments. Compaction and diagenesis may release metals to the connate fluids by desorbtion, cation exchange and recrystalization in carbonates and clays. These basinal waters (fluids) may be expelled to the margins of the basins in porous aquifers. Ore bodies may accumulate where permeability forms a

plumbing system for the escape of large volumes of fluids. Further, they regard an evaporitic association with the carbonate sequence as a favourable regional feature, in an economic appraisal, as a source of sulphate (ultimately ($H_2S$) and potential areas for solution, collapse and brecciation, to provide a conduit for fluids.

2.2.2.1 Relationship to the Lake MacFarlane - Pernatty Region

Considering the Lake MacFarlane - Pernatty region and Tonkin's (1968) possible controls for the Mt. Gunson mineralisation (see page 6 of this report) in relation to the above data, the following features may be observed:

(a) The Pernatty Culmination forms a positive structural feature (Pandurra basement high) with a flanking algal reef, in a passive structural environment. It is situated marginal to small basins on the Stuart Stable Shelf to the west and the Adelaide Geosyncline on the east.

(b) The disconformable Pandurra-Whyalla contact provides a potential aquifer for fluids. The lower surface of this aquifer (the Pandurra sandstones and quartzites) contain disseminated pyrite which may cause precipitation of metal sulphides.

(c) Proximity to the Wocalla Dolomite may cause precipitation of sulphides from fluids, as a result of local increases in pH.

(d) Basement fractures (as indicated by the magnetic data) may result in local increased jointing and possible fracturing and brecciation in the Pandurra Formation and possibly the Wocalla Dolomite, thus making them more permeable, possibly forming a conduit passage of fluids.

(e) Basement uplifts (if the case) are a feature forming the Pernatty Culmination.

Johns (1967) gives a number of analyses for the Wocalla Dolomite which indicate that it contains (near the Pernatty Culmination) anomalous amounts of Barium and Fluoride. On the western edge of Pernatty lagoon barite and minor fluorite occur associated with manganese at the Pandurra - Wocalla Dolomite contact.

TABLE 1

TABLE SHOWING ANALYSES FOR WOCALLA DOLOMITE

| Location | Ba | F. |
|---|---|---|
| 1 mile south-east of Wocalla | 0.16% | 0.07% |
| Wocalla Quarry | 0.16% | 0.05% |
| Sweet Nell | 0.33% | 0.02% |
| Near main Mn mine | 0.24% | 0.02% |
| Near north Mn mine | 1.17% | 0.03% |
| Mt. Gunson | 0.35% | 0.02% |

TABLE 2

TABLE SHOWING ANALYSES FOR DOLOMITE OF THE TENT HILL FORMATION

| Location | Ba | F |
|---|---|---|
| Salt Creek | 0.07% | 0.01% |

TABLE 3

TABLE SHOWING ANALYSES FOR ANDAMOOKA LIMESTONE

31 analyses were made, all recorded less than 0.05% Ba and F was not ~~detected~~ determined.

Hawkes and Webb (1965) give the average analyses for limestone as 0.002 - 0.02% Ba and 0.005% F.

Barium and fluorine are often associated with some Mississippi Valley type ore deposits, as a zonation feature. Thus if we speculate that the Lake MacFarlane-Pernatty region represents an environment for the deposition of ore minerals from saline fluids, then the search for ore should be directed towards locating possible conduits for fluids along the Pandurra - Whyalla disconformity adjacent to the Pernatty Culmination. As mentioned previously, zones of increased joint density and possible fracturing and brecciation, underlain by basement fractures, might provide such permeable conduits. Also troughs and erosional gorges in the Pandurra surface, particularly those filled by the porous Whyalla sandstone, might provide conduits for potentially ore bearing fluids. The Pandurra-Whyalla disconformity flanking these structures may then provide exploration targets. Determination of Ba and F should be made during future drilling programmes, as these elements may reflect zoning features within mineralisation.

## 2.3 Geophysical Data - Aeromagnetics

An interpretation of available aeromagnetic data for the Lake MacFarlane-Pernatty region was carried out by Austral Exploration Services in 1967. The results of this investigation were submitted in two stages (Webb and Woyzbun 1967 a and b). The first stage provided information on the structure of the basement, and ideas on the depth of the basement. The second stage contained detailed calculations of depth to basement magnetic anomalies. The magnetic interpretations distinguished three zones of different character (Tonkin 1968):-

(a) The eastern zone where magnetic trends are masked by younger sediments. This zone is characterised by broad deep seated anomalies at depths in excess of 20,000 feet.

(b) The central zone which contains strong anomalies which were regarded as basement uplifts. Boyd (pers. comm.) suggested these anomalies may rather represent the magnetic character of the basement rather than necessarily reflecting a basement uplift. These anomalies occur at a depth of 4,000 - 6,000 feet.

(c) The western zone contains a series of large north west trending anomalies. Boyd (pers. comm.) considers that these anomalies may represent dolerite intrusions along ancient fault zones. These occur at depths of 500 - 1,200 feet.

These interpretations generally support geological evidence - that this area forms part of the Stuart Stable Shelf, which is a thin veneer of sediments on an Archean basement with the deeper structures of the Adelaide Geosyncline to the east.

The uplift of the central zone (if the case) along the north west lines of weakness (Webb and Woyzbun 1967) has been effected by basement cross fractures, which often visibly offset basement magnetic features. It is suggested that these fractures may control the configuration of the Pernatty Culmination, and may have caused fracturing, brecciation and increased joint density in the overlying Pandurra Formation. Thus they are probably of considerable importance in controlling mineralisation. Mineralisation at Mt. Gunson and Sweet Nell is adjacent to major cross fractures which show offset of basement features.

## 3. RECOMMENDATIONS

### 3.1 Geophysical Investigations

It is considered that features of the upper surface of the Pandurra Formation may be of considerable importance in localising mineralisation. The most important localising features would be:-

(a) Large gullies and troughs marginal to but cross cutting the Pernatty Culmination. These troughs and gullies in the Pandurra upper surface may provide conduits for ore bearing fluids.

(b) Small basins in the Pandurra upper surface, filled by Whyalla Sandstone, may form reservoirs for recent copper bearing solutions (originating from possibly eroded copper deposits at the Pandurra-Whyalla disconformity on the Pernatty Culmination). The copper in these solutions may be precipitated as sulphide by the reduction of sulphate by bacterial action, as in Gunyah Lake.

Thus a knowledge of the configuration of the upper surface of the Pandurra Formation would be of great advantage in selecting future drilling targets.

The Pandurra Formation, the Wocalla Dolomite and the Whyalla Sandstone may have sufficient contrasting seismic velocities to permit their recognition by seismic method. Due to the limited depth (only areas flanked by long Pandurra outcrop areas warrant seismic investigation, and we would consider about 300 feet as maximum economic basement) and small dimensions of a potential target, a refractive seismic technique would be most useful. This technique could be evaluated on areas already tested by drilling and on outcrops of the relevant rock types.

Two geophysical contractors offering seismic services were contacted:-

(i) Geophysical Services International (Sydney)

This group indicated that refractive seismic techniques would be most useful in this situation, and evaluation tests on drilled areas were suggested. Provisional estimate of the cost was $850-1000 per line mile. A truck mounted Mayhew drill is used for short holes, and would be

available to Noranda at no extra cost when not in use by Geophysical Services International during the programme. The very high cost of survey by this petroleum orientated group precludes them from this type of investigation.

(b) Compagnie Generale de Geophysique (Brisbane) - have offered a combined refractive seismic - resistivity survey. A provisional cost estimate from this group will be available shortly. This group will have a survey unit available in South Australia in the near future.

These types of seismic techniques are extremely expensive, especially considering the information gained and the low grades of mineralisation encountered to date. More primitive (simpler) and thus cheaper seismic techniques do not seem to be able to penetrate to depths greater than 75 feet.

We have proposed (see Plate 3) seismic lines flanking the Pernatty Culmination and totalling 97 line miles (subject to technical and economic feasibility). If this method did lead to the discovery of higher mineral grades further seismic work should then be undertaken along other Pandurra outcrops.

## 3.2 Drilling Programme

A drilling programme is proposed to test targets representing possible mineralisation, as indicated by this investigation. The aim is:-

(a) To test for a copper rich facies and better grades of lead zinc mineralisation within a possible sedimentary, syn-genetic environment in black muds, dolomitic shales and dolomites of the Wocalla Dolomite. It is suggested that six 300 ft. vertical holes be drilled. These holes should be cored (if possible using a Mayhew truck mounted drill). The proposed sites for these holes L.D.C. 1 - 6 are shown on Plate 3.

(b) To test for mineralisation possibly originating from saline fluids in conduits marginal to the Pernatty Culmination. The following drilling has been proposed:

(i) Adjacent to possible conduits interpreted from basement fractures. Two 150 ft. vertical percussion holes are proposed for each of the areas A, B and C. These holes L.D.P. 1-6 are shown on Plate 3.

(ii) Adjacent to possible conduits indicated by the geophysical investigation (if feasible). Six 150 ft. percussion holes are suggested for this follow up.

(c) To test for possible secondary copper sulphide deposits in small basins in the Pandurra Formation surface, marginal to the Pernatty Culmination. Two types are indicated:

(i) Basins indicated by geological interpretation. It is suggested that two vertical percussion holes 150 ft. deep be drilled in each of the areas D and E. The proposed holes L.D.P. 7 - 10 are shown on Plate 3.

(ii) Basins indicated by geological investigations (if carried out). Four percussion holes are suggested for this follow up.

The total programme envisaged would involve the drilling of:-

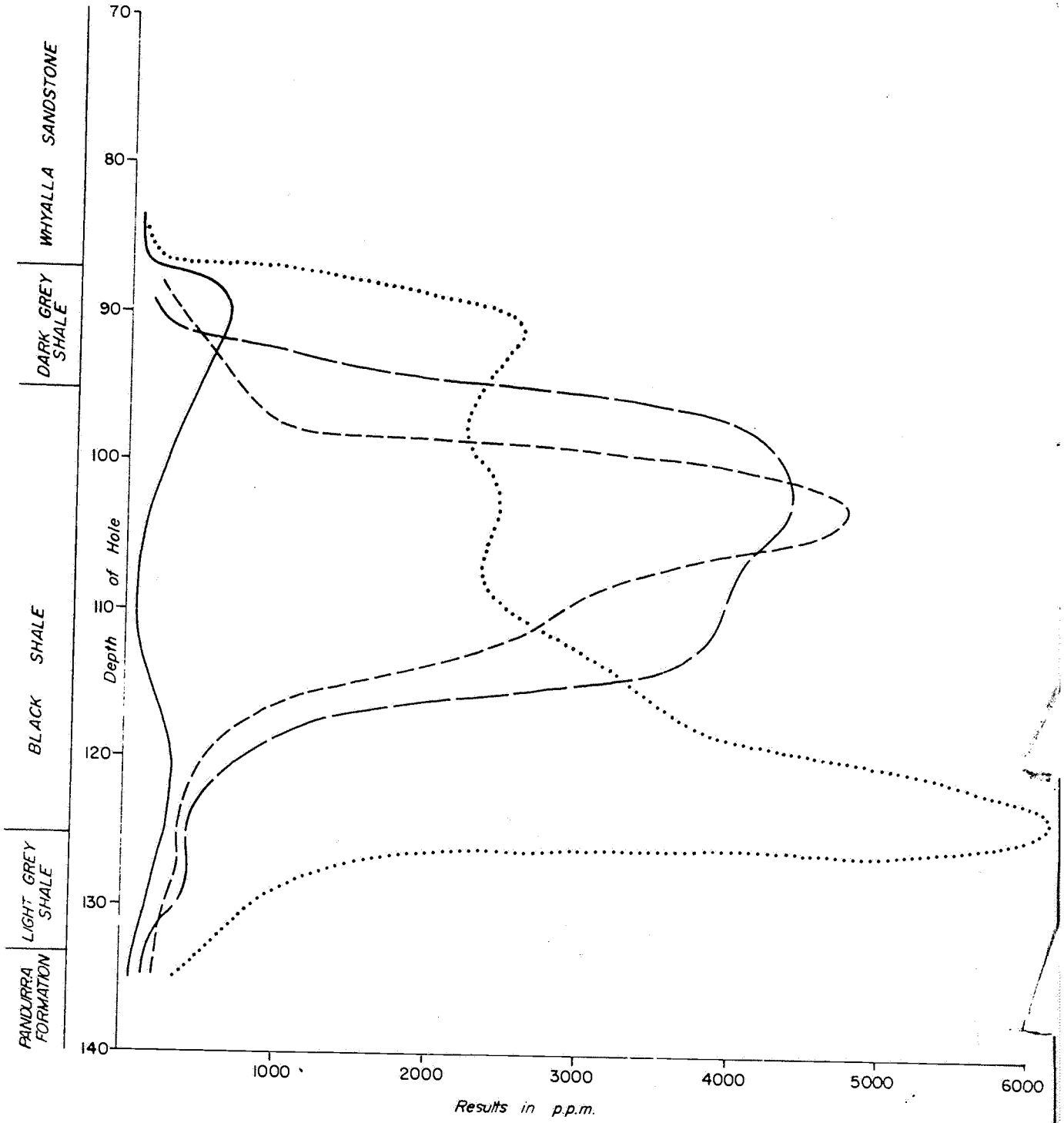
20 vertical percussion holes of 150 ft. each - total 3,000'
6 vertical cored holes of 300 ft. each - total 1,800'

Total Drilling - 4,800 feet

ACKNOWLEDGEMENTS

The authors would like to acknowledge the assistance and informative discussions of the following:

Professor Boyd of Adelaide University;
Dr. J. McAndrew of C.S.I.R.O., Melbourne;
R.K. Johns of the South Australian Mines Department;
A. Thomas of Noranda Australia Limited.




Copper
Lead
Zinc
Manganese

Plate 8 of report no 147
Plate 2 of report no 137

Env 1043

PLATE 2

SCALE Vertical 1 inch = 10 feet
Horizontal 1 inch = 1000 ppm.

ENV 1043 (11) -1

| NORANDA AUSTRALIA LIMITED | | |
|---|---|---|
| SPECIAL MINING LEASE N°256 LAKE DUTTON S.A. GEOCHEMICAL RESULTS W.P. 20 | | |
| Date: April 1970 | Geochemistry L.Szoke | Drawn: N.W. |
| Approved: A.T. | Dwg. No. 308-E-201 | |

137° E

MT. GUNSON

PERNATTY LAGOON

LAKE FINNISS

LAKE BLYTH

LAKE DUTTON

LAKE MACFARLANE

"Oakden Hills"

Birthday

SWEET NELL

TREVENNA

Winnie Finnie Dam

32° S

Boundary of S.M.L. 256

## REFERENCE

| | | |
|---|---|---|
| a | Upper Tent Hill formation | (Corraberra sandstone and Simmens quartzite) |
| b | Lower Tent Hill formation | (Whyalla sandstone and Tregolana shale) |
| c | Woocalla Dolomite | |
| d | Pandurra formation | |
| e | Gawler Range volcanics | |

## LEGEND

- Geological boundaries
- Geophysical discontinuities
- Geophysical discontinuities - offsetting basement structures
- Approximate area tested by drilling 1968
- • 800' Spot determinations for basement depth
- Proposed seismic lines
- ⊕ Proposed stratigraphic cored drill holes
- ⊙ Proposed percussion drill holes
- x 50 Cu / 850 Pb — Rock sample location and results in ppm (In descending order Cu, Pb)

Plate 9 of report no 147
Plate 3 of report no 137

PLATE 3

# NORANDA AUSTRALIA LTD. Env 1043

SPECIAL MINING LEASE No 256

LAKE DUTTON S.A.

## GEOLOGICAL and GEOPHYSICAL

INTERPRETATION PLAN SHOWING

## RECOMMENDED EXPLORATION TARGETS

SCALE 2 1 0 2 4

| | | |
|---|---|---|
| DATE: April 1970 | GEOLOGY: D.G. Tonkin<br>GEOPHYSICS: Austral Exploration Services<br>RECOMMENDATIONS: A.C. and C.P. Dunlop | DRAWN: N.S. |
| APPROVED: A.T. | | DRAWING No. 308-C-205 |

ENV 1043(1)-2

ENV: 1043

060

# SPECIAL MINING LEASE NO. 256

# LAKE DUTTON AREA - SOUTH AUSTRALIA

## REPORT FOR SIX MONTHS ENDED SEPTEMBER 30, 1970.

(Incorporating a review of work carried out in the area to date.)

Report No. 147 September, 1970.

By

G. R. APPLEYARD

Melbourne, Victoria.

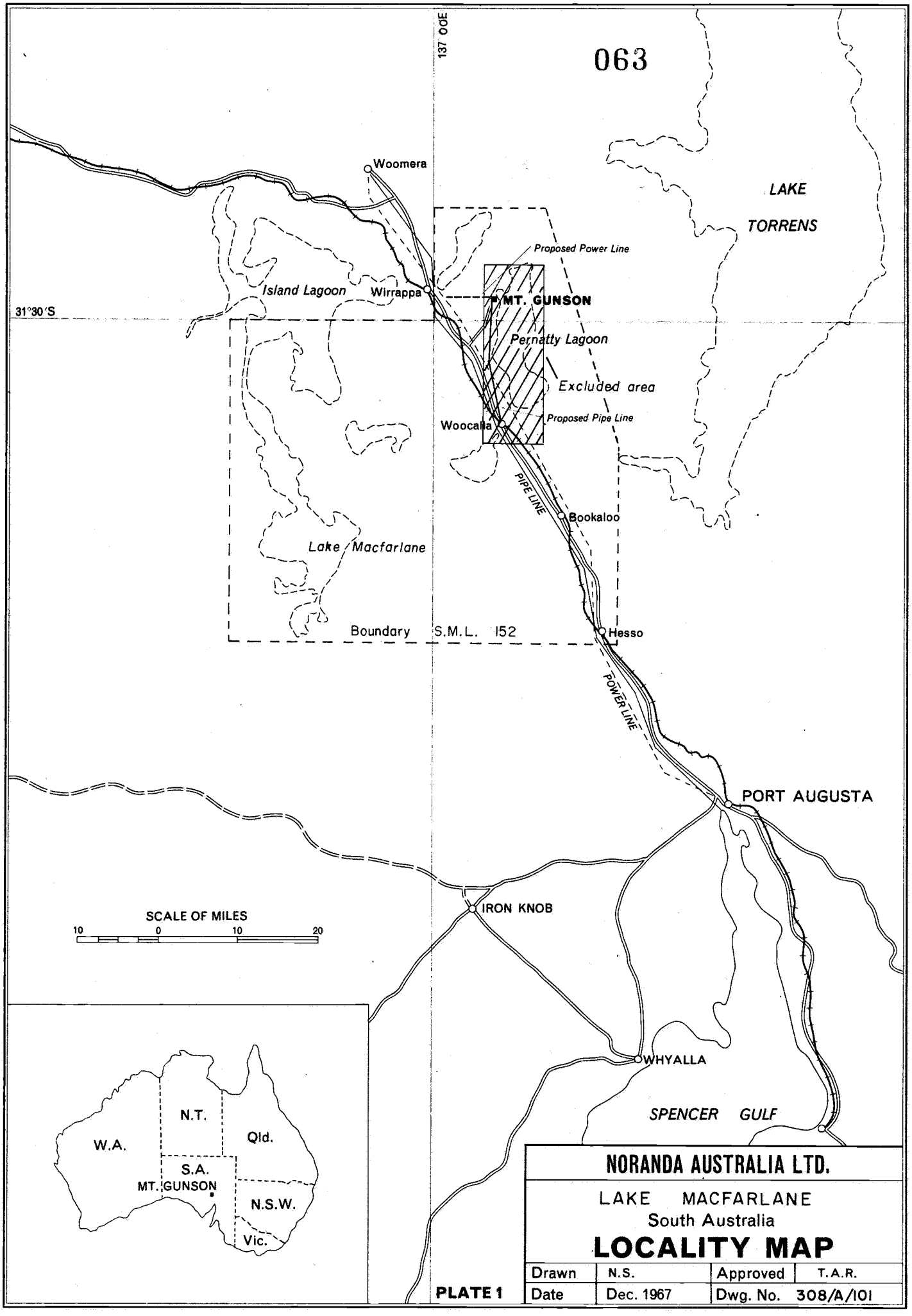
061

# LIST OF CONTENTS



D.H61/68

## LIST OF PLATES


063
137 00E
Woomera
LAKE
TORRENS
Proposed Power Line
Island Lagoon
Wirrappa
MT. GUNSON
31°30'S
Pernatty Lagoon
Excluded area
Proposed Pipe Line
Woocalla
PIPE LINE
Bookaloo
Lake Macfarlane
Boundary S.M.L. 152
Hesso
POWER LINE
PORT AUGUSTA
IRON KNOB
SCALE OF MILES
10 0 10 20
WHYALLA
SPENCER GULF
N.T.
W.A.
Qld.
S.A.
MT. GUNSON
N.S.W.
Vic.
NORANDA AUSTRALIA LTD.
LAKE MACFARLANE
South Australia
LOCALITY MAP
PLATE 1
Drawn N.S. Approved T.A.R.
Date Dec. 1967 Dwg. No. 308/A/101

## 1. REVIEW OF WORK LEADING TO APPLICATION FOR S.M.L. 256.

On July 1, 1967, Noranda Australia was granted a six month Special Mining Lease (S.M.L. 152) over 2700 square miles of the Lake MacFarlane-Lake Dutton area to the west of Lake Torrens. The desire to explore this area followed work done by this Company and others in the investigation of the Mount Gunson-Pernatty Lagoon copper deposits. Whilst this work was being carried out it was suggested that there might be a repetition of this type of deposit elsewhere along the Stuart Shelf. This shelf separates the pre-Cambrian Gawler Platform from the Adelaide Geosyncline.

During exploratory drilling of the Mount Gunson deposit it was recognised that the copper mineralisation may be related to a disconformity above the Pandurra Formation. This same disconformity was simultaneously recognised near Whyalla by geologists of the South Australian Department of Mines.

An exploration programme for S.M.L. 152 was framed after discussions with officers of the South Australian Department of Mines and the programme, as subsequently carried out, included:

(a) Geological mapping with the emphasis on stratigraphy and on the tracing of the disconformity.

(b) Rock sampling in an attempt to define the most favourable stratigraphic patterns and the areas for more detailed investigation.

(c) Interpretation of all existing aeromagnetic data in an attempt to define basement structures and their possible relationship to mineralisation.

The geological work and to a lesser extent, the magnetic interpretation, suggested the "Pernatty Culmination", which is a positive basement feature striking northerly from Trevanna along the western edge of Pernatty Lagoon to the northern end of Lake Windabout. This culmination is expressed by the previously recognised disconformity.

The magnetic interpretation provided information on the basement sub-structures and allowed the tectonic history of the area to be

inferred. More specifically it indicated strong magnetic anomalies at the Mount Gunson copper deposit and in an area to the east of Lake Dutton; both areas being on the axis of the "Pernatty Culmination". Areas of major faulting were also indicated by the magnetics.

Previous geochemical work had indicated that the most favourable locus for mineralisation was the base of the Tent Hill formation where it disconformably overlies the Pandurra Formation and, in particular, where a pre-Tent Hill but discontinuous dolomitic shale (the Wocalla Dolomite) lies above the unconformity. The basal member of the Tent Hill formation is the Whyalla sandstone member.

In only 15% of the area is there rock outcrop or sub-outcrop. The results of initial sampling suggested two anomalous areas for more detailed follow up. These areas (and the aeromagnetic anomaly) were numbered and named as follows:

Area 1 - Birthday-Oakden Hills: Anomalous lead values were returned from the general vicinity of the disconformity.

Area 2 - Trevanna-Winnie Pinnie: The shale equivalent of the Wocalla Dolomite contains anomalous lead values over a length of 5 miles.

Area 3 - Magnetic anomaly east of Lake Dutton. No outcrop.

Further more detailed sampling was carried out in these areas and as a result an application was made for a new lease in the Trevanna-Winnie Pinnie area in September 1968. An area of 88 square miles was granted as S.M.L. 247, to apply for one year from October 1, 1968.

A programme of percussion drilling was commenced in October 1968 and in early drilling minor lead and other base metal mineralisation was intersected in clays and black shales. This early encouragement provided support for the Company's current theories of mineralisation control and it was felt that a much larger area in which favourable structures and stratigraphy were known to exist should be investigated.

Accordingly, an area of 900 square miles (inclusive of S. M. L. 247) was applied for and was granted as a two year lease to be effective from October 1, 1968. This lease was to be numbered S. M. L. 256.

At this stage the parameters which were being used to select areas favourable for mineralisation, included:

(i) The disconformable Pandurra/Whyalla contact.

(ii) The zone of structural weakness known as the "Pernatty Culmination".

(iii) Proximity to the Woocalla Dolomite which, because of its inherently high PH character, could be considered as a precipitant of metallic ions.

(iv) Basement uplift and basement fracturing.

## 2. REVIEW OF WORK CARRIED OUT IN S.M.L. 256.

Percussion drilling in the Winnie Pinnie-Trevanna area continued in December 1968 and a total of 30 holes for 3,187 feet were drilled. Drilling conditions were extremely difficult because of the relatively shallow depth to water, because of the clayey nature of the target formations and because of the sandy overburden.

Very fine grained galena, sphalerite and pyrite were noted in the black clay and shale member which separates the Whyalla sandstone from the older Pandurra Formation. The shale unit (which was absent in some holes) usually consists of vari-coloured clays underlain by the (mineralised) black clays and shale.

The highest individual analyses were 0.64% and 0.62% lead. Over an area of one mile by half a mile at the western end of the area tested, an average thickness of 20-30 feet of dark clay contained an average 0.2% lead and 0.3% Zn. Silver values of the order of 7 ppm were recorded in the better grade sections.

A central zone of about two miles by half a mile averaged 0.1% lead and 0.1% zinc in similar thicknesses but values decreased towards the east.

As it might be suspected that absorption of secondary metallic ions on to collectors such as manganese etc. could cause abnormal metal concentrations, it was decided to analyse for manganese. There appeared to be no correlation between manganese and lead or zinc and this fact, together with the visible presence of sulphides, was taken as encouraging evidence for primary metal sulphide mineralisation. The dark mineralised clays appear to occupy depressions in the eroded surface of the Pandurra Formation.

At this stage it was felt that a possibly significant base metal accumulation could exist in this environment. However, the values obtained were far from economic and it is possible that they could represent an unusual fluctuation in background metal content in this type of sediment. The problem was to find a method or methods to define the most likely area of mineralisation in an environment where results to date did not justify the very large expenditures involved in pattern drilling on a statistical basis or in blanket geophysical techniques.

As in most of the area the favourable shale-clay unit is overlain both by younger sandstone formations and by unconsolidated Recent sediments, geochemical methods have a very limited use. It was considered that seismic techniques perhaps followed by Induced Polarization surveys of selected areas might offer a possible means of exploration.

However, before the planning of detailed geophysical surveys or further drilling it was felt that additional geological and mineralogical research should be undertaken. The purpose of the mineralogical work was to confirm the indicated presence of primary sulphide metal and to enable petrological and mineralogical comparison between this environment and other environments where stratigraphically controlled base metal mineralisation was known to exist.

Accordingly, drill sludges were examined by McPhar Geophysics Pty. Ltd. of Adelaide. Their report (see six monthly report No. 131 of September 1969) confirmed the presence of primary sulphides and indicated that whilst there was no apparent chemical relationship between the sulphides and manganese minerals, there was an apparent association of lead, zinc and copper sulphides with carbonate material in the host rock. This latter fact is of significance in view of the correlation between the host clays and muds with the Wocalla Dolomite Formation.

An intensive literature research into stratigraphic base metal mineralisation was then carried out by two of the officers of Noranda. In this they were greatly assisted by discussion with Dr. J. McAndrew of the C.S.I.R.O. Melbourne, and Mr. R.K. Johns of the South Australian Mines Department, Professor Boyd of Adelaide University and others. The work was aimed at co-ordinating all previous investigations, researching literature on other similar environments and recommending further exploration targets.

A copy of the research report is appended to the 6 monthly report of April 1970.

It was shown that in the Winnie Pinnie area, the dark sulphide mineralised shales have some analogies with the Kupferschiefer of Europe. The thicknesses of shale are much greater and the sulphide grades correspondingly lower. There is some evidence of both vertical and horizontal metal zoning.

It was concluded that base metal concentrations could occur by a mechanism of solution and transportation in saline groundwater from a disseminated source to a point of concentration in structurally favourable localities. Such transportation would require the presence of suitable conduits for fluids along the Pandurra-Whyalla disconformity. These conduits could be provided by troughs and erosional gorges in the Pandurra surface or by zones of strong fracturing underlain by basement fractures.

Small basins in the Pandurra upper surface filled by Whyalla sandstone might also form reservoirs for copper bearing solutions originating from possibly eroded copper deposits at the disconformity.

As a result of these studies it was recommended that refractive seismic techniques be used in an attempt to define the sub-surface structure of the upper surface of the Pandurra Formation in the vicinity of the Pernatty Culmination.

This programme could be supplemented by a drilling programme designed to test for copper rich facies and better grades of lead-zinc mineralisation in the black muds and shale; for mineralisation originating from saline fluids in conduits interpreted from basement fractures and for possible secondary copper sulphide deposits in basins in the upper surface of the Pandurra formation.

As anomalous barium and fluorine content is often associated with deposits arising from precipitation from saline fluids, it was also recommended that all samples be analysed for these elements.

070

## 3. WORK CARRIED OUT ON S. M. L. 256 IN CURRENT PERIOD.

Approaches were made to two contract geophysical companies to obtain estimates of the costs involved in a comprehensive seismic survey. The extremely high cost of refractive seismic techniques to the depths necessary in this environment are prohibitive unless some other way is found to better define the most interesting areas.

Following a further review of all of the foregoing work a drilling programme was proposed as follows:

(a) About eight rotary holes of average depth 500 feet to be drilled at intervals of 8 to 10 miles throughout the area. These would be stratigraphic holes as well as being aimed at testing the base metal content of the dolomite and/or dolomitic shales which immediately overlie the disconformity.

(b) About 20 rotary holes of average depth 200 feet to be drilled in widely spaced groups of two. In each group the holes would be about a mile or two apart. These would also be aimed at testing for base metals in the shale/dolomite unit but about eight of them would be concentrated on the Oakden Hills area where some copper mineralisation is known to exist. The location of other holes would depend partly on the results of deeper drilling.

The total programme would involve some 8000 feet of rotary drilling. Cuttings would be recovered and logged and sampled where necessary. The proposed drill plan is attached to this report. Further drilling, if warranted, could follow a study of the results of this first programme.

Details of this programme were submitted to the Drilling and Mechanical Branch of the South Australian Mines Department on August 31, 1970 and a tender for the work invited.

In a letter dated September 23, 1970, the Department advised that, due to heavy commitments and shortage of crews, it would not be possible to commence the programme before February 1971.

## 4. SUMMARY AND FURTHER WORK.

The investigation of the Mount Gunson and Pernatty Lagoon deposits has led to the recognition of a major control on copper (lead-zinc) mineralisation in shelf environment adjacent to the Adelaide Geosyncline.

The control - the Pandurra/Whyalla disconformity - has been shown to be coincident with a major positive feature in the structure of the ?Archean basement. Subsequently local controls on mineralisation (some of which are themselves related to the positive basement feature) have been recognised and environments for the localisation of both primary and secondary base metal sulphide concentrations have been defined.

In addition a stratigraphic unit favourable to the precipitation of primary metallic sulphides has been located and above-background concentrations of lead and zinc sulphide proven to exist in it. However, it still cannot be ascertained whether average values of 0.1 - 0.2% lead and zinc in black muds and shales represent an unusually high fluctuation in background metal content or whether these values are indeed an indication that there may be economic grade primary concentrations of these metals somewhere in the many square miles of aereal extent of this unit.

Very intensive research has been undertaken in an attempt to define the controls on potential mineralisation in this area. Whilst we feel that we have at this stage developed some workable parameters it is by no means certain that these are the only, or the most significant, controls.

This is an area of essentially flat lying lithology in which the favourable horizons rarely outcrop and are usually covered by up to several hundred feet of younger Proterozoic sediments and unconsolidated Recent sediments. A large part of the area is covered by windblown sand and drainage patterns elsewhere consist of minor channels draining into salt lakes. Soil and drainage geochemistry are inapplicable and rock geochemistry has limited use.

Electrical geophysical techniques would be hampered by the flat lying nature of the lithology and the probably saline overburden. Refraction seismic techniques may help define the upper surface of the Pandurra formation but these are extremely expensive when used as a reconnaissance method.

The lead-zinc mineralisation proven to date is a long way from being economic. Until the discovery of greater concentrations it is difficult to justify an expensive programme of seismic survey and/or pattern drilling.

However, the technical staff of this Company think that the Lake Dutton area has a potential for large low-grade stratiform base metal deposits and that this potential warrants further testing. We feel that our geological studies to date have been successful in recognising controls on mineralisation and that the parameters of these controls are useable in future exploration. We also feel that further work will have to be carefully controlled by detailed mineralogical, chemical and structural studies. At this stage a programme of rotary drilling as presently planned, followed by a careful geological assessment of the results, is felt to be the best means of exploration.

# REFERENCE

CAINOZOIC

QUATERNARY

- Lake and claypan deposits, saline and gypseous clays and silts.
- Alluvium, gravels and silts, outwash flood plains.
- Outwash slope deposits.
- Pediments and thin alluvium over shallow bedrock.
- Sand ridges and sand spread with claypans.

TERTIARY

- Stream deposits: boulder beds, ferruginous grits.
- Silicified cappings (Duricrust)

PROTEROZOIC

ADELAIDE SYSTEM

MARINOAN

TENT HILL FORMATION

1. Simmens Quartzite Member. Dense current bedded white and pale brown quartzites. Upper surface often silicified.
2. Corraberra Sandstone Member. Dark red brown micaceous shaly sandstone.
3. Tregolana Shale Member. Purple and brown siltstone and shale. Pale purple or white in outcrop.
4. Whyalla Sandstone Member. Basal grits and sandstones with abundant cobbles of Pandurra Fm. Lithic sandstones with well rounded grains. Upper surface often silicified.

5. Woocalla Dolomite. Dolomite and dolomitic limestones and shales. Abundant cobbles of Pandurra Fm. near base.
6. PANDURRA FORMATION. Lithic medium and coarse grained sandstones, quartzites and grits, commonly red or reddish but purple near base. Cross bedded; conglomeratic near base. Characterised near Pernatty Lagoon by secondary banding and silicification.

WILLOURAN

7. ROOPENA VOLCANICS. Pyroxene basalt (section only).

CARPENTARIAN SYSTEM

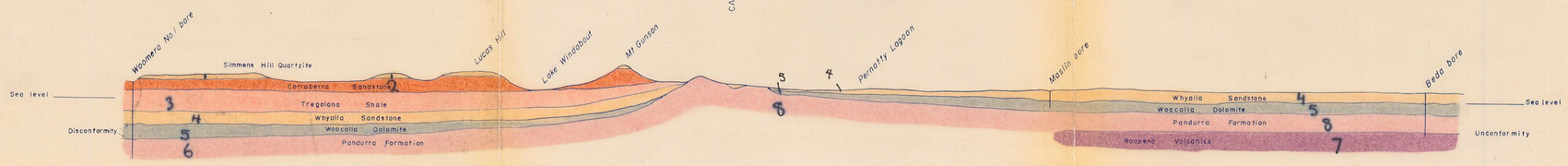
8. GAWLER RANGE VOLCANICS. Quartz-feldspar porphyry, orthoclase-hornblende porphyry columnar jointed rhyolite and acid welded tuffs.

9. Ironstone

GEOLOGICAL BOUNDARIES

- Accurate
- Approximate
- Concealed

- Roads
- Swamp
- Bore
- Well
- Dam
- Mine




SECTION SCALE Horizontal 1: 250000
Vertical 1 inch = 2000 feet

S.M.L. 152



ENV 1043(1)-9

Plate 2 of report no 147

PLATE 2

NORANDA AUSTRALIA LTD.

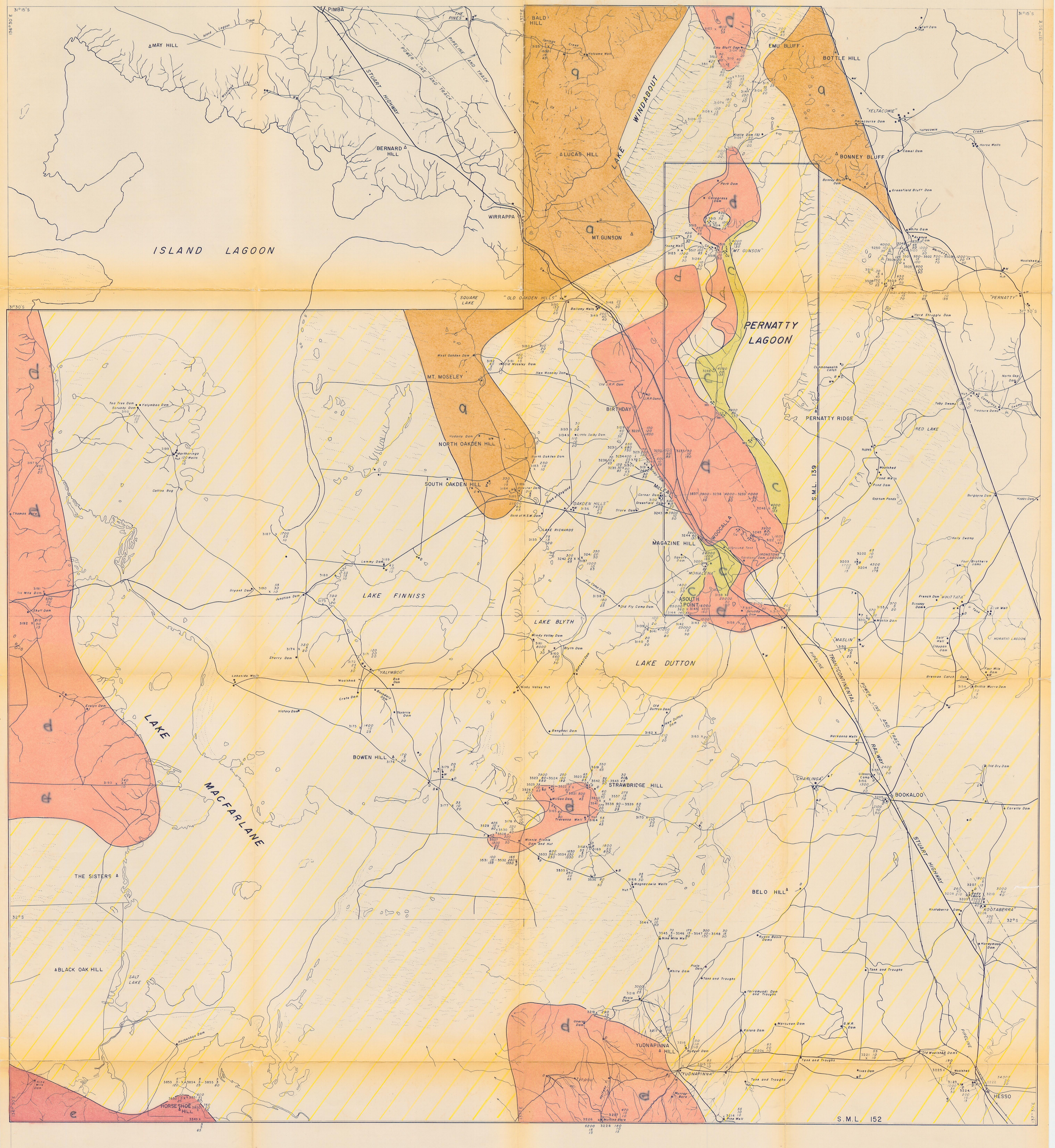
GEOLOGICAL MAP

LAKE MACFARLANE

South Australia

SCALE 1 0 1 2 3 4 miles
1: 125000

| | | | |
|---|---|---|---|
| Geology | D.T. | Drawn | N.S. |
| Approved | T.A.R. | | |
| DATE Dec '67 | Dwg No 308/C/101 | | |




## REFERENCE

- q — Upper Tent Hill Formation (Corraberra sandstone and Simmens quartzite)
- b — Lower Tent Hill Formation (Whyalla sandstone and Tregolana shale)
- c — Woocalla Dolomite
- d — Pandurra Formation
- e — Gawler Range Volcanics

Geochemical rock sample number

3844 X — Geochemical rock sample location

30 — Manganese
10 — Geochemical assays in p.p.m. — Copper
50 — Lead

70 175 300
X 3531 5 – 3546 15 – 3547 10
35 90 130

Samples taken from same location

Manganese analyses by Atomic Absorption Spectrephotometry following Aqua Regia leach

Copper and Lead analyses by Atomic Absorption Spectrephotometry following hot 25% $HNO_3$ leach

Roads
Swamp
Bore • B
Well • W
Dam • D
Mine



PLATE 3

Plate 3 of report no 147

# NORANDA AUSTRALIA LTD.

GEOCHEMICAL PLAN
AND
TECTONIC SKETCH
LAKE MACFARLANE
South Australia

SCALE 1 0 1 2 3 4 miles
1:125000

| | | | |
|---|---|---|---|
| Geology | D.G.T. | Drawn | N.S. |
| Approved | T.A.R. | | |
| DATE Dec '67 | Dwg No 308/E/101 | | |

ENV 1043(7)-8

ISLAND LAGOON

LAKE MACFARLANE

137°00'E

31°45'S

32°00'S

Pernatty Lagoon

BIRTHDAY

ANOMALOUS LEAD, ZINC

Greenfield Dam

McLEAY

Oakden Hills Hs

PROPOSED DRILL THIS AREA

Sweet Neil Copper Mine

WOOCALLA

LAKE FINNISS

LAKE BLYTH

LAKE DUTTON

TRANSCONTINENTAL RAILWAY

Trevenna Q.S.

WINNIE PINNIE—TREVENNA AREA

Devonne Mineral Bore

Beda Bore

Yadnopinna Hs

LEGEND

| | | |
|---|---|---|
| A | | Mainly sand or soil |
| B | | Gravels, sands, clays |
| C | | Whyalla sandstone |
| D | | Woocalla dolomite |
| E | | Woocalla dolomite – shale equivalent |
| g | | Pandurra sandstone |
| × | | Proposed drill site |
| ×? | | Possible drill site (stratigraphic) |



PLATE 4

Plate 4 of report no 147
Plate 1 of report no. 110

# NORANDA AUSTRALIA LTD.

LAKE DUTTON S.M.L. 256

SOUTH AUSTRALIA

## GEOLOGICAL MAP

SCALE

| | | |
|---|---|---|
| DATE: 28 March 1969 | GEOLOGY: A THOMAS | DRAWN: N.S. |
| APPROVED: T.A.R | DRAWING No. 308/C/201 | |

ENV 1043(1)-2

137°00'E.

31°54'S.

WP24 −30 100'

WP12 11-25 75-4

Lake

WP13 −40 115'

WP23 14.5 180°

WP11 −5 120'

WINNIE PINNIE Dam

WP10 −10 150'

WP22 +12·5 100'

WP9 −15 50'

WP19 00' 100'

WP5 +2·5 150'

WP7 00 90'

WP8 −10 150'

WP16 −10 60'

WP20 +25 150'

WP21 +21·5 100'

WP4 +16 84'

Track

Abandoned Holes
WP1 80'
WP2 30'
WP3 50'

WP6 00 96'

WP17 +19 150'

WP18 +17·5 70'

WP19 +37·5 117'

To Hoxton and Tuttleponds H.S.

DATUM

TREVENNA O.S.

6°30'

Magnetic

Dam south of Trevenna O.S.

Lake

WP25 −33 200'

WP26 −33·5 193'

WP14 −40 68'

WP27 −10 93'

WP28 −5 50'

Track

To Trevenna H.S.

WP30 −30 129'

WP29 −17 114'

Lake

Legend

WP27 Drill Hole
−10 Reduced level of collar Relative to datum
93' Depth

DATUM COLLAR WP6

Cross sections

137°00'E.

ENV 1043(1)-7

RECEIVED
7 OCT 1970
DEPT. OF MINES
REGISTRY
1043

Plate 5 of report no 147
Plate 2 of report no 110

PLATE 5

# NORANDA AUSTRALIA LTD.

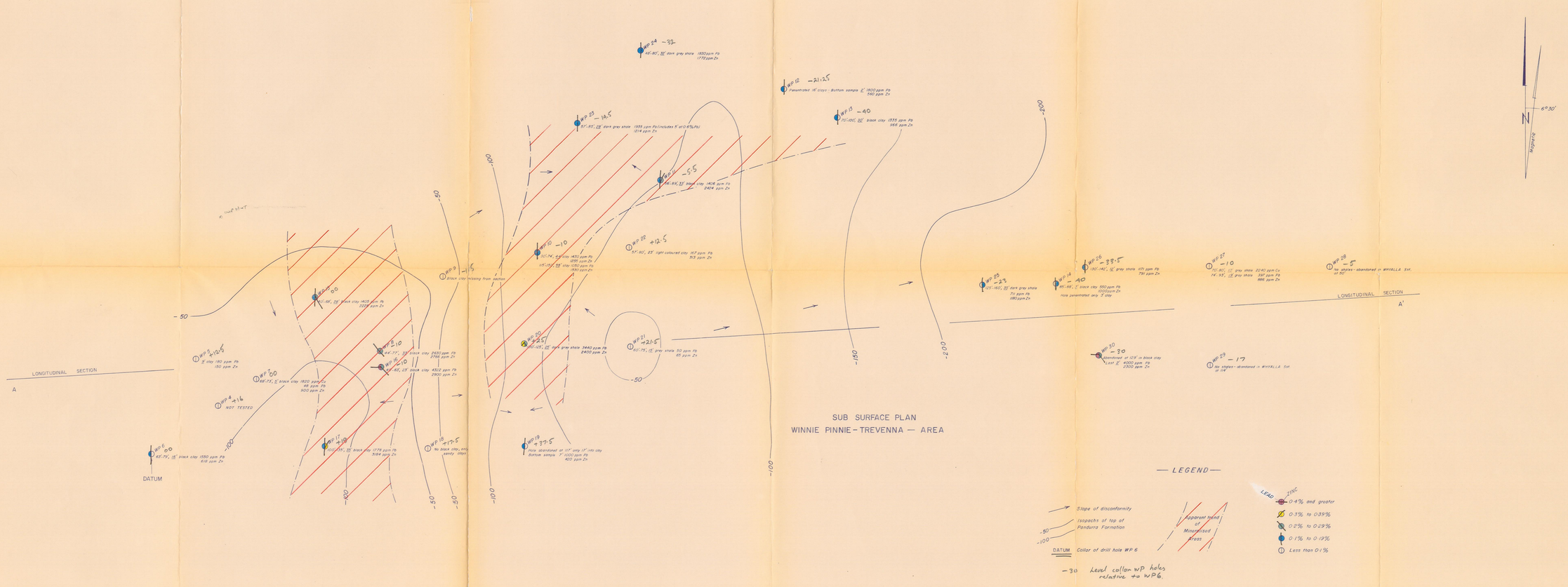
LAKE DUTTON SML 256
South Australia

## SURFACE PLAN

WINNIE PINNIE – TREVENNA AREA
Showing
DRILL HOLES

SCALE
1 inch = 1000 500 0 1000 2000 FEET

| | | |
|---|---|---|
| DATE: 28 MARCH 1969 | GEOLOGY: A. THOMAS | DRAWN: G.C. |
| APPROVED: T.A.R. | DRAWING No. 308/C/202 | |




SUB SURFACE PLAN
WINNIE PINNIE – TREVENNA — AREA

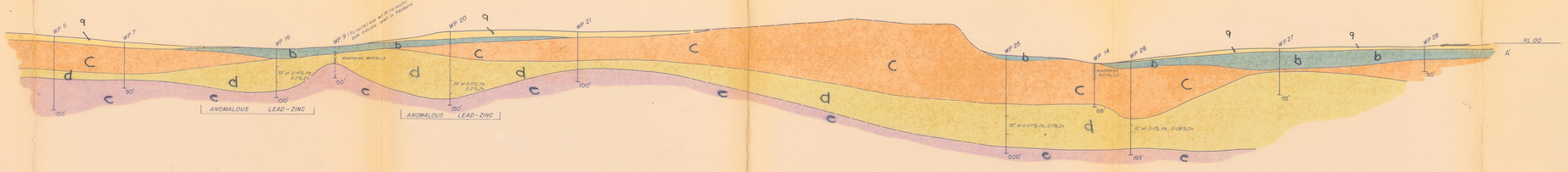
— LEGEND —

- Slope of disconformity
- Isopachs of top of Pandurra Formation
- Apparent trend of Mineralised Areas
- DATUM Collar of drill hole WP 6
- -30 Level collar WP holes relative to WP6

LEAD – ZINC
- 0·4% and greater
- 0·3% to 0·39%
- 0·2% to 0·29%
- 0·1% to 0·19%
- (1) Less than 0·1%

SUB SURFACE PLAN

LONGITUDINAL SECTION A-A'




LONGITUDINAL SECTION A—A' LOOKING NORTH

SCALE NOTE: Horizontal 1 inch = 1000 feet
Vertical 1 inch = 100 feet

— LEGEND —

- q Sand
- b Gravels
- c Whyalla sandstone
- d Woocalla dolomite (shales and clays)
- e Pandurra sandstone



Plate 6 of report no 147
Plate 3 of report no. 110

PLATE 6

**NORANDA AUSTRALIA LTD.**

LAKE DUTTON S.M.L. 256
South Australia

**SUB SURFACE PLAN**
WINNIE PINNIE – TREVENNA AREA SHOWING DRILLING RESULTS
**LONG SECTION A—A'**
SCALE
1000 500 0 1000 2000
FEET

| | | |
|---|---|---|
| DATE: 28th Mar. 1969 | GEOLOGY: A. Thomas | DRAWN: N.S. |
| APPROVED: T.A.R. | DRAWING No. 308-C-203 | |

ENV 1043(1)-6

ISLAND LAGOON

LAKE MACFARLANE

LAKE FINNISS

LAKE BLYTH

LAKE DUTTON

Pernatty Lagoon

BIRTHDAY

McLEAY

Dakeyan Hills Hd

Sweet Nell Copper Mine

WOOCALLA

WINNIE PINNIE — TREVENNA AREA

Winnie Pinnie Dam

Yudnapinna Hs

TRANSCONTINENTAL RAILWAY

Beda Bore

137°00' E

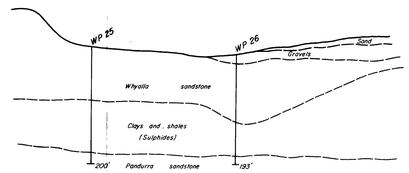
31°45'S

32°00'S

500'

200'

Typical Section at Winnie Pinnie Dam – Trevenna Area




LEGEND

- Mainly sand or soil
- Gravels, sands, clays
- Whyalla sandstone
- Woocalla dolomite
- Woocalla dolomite – shale equivalent
- Pandurra sandstone
- 200' Proposed Drill Hole collar and depth



PLATE 7

Plate 7 of report no 147

# NORANDA AUSTRALIA LTD.

LAKE DUTTON S.M.L 256

SOUTH AUSTRALIA

DRILL HOLE PLAN showing LOCATION and DEPTH

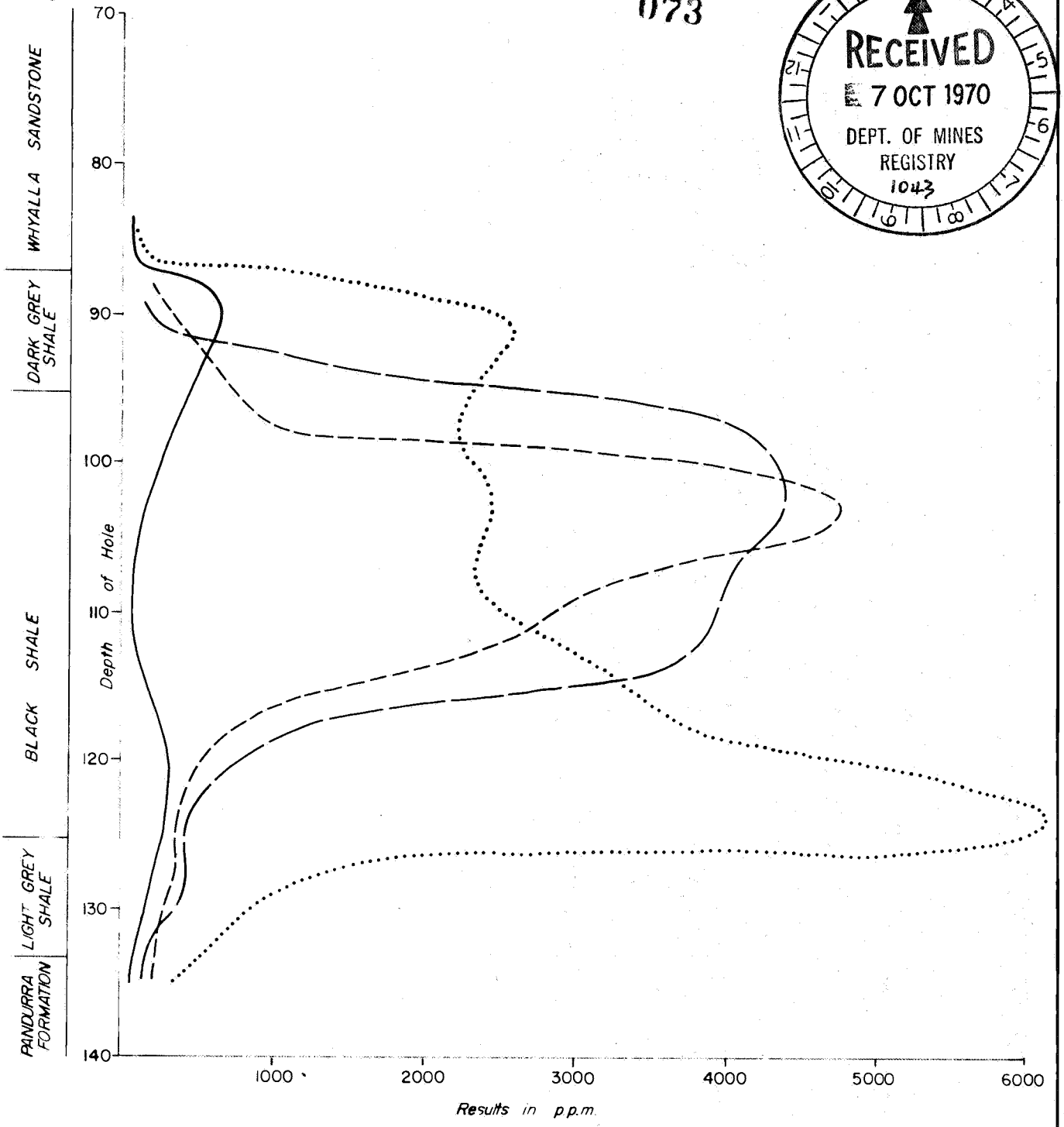
SCALE

MILES

| | | |
|---|---|---|
| DATE: June 1970 | Compiled: A. THOMAS | DRAWN: N.S. |
| APPROVED: G.C.B. | DRAWING No. 308/C/204 | |

073






Copper
Lead
Zinc
Manganese

SCALE Vertical 1 inch = 10 feet
Horizontal 1 inch = 1000 ppm.

Plate 8 of report no 147
Plate 2 of report no 137

PLATE 8

NORANDA AUSTRALIA LIMITED

SPECIAL MINING LEASE N°256
LAKE DUTTON S.A.
GEOCHEMICAL RESULTS W.P. 20

| | | |
|---|---|---|
| Date: April 1970 | Geochemistry L.Szoke | Drawn: N.W. |
| Approved: A.T. | Dwg. No. 308-E-201 | |

137° E

MT. GUNSON

PERNATTY LAGOON

LAKE FINNISS

LAKE BLYTH

LAKE DUTTON

LAKE MACFARLANE

"Oakden Hills"

Birthday

SWEET NELL

TREVENNA

Winnie Finnie Dam

32° S

Boundary of S.M.L. 256

## REFERENCE

| | | |
|---|---|---|
| a | Upper Tent Hill formation | (Corraberra sandstone and Simmens quartzite) |
| b | Lower Tent Hill formation | (Whyalla sandstone and Tregolana shale) |
| c | Woocalla Dolomite | |
| d | Pandurra formation | |
| e | Gawler Range volcanics | |

## LEGEND

- Geological boundaries
- Geophysical discontinuities
- Geophysical discontinuities - offsetting basement structures
- Approximate area tested by drilling 1968
- • 800' Spot determinations for basement depth
- Proposed seismic lines
- ⊕ Proposed stratigraphic cored drill holes
- ⊙ Proposed percussion drill holes
- x 50 Cu / 850 Pb — Rock sample location and results in ppm (In descending order Cu, Pb)

Plate 9 of report no 147
Plate 3 of report no 137

PLATE 3

# NORANDA AUSTRALIA LTD. Env 1043

SPECIAL MINING LEASE No 256

LAKE DUTTON S.A.

## GEOLOGICAL and GEOPHYSICAL

INTERPRETATION PLAN SHOWING

## RECOMMENDED EXPLORATION TARGETS

SCALE 2 1 0 2 4

| | | |
|---|---|---|
| DATE: April 1970 | GEOLOGY: D.G. Tonkin<br>GEOPHYSICS: Austral Exploration Services<br>RECOMMENDATIONS: A.C. and C.P. Dunlop | DRAWN: N.S. |
| APPROVED: A.T. | | DRAWING No. 308-C-205 |

ENV 1043(1)-2