DEPARTMENT OF MINES
SOUTH AUSTRALIA

# INDUCED POLARIZATION AND MAGNETIC SURVEYS OF THE ANABAMA COPPER MINE PROSPECT AND THE CRONJE PROSPECT (E.L. 16), Anabama in OLARY 1:250,000.

by

R.A. GERDES
Assistant Senior Geophysicist
Exploration Geophysics Section.

Rept.Bk.No. 75/60
G.S. No. 5595
D.M. No. 831/72
E.L. No. 16/1

29th April, 1975

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# INDUCED POLARIZATION AND MAGNETIC SURVEYS OF THE ANABAMA COPPER MINE PROSPECT AND THE CRONJE PROSPECT (E.L. 16), Anabama in OLARY 1:250,000.

## ABSTRACT

Induced polarization and magnetic surveys have been conducted over two prospective geochemical prospects, the Anabama Copper Mines prospect and Cronje Prospect in Anabama. The results show significant frequency effects were recorded in the vicinity of the old mine shaft at Cronje prospect.

## INTRODUCTION

At the request of B. Morris of the South Australian Geological Survey, Metallic Minerals Section, a geophysical investigation, using induced polarization and magnetic methods, was undertaken at two copper prospects viz. Cronje prospect and Anabama Copper Mine prospect located in the southern portion of E.L. 16. This investigation was undertaken to verify the existence or otherwise of significant sulphide mineralization in areas of anomalous geochemical copper indications. These latter results were based on analyses for copper, lead and zinc of preliminary soil and rock chip samples, taken along a number of approximately north-south traverses and reported by Morris (1975).

Both of these prospects are located south and at a similar distance beyond the metamorphic aureole of the Anabama Granite. The mineralization is considered to be derived from the later stages of the consolidation of this granite. Copper mineralization has been reported at Anabama Hill and at Netley Hill.

The areas under investigation are shown in drawing No. S10115. The survey was carried out between the 17th Sept. and 10th Oct. 1974.

## 2. GEOLOGY

The preliminary geology of Anabama was mapped by Currie (1970) and later surveyed by Edwards (1971), who reported on the exploration of Special Mining Lease 556 for Longreach Metals N.L. The geology and the locations of the prospects are shown in drawing No. 74-1052. These prospects have been remapped in considerable detail, (Morris, 1975).

The geology and mineralization of each of the prospects will be discussed separately below.

### 2.1 Anabama Copper Mine

This copper mine situated 45 km. south-east of Mannahill was in operation in 1909. The various shafts were sunk to a maximum depth of 18.3 metres and trenches extended over approximately 0.8km along strike. The lodes trended northeast, dipping at 60 degrees northwest and consisted of ferruginous quartz, impregnated with copper carbonates. Copper and minor silver were extracted. For further details on production figures see Mining Review No. 10 p.26. The country rock previously considered to be a siltstone (Edwards, 1971), is now interpreted by Forbes (pers.com) to represent the Yudnamutana Sub-Group.

### 2.2 Cronje Dam Prospect

In the Two Brothers area, (Edwards, 1971) report quartz-muscovite schists, which he interpreted to be deformed rhyolites. These rocks were once thought to form part of a small Archaean inlier, (Thomson, 1968), but recent workers now consider that the existence of this inlier is very doubtful.

The metamorphic grade (Edwards, 1971) of the surrounding area of the Two Brothers appears to have reached the chlorite grade, with local hornfels near the Anabama Granite contact. Edwards considered that there is a marked increase in metamorphic grade in the Two Brothers area.

The mineralization in the Cronje prospect, were reported by Edwards, (op.cit) to be copper carbonates (Malachite) occurring in a quartz reef and along schistosity planes of the highly sheared rhyolite.

## 3. PREVIOUS GEOPHYSICAL DATA

No ground detailed geophysical surveys have been previously undertaken directly related to these prospects. However, regional and detailed geophysical studies were undertaken in the vicinity of the Anabama Fault, (Gerdes, 1973) situated, just south of these prospects. A study of the Bouguer gravity data revealed a possible northeast trending fault, or distinct lithological contact in the region of Anabama Copper Mine (see drawing No. 73-73 not included in this report).

## 4. SURVEY PROCEDURES

Induced Polarization measurements in the frequency domain, using frequencies of 3 and 0.3 Hz, were taken using a McPhar P660 I.P. receiver and initially, a high powered Geoscience transmitter. This latter instrument during the course of the survey showed irregular transmission characteristics. Therefore, a low powered Geoscience transmitter was then used. Readings were taken using a linear dipole-dipole electrode configuration with a dipole spacing of 60m.

The total magnetic intensity data was initially recorded using a Sander proton magnetometer and later an Elsec proton magnetometer. The field was sampled at 15 metres intervals along each of the surveyed lines. A base line tie system was not undertaken.

A regular line system was established in both prospect areas due to irregular nature ofthe geochemical sampling traverses and the lack of a well defined grid layout. The lines surveyed were pegged at 60 metres intervals.

## 5. RESULTS

The induced polarization results, corrected for instrumental drift and calibration errors are presented as pseudo-sectional plots of apparent resistivity, percentage frequency effect and metal factor. The pseudo-profiles are plots of readings at a sectional depth of the dipole spacing "a" times n/2, where n, for this survey, lies between 2 and 5; and "na" is the distance between the centres of the transmitting and receiving dipole pairs. Each result was plotted vertically beneath a point representing the mid-point between the dipoles used.

Magnetic data corrected for drift were plotted in profile form with the same horizontal scale as the induced polarization results, for the convenience of interpreting the data.

## 6. INTERPRETATION

### 6.1 Anabama Copper Mine Prospect

The grid system established for the induced polarization traverses is shown in drawing No. 74-1051, together with the geochemical grid and copper value contours for the soil sampling. Geophysical data comprises two I.P. traverses on lines 2 and 4 and a magnetic traverse of line O. The pseudo-profiles are shown in drawing No. S11313.

The magnetic data recorded on traverse O show little magnetic response north of 670N, indicating a possible change in lithology to the south. Two local anomalies were located centred around 580N and 520N. Due to instrument problems, data recorded on other traverses were unsatisfactory.

6.1.1 Induced Polarization

The apparent resistivity results show a low resistivity zone of approximately 10 ohm-metres in the south over sands and clays, and a general high resistivity region in the north, correlating with near outcropping rocks on the broad hill. There is a possible intermediate resistivity zone in the centre of the area.

With the aid of theoretical resistivity and frequency effect profiles produced by Geoscience Inc. these sections have been interpreted. The interpreted models are shown in drawing No. 74-1051.

The general 5% frequency effect region was interpreted as being produced by a resistive band having a resistivity of 500 ohm m., and a width equal to the dipole spacing. This model appeared to be deeper to the north. The frequency effect of this band was assumed forthe model to be approximately 15%. This band probably represents a lithological formation, (eg. graphite or pyrite rich rock) and there is some suggestion that the top of the band is dipping westwards. The model theoretical curves used are a first approximation, as this assumes the same resistivity of both sides of the body. However the field results indicate different resistivities on each side of the body. The theoretical curves for the latter model are not available.

Three other smaller possible I.P. effects are also shown, but are indicated by one point anomalies and should therefore be considered with caution. It is interesting to note that there was no response over the old mine workings.

6.2 Cronje Dam Project

A traverse system for the induced polarization and magnetic data was established to overlie the previously existing geochemical traverses. These are shown in drawing No. 75-62. The localized geochemical sample points and geology, (Morris,1975) are shown in drawing No. 75-18. The geochemical results showed some significantly anomalous values in the vicinity of the old mine shaft.

The geophysical data was obtained over five magnetic and four induced polarization traverses. Unfortunately, it was impractical to obtain geophysical data along the fence line, ie. line 9, since responses are produced by both the magnetic and conductive effects of the star pickets and fencing wires.

6.2.1. Magnetic Data

The magnetic data shown in profile form are shown in an extended sheet presentation, drawing No. 75-55. These profiles show a correlatable response for the eastern lines 1,3 & 5A and a distinctively different response on the lines 7 and 10 located, near and west of the main mine workings. The distinctive change in response is assumed to represent two magnetic provinces separated by a discontinuity or major fault zone, having an approximate north-south orientation.

Magnetic data were interpreted using magnetic trends and zone types, shown in drawing No. 75-59. Zone classification and anomaly characterisitics are given below.

| ZONE TYPE | ANOMALY RANGE | CHARACTERISTICS |
|---|---|---|
| 1 | less than 100 gammas | Poor Linearity |
| 2 | between 100 to 250 gammas | " " |
| 3 | between 250 to 500 gammas | " " |
| 4 | greater than 500 gammas | " " |
| 5 | between 200 to 500 gammas | Good Linearity |

The correlation of magnetic zone types with rock types was in general very inconclusive, due to the relatively little overall geological information.

Type 1 zones are interpreted to correlate with either non-ferruginous metasedimentary rocks or homogeneous acidic rocks. The Type 2 zones are interpreted as being slightly more magnetic than zone type 1.

Type 3 zones are interpreted to correlate with iron rich metasediments and intermediate igneous material. The zone type 3 located around the main shaft and to the west correlates with pyritized rhyolitic material.

Type 4 zones are interpreted to correlate with magnetite quartz veins, which are known to occur in the region.

The trended type 5 zones are interpreted to correlate with magnetic bands within the metasediments which could outline pyritic shales. The magnetic trends indicate a general eastwest strike direction of the metasediments, similar to the trend of major outcrops. These trends shown a probable displacement on either side of the proposed fault zone.

### 6.2.2 Induced Polarization

The pseudo-profiles of apparent resistivity, percentage frequency effect and metal factor are shown for lines 3 and 5 in drawing No 75-60 and for lines 7 and 8 in drawing No. 75-61. The significant resistivity data show three apparent resistivity ranges, as given below and shown in drawing No. 75-59.

| RESISTIVITY ZONE | APPARENT RESISTIVITY RANGE (in ohm metres) | CORRELATION |
|---|---|---|
| LOW | less than 50 | Weathered & fractured outcrop and thick sand cover. |
| INTERMEDIATE | 100 to 250 | |
| HIGH | 1000 | Resistive Basement. |

The intermediate resistivity zone occurs in the neighbourhood of the mine shaft.

The major frequency effects ranging between 2.5 to 4% occur in an overall background region of 2% near the mine shaft. These frequency effects are probably due to disseminated pyrite and or other sulphides or to magnetite. The remaining frequency effects are low magnitude and generally occur on the flanks of magnetic anomalies. Two of the anomalous frequency effects between 1480 to 1540N on line 3 and 2010N on line 5A may have been produced by a four inch water pipe.

## 7. CONCLUSION AND RECOMMENDATIONS

The I.P. effects located, just north of Anabama Copper Mine prospect, are worthy of further geochemical investigation, to clarify whether these effects are produced by either mineralization or correlated to a lithological unit.

The I.P. effects recorded at the Cronje prospect were localized around the mine area, but may extend westwards as indicated by the geochemical results. Further work in this area is recommended.

R.A. GERDES
ASSISTANT SENIOR GEOPHYSICIST
EXPLORATION GEOPHYSICS SECTION

29th April, 1975

REFERENCES

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EDWARDS, A.E., 1971. Technical report for Special Mining Lease 556, Wadnaminga South Australia for period 30th June 1971 to 30th September, 1971 for Longreach Metals No Liability. S.A. Dept. Mines Env. 1637 (openfile).

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Part A. Regional Geophysical Interpretation of the Southern Half of OLARY and the northern half of CHOWILLA 1:250,000 sheet area.
Part B. Detailed Geophysical Interpretation of Gravity and Vehicle Mounted Magnetic Traverses in Anabama and Lilydale 1:63,360 sheet area.
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MORRIS, B.J., 1975. Exploration Licence 16. Progress Report for the six monthly Period Ending 25th October, 1974 - Final Report (OLARY 1:250,000). S.A. Dept. Mines Rept. Bk. No. 75/39 (unpublished).

THOMSON, B.P. 1969. The Cambrian crystalline basement, *in* Parkin, L.W. (Ed.) 1969. Handbook of South Australian Geology. Government Printer, Adelaide, Ch.1. pp.33-35.

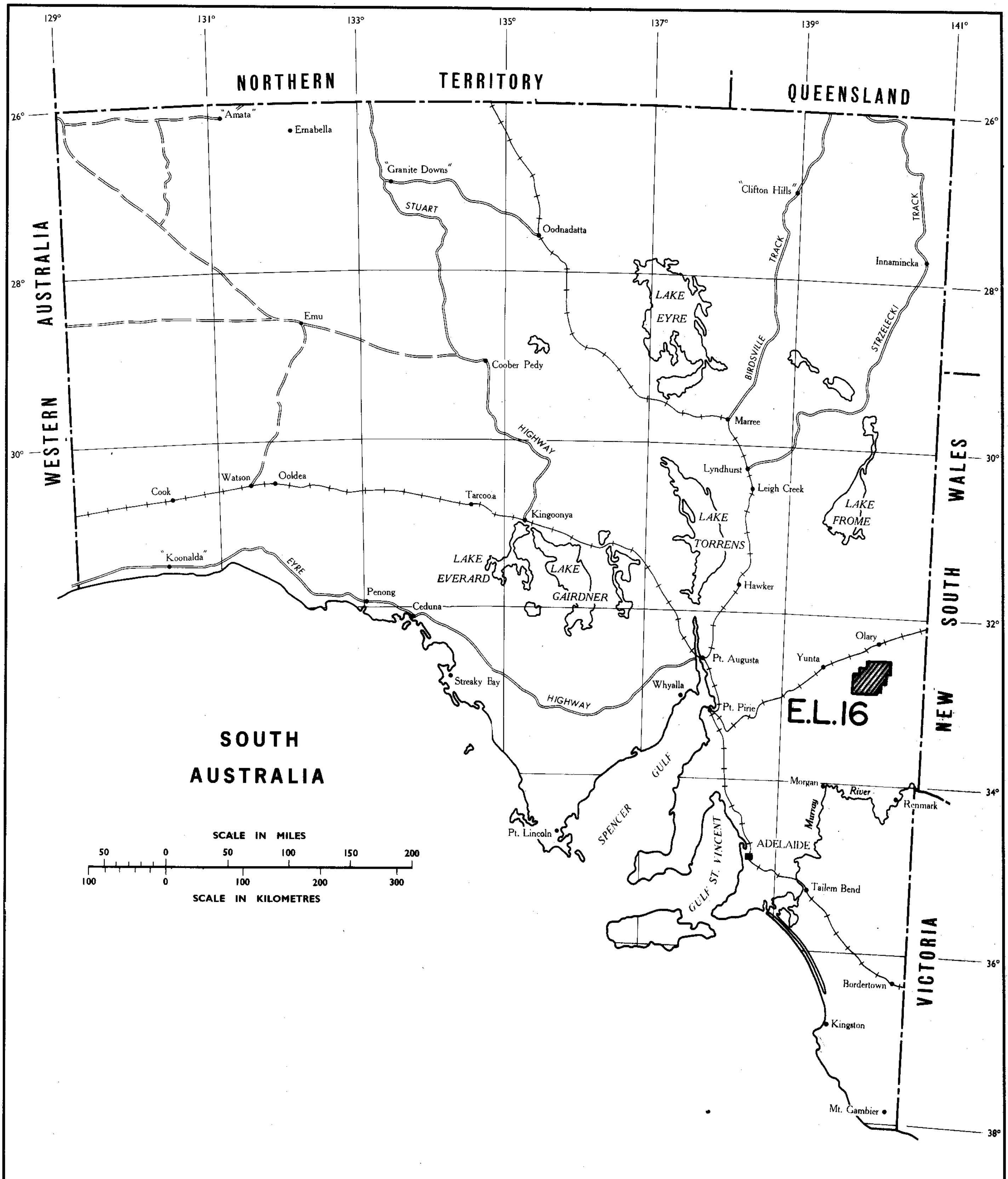
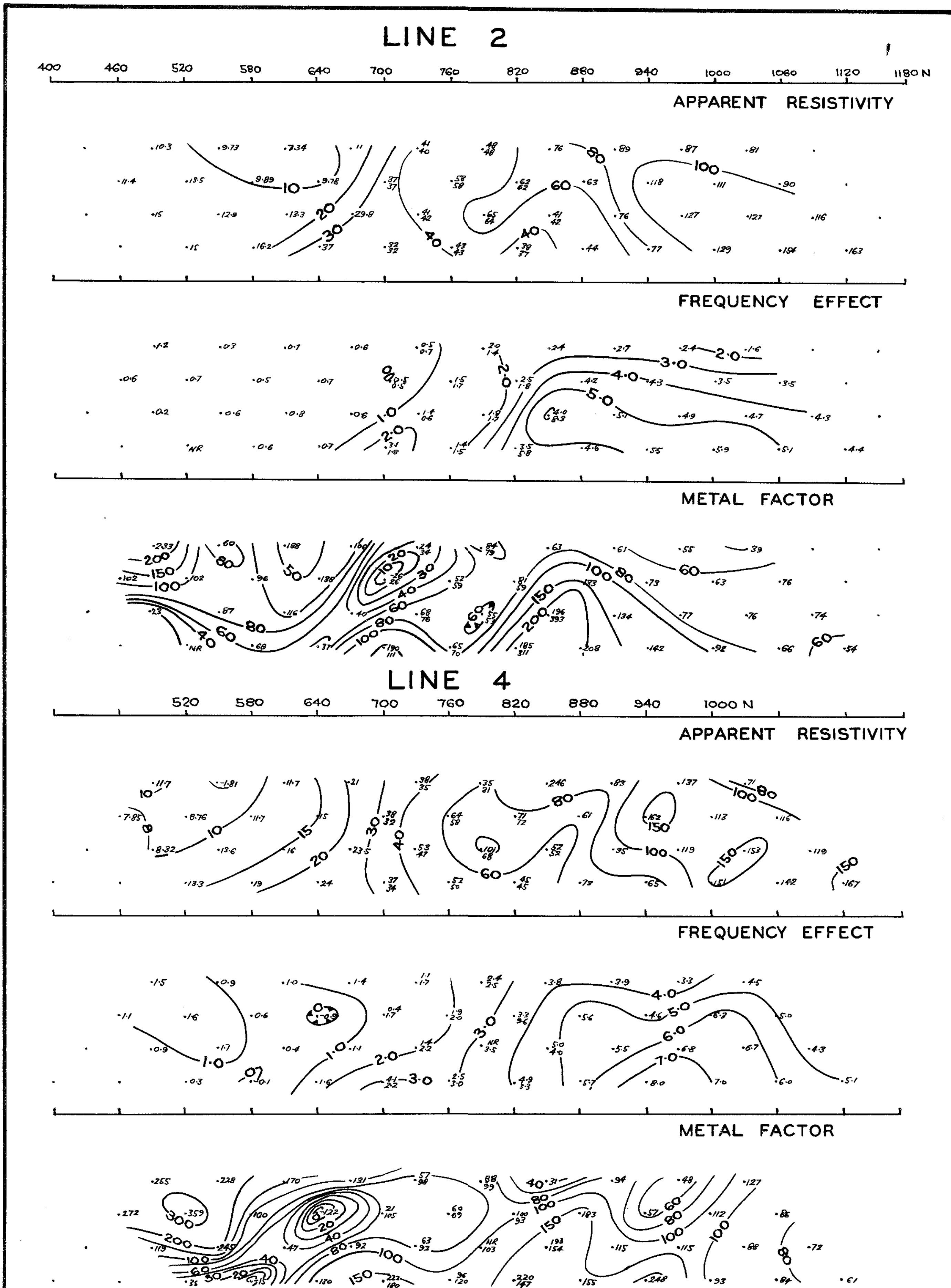



**FIG. I**

DEPARTMENT OF MINES —— SOUTH AUSTRALIA

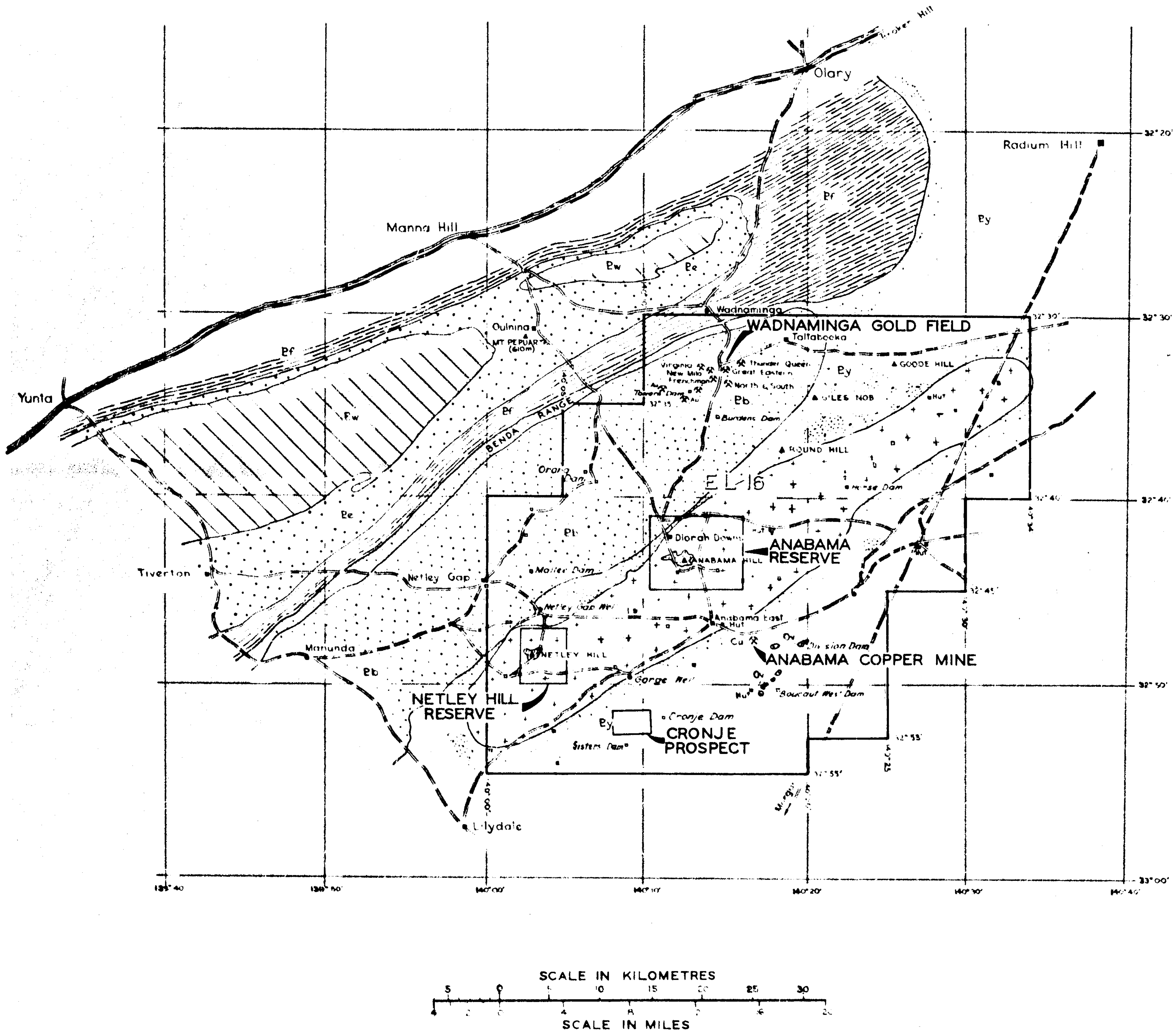
| Compiled. A.S.F. | | EXPLORATION LICENCE 16<br>ANABAMA PROJECT<br>LOCALITY PLAN | Date: 30 JAN. 1973 |
|---|---|---|---|
| Drn. D.J.M. | Ckd. | | Drg. No.<br>S10115<br>Fl |

P.F. No. 55850 994.2




| | | |
|---|---|---|
| | **DEPARTMENT OF MINES — SOUTH AUSTRALIA** | Scale : 1:4728 |
| Compiled : R.A.G. | ANABAMA COPPER MINE PROSPECT<br>APPARENT RESISTIVITY FREQUENCY EFFECT<br>AND METAL FACTOR CURVES<br>FOR LINES 2 & 4 | Date : 5 Feb 1974 |
| Drn. A.F. / Ckd A.F. | | Drg. No. S11313 |

750—8.74 F332 O
6932-111




## LEGEND

| | |
|---|---|
| | "Anabama Complex" Greisened granitic suite |
| | Anabama Granite (Ordovician) Biotite granite adamellite and granodiorite |
| Gv | Acid volcanics |

ADELAIDEAN (PROTEROZOIC) — UMBERATANA GP.

| | |
|---|---|
| Ew | WILPENA GROUP<br>Limestones, siltstones, dolomites & quartzites |
| Ee | YERELINA SUB-GROUP<br>Sandstones, quartzites, Pepuarta Tillite in upper part |
| Ef | FARINA SUB-GROUP<br>Siltstones, shales |
| Ey | YUDNAMUTANA SUB-GROUP<br>Siltstones, quartzites with Braemar Iron Formation and Appila Tillite |
| Eb | BURRA GROUP<br>Siltstones, dolomite, quartzites, sandstones |

- Exploration Licence boundary
- Railway
- Highway
- Graded road
- Track
- Homestead
- Dam

Geochemical Sampling Project

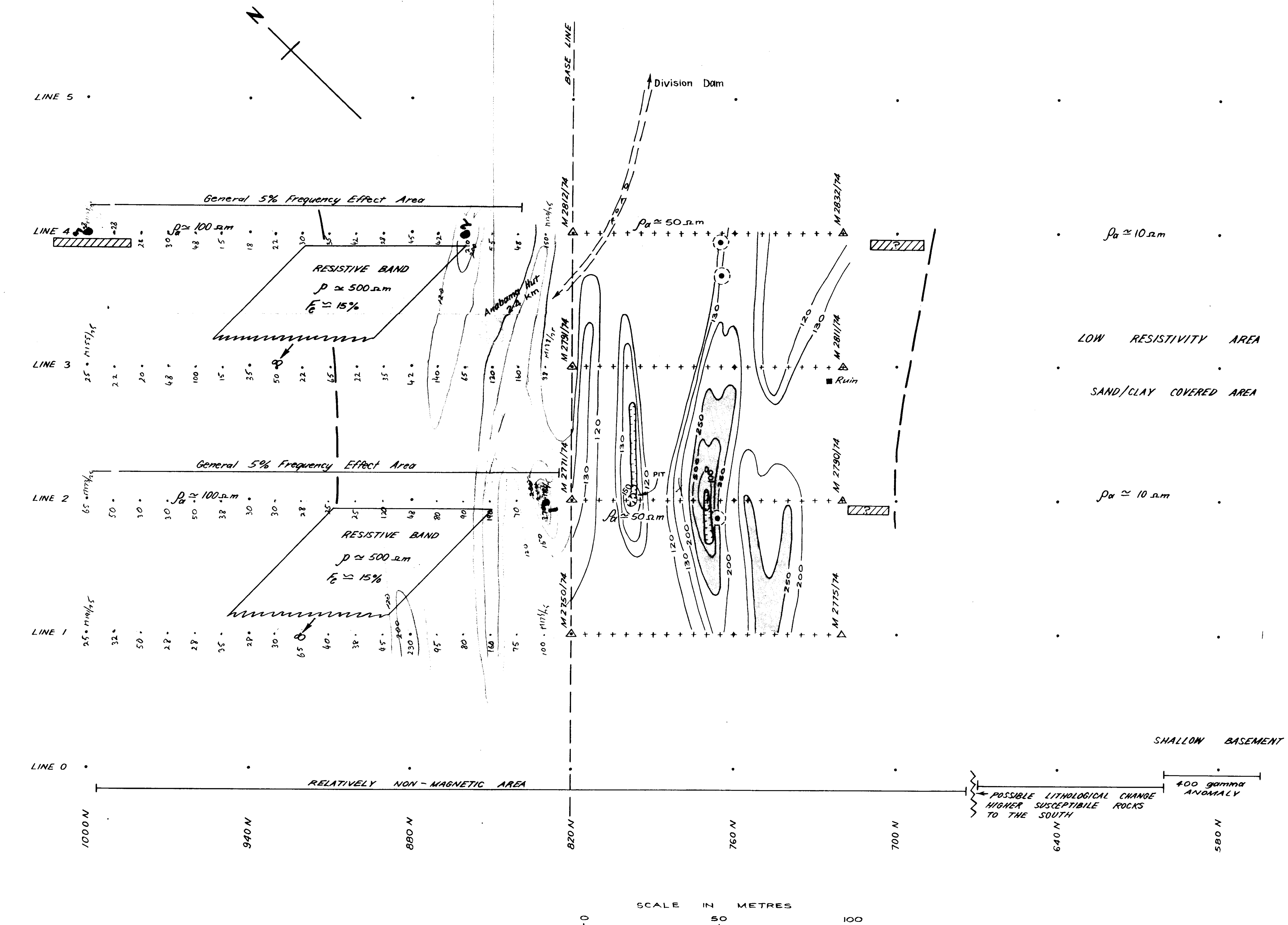
See Drg No 75-266 for enlargement of Wadnaminga goldfield area

See Drg No 75-130 for enlargement of Anabama copper mine area

See Drg No 75-18 for enlargement of Cronje Prospect

Regional geology after B. Forbes, (Olary 1:250 000)

| DEPARTMENT OF MINES — SOUTH AUSTRALIA | | | |
|---|---|---|---|
| EXPLORATION LICENCE 16<br>LOCATION OF PROSPECTS AND<br>REGIONAL GEOLOGICAL MAP | | | |
| METALLIC MINERALS SECTION | B.J. Morris<br>GEOLOGIST | Drn. B.J.M. | SCALE 1:250 000 |
| | | Trd. A.F. | 74-1052 |
| | | Ckd. | |
| Director of Mines | | Exd. | DATE January 197 |




LEGEND

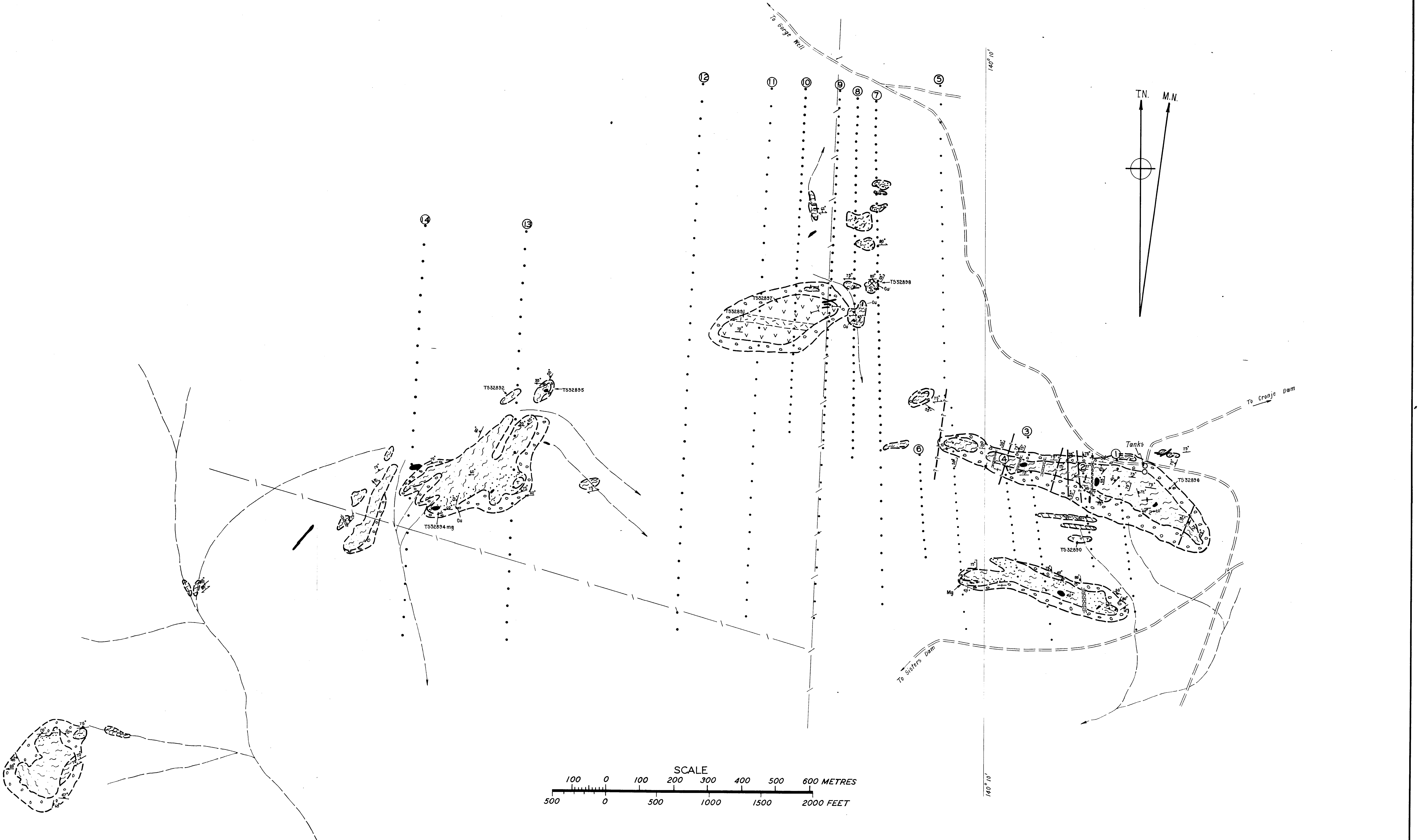
- I.P. Survey Pegs
- M 2791/74 Geochemical Soil Sampling Grid Control Point, and Sample Number
- Geochemical Sample Point
- Mine Shaft
- Trench
- Geochemical Copper Contour in p.p.m. (Data after B.J. Morris, 1974)
- Significant Copper Anomaly
- Major I.P. Model
- Secondary I.P. Effect
- $\rho_a$ Apparent Resistivity in ohm-metres
- Approximate Position of Apparent Resistivity Boundary

**DEPARTMENT OF MINES — SOUTH AUSTRALIA**

# ANABAMA COPPER MINE PROSPECT
## INDUCED POLARIZATION GRID SYSTEM AND GEOCHEMICAL GRID

| | | | |
|---|---|---|---|
| EXPLORATION GEOPHYSICS SECTION | Drn. R.A.G. | SCALE: 1:1000 (ORIGINAL) | |
| | Tcd. A.I.W. | 74-1051 | |
| | Ckd. A.F. | | |
| Director of Mines | Exd. | DATE: 10-12-74 | |

6932




| | |
|---|---|
| (blank box) | Quaternary alluvium Pooraka Formation : calcrete |
| (schist symbol) | Grey – green muscovite – quartz schist with a Crenulation cleavage developed in parts. |
| (crenulated symbol) | Pink and white altered quartz – muscovite schist, strongly crenulated with numerous limonite pseudomorphs after pyrite. |
| (dotted symbol) | Grey-white silicified quartz – muscovite schist with FeO octahedral pseudomorphs after magnetite in parts. |
| (black symbol) | Glassy – white vein quartz. |
| V V | Creamy – grey fine grained partially recrystallized rhyolite that has been pyritized and tourmalinised. |
| (dash symbol) | Dark grey metamorphosed/metasomatised porphyritic rhyolite. |
| T T | Pink and grey altered lava tuff or sediment. |
| (circles symbol) | Scree material. |
| (dots symbol) | Mullock heap |

| | |
|---|---|
| Cu | Copper at surface |
| Mg | FeO octahedral pseudomorphs after magnetite |
| ⑦ | Traverse number |
| • | Soil sample locations |
| T532876 | Thin section number from AMDEL petrological report MP1330/75 |
| | Strike and dip of jointing |
| | Strike and dip of layering |
| | Strike and dip of foliation |
| | Strike and dip of cleavage (crenulation) |
| | Strike and dip of schistosity |
| | Anticline |
| | Plunge of minor fold |
| | Shear zone |
| | Probable fault |
| | Approximate position of lithological bdy. |
| | Track |
| | Creek |
| | Fence |
| o | Water tank |
| | Mine shaft |

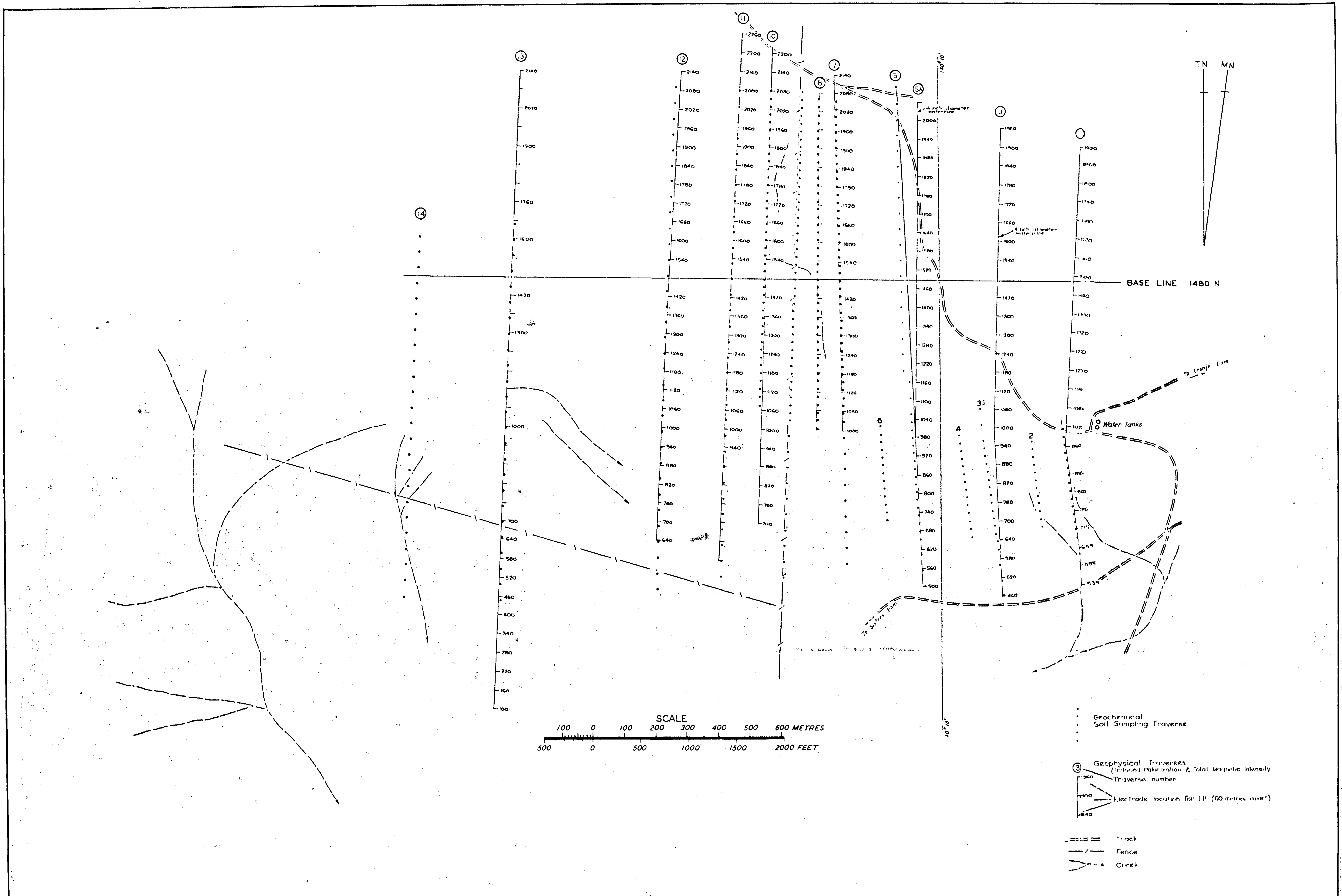
Nb. For location of area see plan no. 74–1052

**DEPARTMENT OF MINES – SOUTH AUSTRALIA**

# EL16 CRONJE PROSPECT
# LOCAL GEOLOGY AND SOIL SAMPLING TRAVERSES

| | | | |
|---|---|---|---|
| METALLIC MINERALS SECTION | B. MORRIS GEOLOGIST | Compiled B. M. | Scale: 1 : 5000 |
| | | | Date: 10 JAN. 1974 |
| Director of Mines | | Drn. B.W. Ckd. A.F. | Drg. No. 75-18 |

932



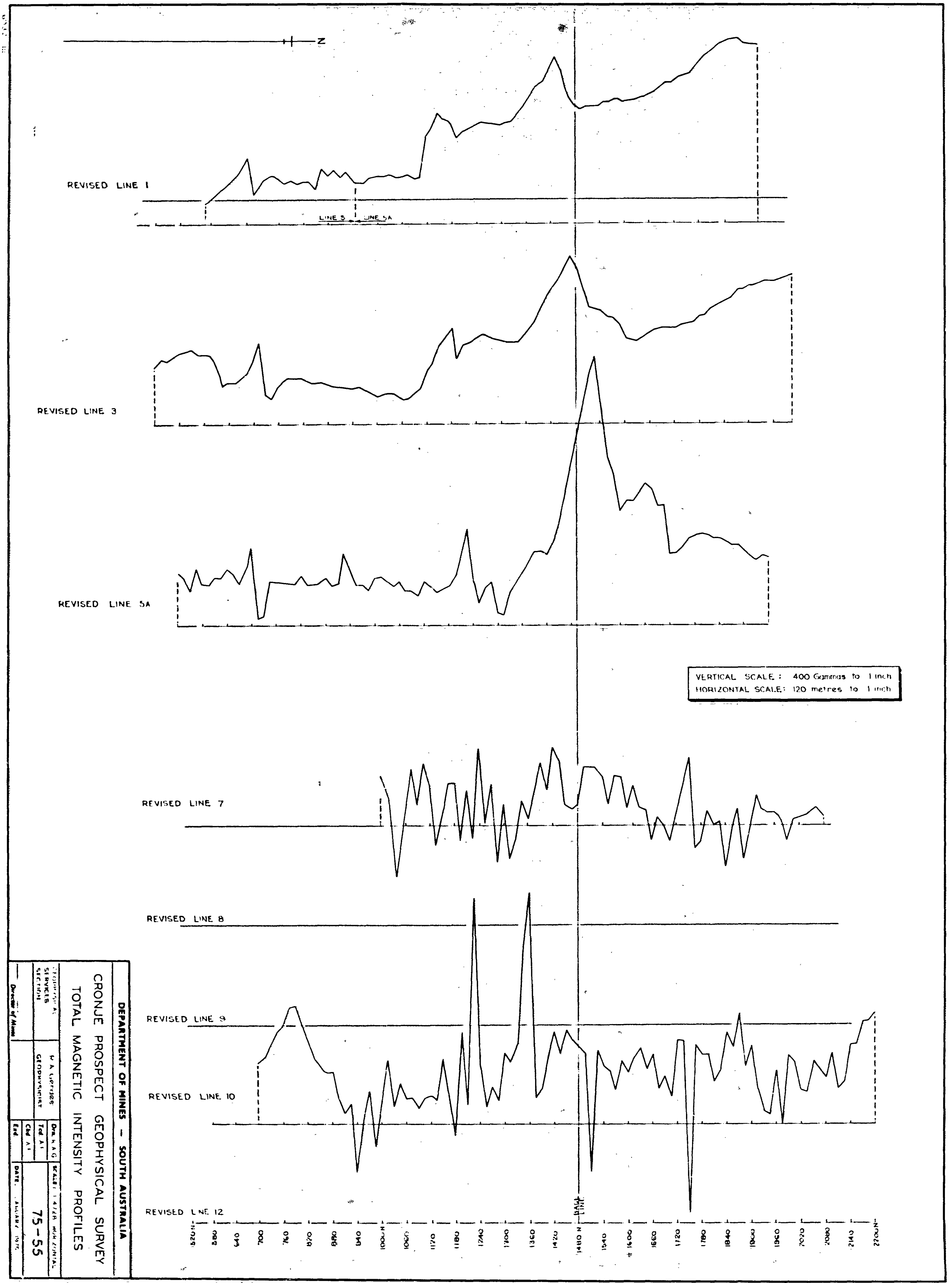

DEPARTMENT OF MINES — SOUTH AUSTRALIA

EL16 CRONJE PROSPECT

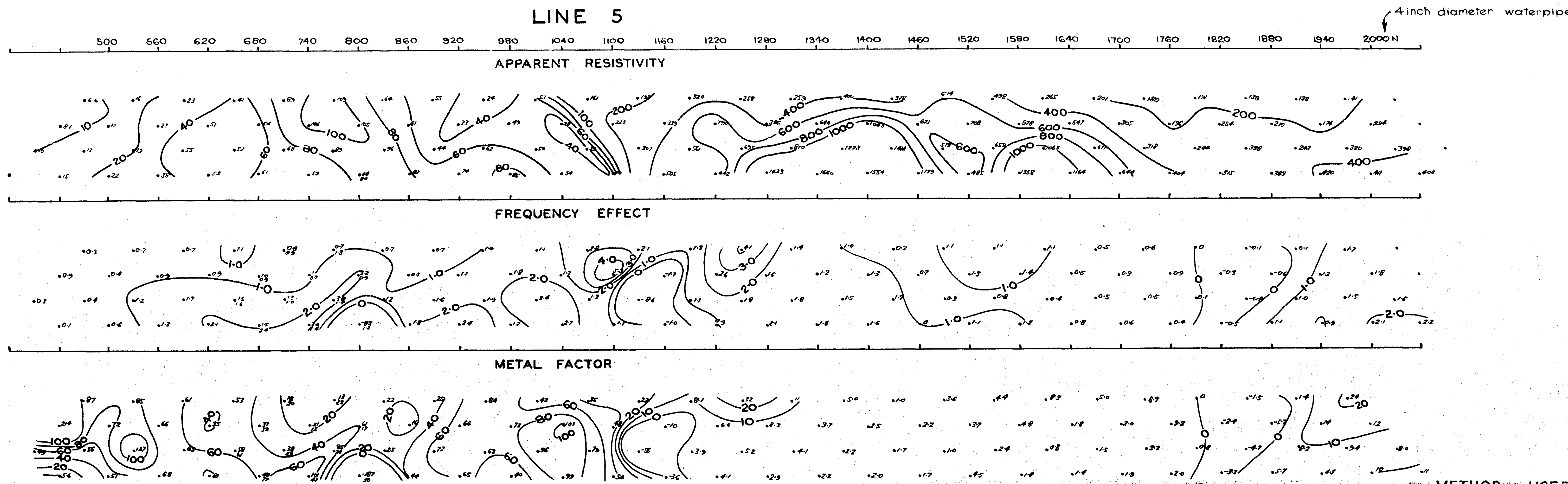
GEOPHYSICAL TRAVERSE LAYOUT

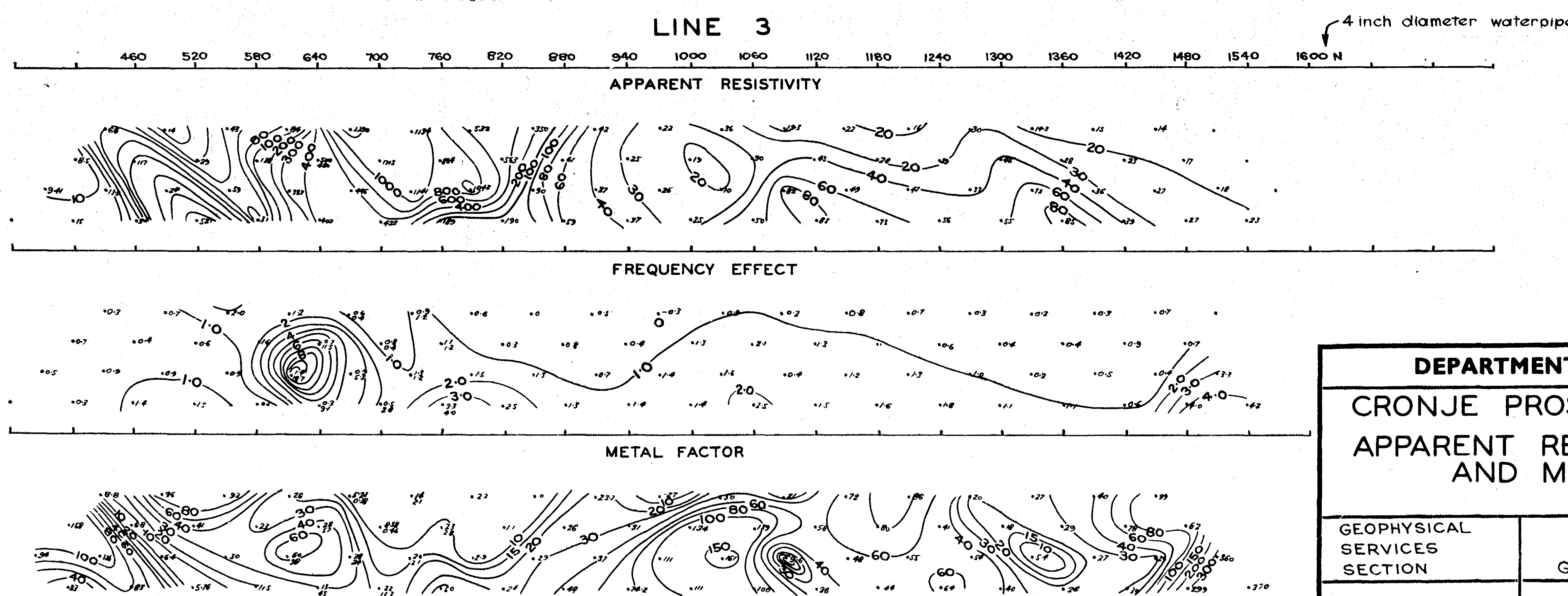
| | | | |
|---|---|---|---|
| GEOPHYSICAL SERVICES SECTION | R A Gerdes GEOPHYSICIST | Compiled R.A.G. | Scale: 1:5000 |
| | | | Date: JANUARY 1975 |
| | | Drn. A.F | Drg. No 75 – 62 |
| Director of Mines | | Ckd A.S | |

6932

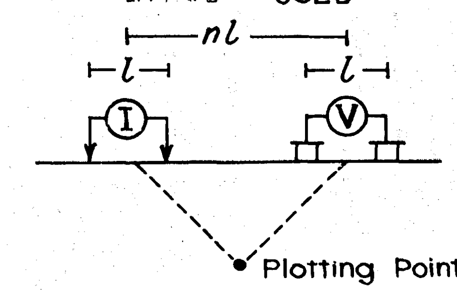


N
REVISED LINE 1
LINE 5
LINE 5A
REVISED LINE 3
REVISED LINE 5A
VERTICAL SCALE: 400 Gammas to 1 inch
HORIZONTAL SCALE: 120 metres to 1 inch
REVISED LINE 7
REVISED LINE 8
REVISED LINE 9
REVISED LINE 10
REVISED LINE 12
BASE LINE
520N
580
640
700
760
820
880
940
1000N
1060
1120
1180
1240
1300
1360
1420
1480N
1540
1600
1660
1720
1780
1840
1900
1960
2020
2080
2140
2200N
DEPARTMENT OF MINES — SOUTH AUSTRALIA
CRONJE PROSPECT GEOPHYSICAL SURVEY
TOTAL MAGNETIC INTENSITY PROFILES
GEOPHYSICIST
Director of Mines
75-55




METHOD USED



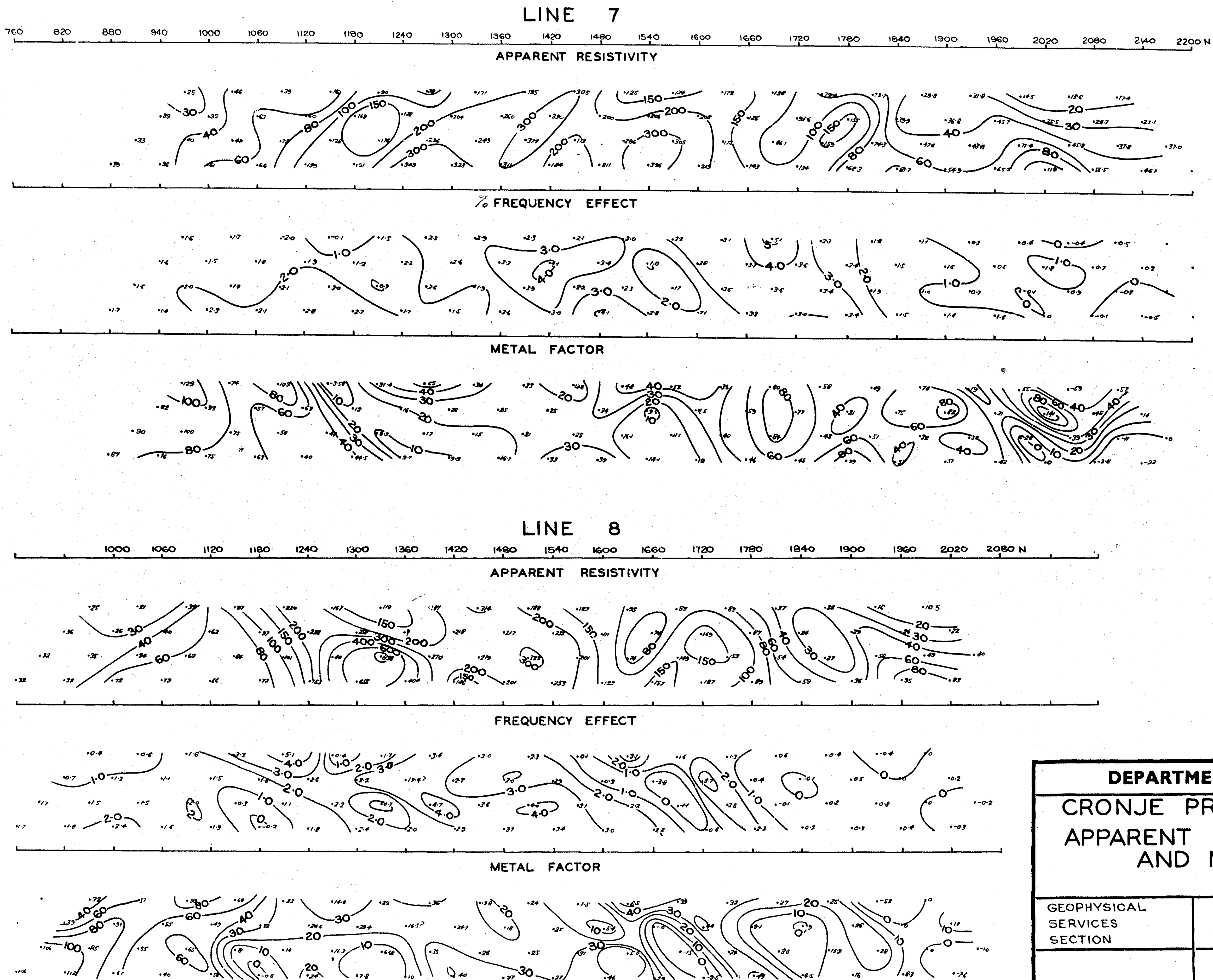

Formula for Dipole - Dipole Configuration

$$\rho a = \frac{V\pi l}{I} \times n(n^2-1)$$

$\rho a$ = apparent resistivity V = voltage read
I = current transmitted $l$ = electrode spacing
n = number of electrode spaces between midway of receiver dipole and transmitter dipole.

| DEPARTMENT OF MINES — SOUTH AUSTRALIA | | | |
|---|---|---|---|
| CRONJE PROSPECT GEOPHYSICAL SURVEY<br>APPARENT RESISTIVITY, FREQUENCY EFFECT AND METAL FACTOR CURVES<br>LINES 3 & 5 | | | |
| GEOPHYSICAL SERVICES SECTION | R.A.Gerdes<br>GEOPHYSICIST | Drn. R.A.G. | SCALE: 1:4728 |
| | | Tcd. A.F. | 75-60 |
| | | Ckd. A.F. | |
| Director of Mines | | Exd. | DATE: JANUARY 1975 |

6932-111




**DEPARTMENT OF MINES — SOUTH AUSTRALIA**

CRONJE PROSPECT GEOPHYSICAL SURVEY

APPARENT RESISTIVITY, FREQUENCY EFFECT AND METAL FACTOR CURVES

LINES 7 & 8

| | | | | |
|---|---|---|---|---|
| GEOPHYSICAL SERVICES SECTION | R. A. Gerdes GEOPHYSICIST | Drn. R.A.G. | SCALE: 1:4728 | |
| | | Tcd. A.F. | 75-61 | |
| | | Ckd. A.F. | | |
| Director of Mines | | Exd. | DATE: JANUARY 1975 | |

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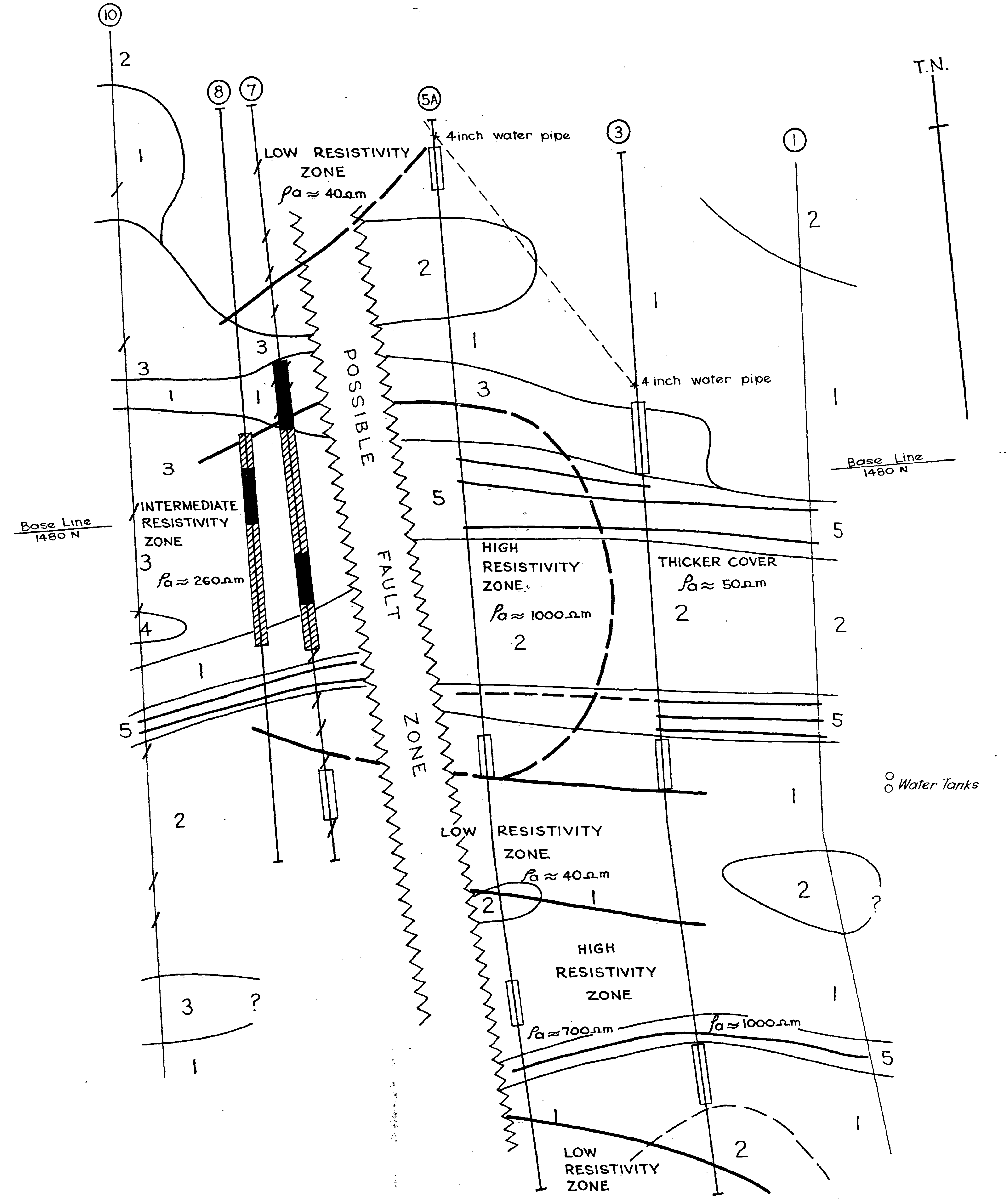


Traverse line with IP coverage

Major percentage IP frequency effects. >3%

Minor percentage IP frequency effects.

Possible IP effects (minor)

Positive magnetic trend

Magnetic zone type 3

Fault zone

Possible fracture

SCALE 1:5000

0 100 200 300 400 METRES

**DEPARTMENT OF MINES — SOUTH AUSTRALIA**

CRONJE PROSPECT GEOPHYSICAL SURVEY

INTERPRETED IP, APPARENT RESISTIVITY AND MAGNETIC DATA

| GEOPHYSICAL SERVICES SECTION | R.A.Gerdes GEOPHYSICIST | Drn. R.A.G. | SCALE: 1 : 5000 |
|---|---|---|---|
| | | Tcd. A.F. | 75 – 59 |
| | | Ckd. A.F. | |
| Director of Mines | | Exd. | DATE: JANUARY 1975 |

6932 – 111