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A REPORT ON

ELECTRICAL INDUCED POLARIZATION SURVEYS

AT MT. LINDSAY NEAR RENISON BELL, WEST COAST TASMANIA

ON BEHALF OF

RENISON LIMITED

OPEN FILE

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GEOPHYSICAL CONSULTANTS AND CONTRACTORS

S U M M A R Y

Reconnaissance electrical induced polarization surveys carried out at Mt. Lindsay recorded a substantial number of induced polarization anomalies which will require close investigation by geological mapping and, where possible, geochemical sampling. The physical interpretation of these responses is given subject to limitations imposed in a reconnaissance technique.

C O N T E N T S

Summary	
Introduction	Page 1
Discussion of Results	
Scope and Presentation	Page 2
Interpretation	Page 5
Conclusions	Page 63
Recommendations	Page 66

Appendix 'IP'

Appendix 'IPR-8'

Plate 1 - Electrical Induced Polarization Data Profiles

Plate 2 - Resistivity Contour Map

Plate 3 - Chargeability Contour Map

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INTRODUCTION

At the request of Mr. L.A. Newnham, Chief Geologist of Renison Limited, Scintrex Pty. Ltd. executed both fixed source and moving source induced polarization surveys over the Mt. Lindsay grid, partially within the Consolidated Gold Fields of Australia/Renison Limited joint venture area EL 18/73 and within the Aberfoyle Limited/ Consolidated Gold Fields of Australia/Renison Limited joint venture area EL 2/63

The work was undertaken variously by party leaders D. Robson BSc., and P. McHugh with auxiliary operators Knutsen, Ekstrom and Mueller operating the second receiver at various times during the field programme. The work was undertaken in two periods - between 24th December, 1973 and 12th January, 1974 and between 15th and 18th February, 1974.

The geological supervision was undertaken by Mr. R. Schellekens, Site Geologist, and Mr. L.A. Newnham, Chief Geologist, while Mr. A.W. Howland-Rose provided technical supervision.

Appendix "IP" briefly describes the method while Appendix "IPR-8" explains the salient features of the receiver used in these surveys. Relevant MIP papers are also appended.

DISCUSSION OF RESULTS

Scope and Presentation

The data profiles are shown on the four sheets of Plate 1. Portions of the survey were carried out by gradient arrays of various current dipoles and the remainder by moving source arrays. Each profile states the electrode geometry employed.

The horizontal scales employed for all profiling was 1:5000 while the resistivity employed a 5 centimetre log cycle to express the apparent resistivity in ohm-metres and the chargeability was shown at the vertical scale of 1 centimetre = 10 millivolts/volt.

Although three areas under the decay curve were recorded in most cases, only M_3 was profiled. Where marked distortions in the decay curve occur, these are referred to in the text.

Contour interpretations of the resistivity and chargeability data from gradient array only, are shown in Plates 2 and 3

at the scale of 1:5000. No contour interpretation of the magnetic data has been made, although the general trends were often used to bias the resistivity data where no other information was available. For the most part, however, curve matching was the most frequently used method of establishing the strike directions. Only those sections of the gradient data have been contoured where the strike can be reasonably assessed, and each current block has been separately contoured.

Unfortunately, due to conductivity and/or logistical reasons, portions of the grid had to be surveyed using moving source arrays. As this data is not strictly comparable to the gradient array, it cannot be incorporated in the contour data.

The fixed source and moving source induced polarization data is discussed in line sequence.

The Gradient Data

Some seven current dipoles were employed as follows:

<u>Current Dipole</u>	<u>Line</u>	<u>Co-ordinates</u>
900N & 3500N on Line 5	1	1225N to 2025N
	2	1075N to 2475N
	3	1125N to 2400N
	5	1325N to 3025N
	7	1425N to 2925N

<u>Current Dipole</u>	<u>Line</u>	<u>Co-ordinates</u>
700S & 1900N on Line 5	2	25N to 1525N
	3	75S to 1525N
	4	75S to 1525N
	5	200S to 1525N
	6	25N to 1525N
	7	75S to 1525N
	700N & 3700N on Line 11	8
9		925N to 3450N
11		975N to 3475N
13		925N to 2375N
1500S & 1500N on Line 11	9	25N to 1175N
	10	25N to 825N
	11	25N to 975N
	13	75N to 1075N
650N & 2150N on Line 17	15	925N to 2225N
	17	875N to 2025N
1500S & 1500N on Line 17	15	25N to 825N
	17	175S to 975N
	19	275S to 1325N
1500S & 00 on Line 17	17	75S to 1025S

The Moving Source Data

Moving source arrays were employed as follows:

<u>Line</u>	<u>Co-ordinates</u>
11	25S to 925S
12	12.5S to 825S
12	962.5N to 2200N
13	250S to 125N
14	800S to 62.5N
14	1162.5N to 2100N

Interpretation

Some comments on the interpretation methods are warranted.

Gradient Array

In the case of the gradient array, positional information is excellent, but depth estimates rely on profile shape and then only give a "maximum depth". An additional inhibiting factor of course, is resolution of the potential dipole used. In this survey the potential dipole employed was 50 metres, thus it is not possible to resolve the depth better than "within 25 metres". Thus many of the 25 metre determinations may in fact either outcrop, or lie within a few metres of surface. The plotted position of the data represents a summation of the characteristics of the material immediately below that point between the potential dipoles.

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Similarly the width of bodies is not easy to determine for narrow zones having a width less than half the dipole spacing used. These estimated maximum widths are educated guesses at best. However, the wider zones are resolved more accurately.

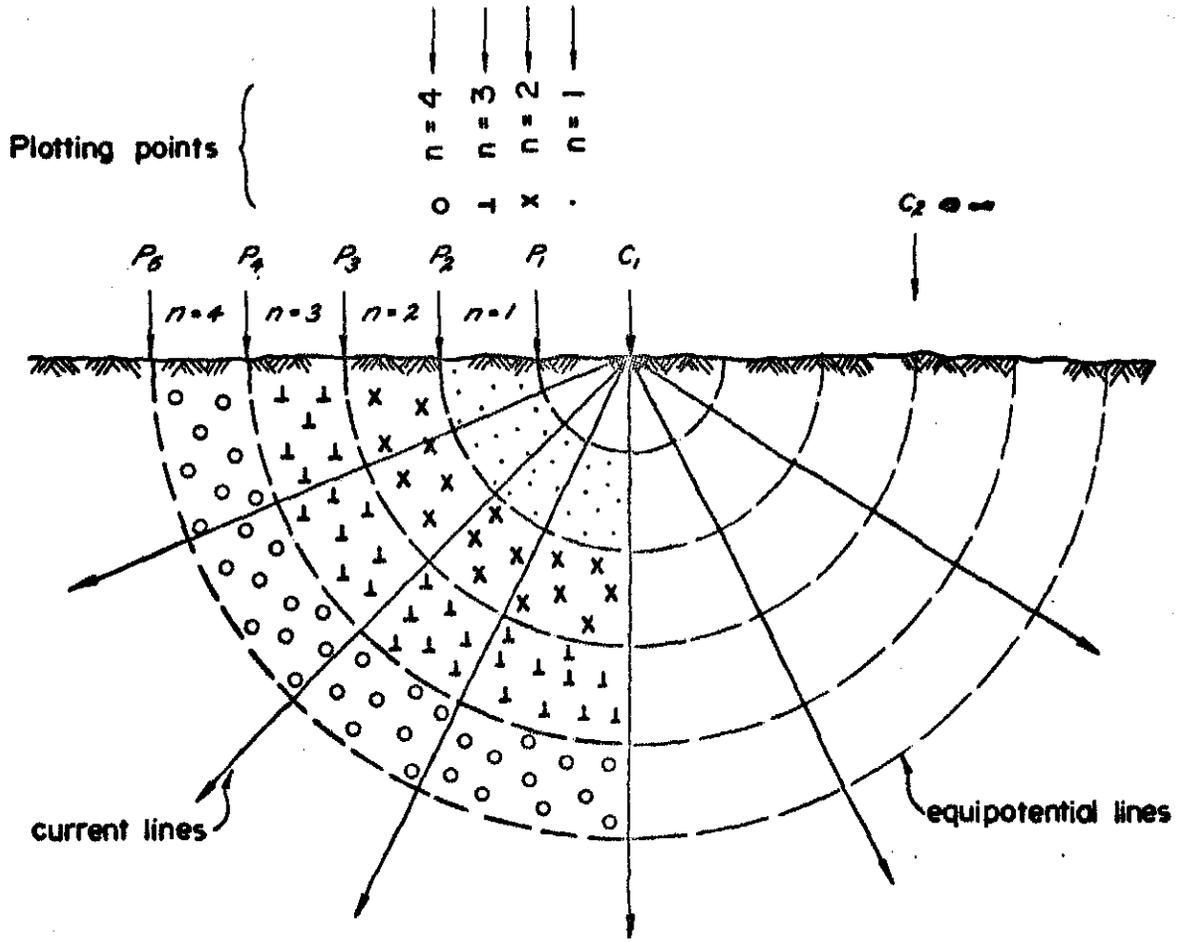
The attitude of a chargeable zone can only really be gauged with any precision in the centre of the gradient array and providing the body has strongly contrasting resistivity and chargeability characteristics to the enclosing rock units.

All field measurements were taken between slope distances along lines. This will, in steep areas, produce errors in the calculated apparent resistivity data, however, these errors will be arithmetic, and as significant changes in resistivity are logarithmic, this source of error is not significant. In assessing the position of the source in areas of extreme terrain, it does not lie vertically below the plotted position of the anomaly, but normal to the "local slope". All positions in the text refer to source positions normal to the local slope.

Each current dipole block has been contoured separately. As would be expected, the continuity along strike is generally good, especially in the chargeability data. However, "end on" current dipole blocks cannot be expected to give identical data due to the different base levels of

EQUIPOTENTIAL DIAGRAM

POLE-DIPOLE ARRAY



SCALE, 1"=200 ft.

5 cm

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the current dipoles, and, in zones close to the current poles, the data will not sample identical volumes on the overlap between current dipoles. This phenomenon will result in more extreme divergence of data as the current dipole is approached. However, these factors are entirely predictable.

Moving Source Arrays

For the moving source arrays such as pole-dipole, depth information is excellent but width and attitude are difficult to define with any precision. For multiple sources within the resolution of the electrode geometry, positional information may be difficult to obtain in some instances. For this reason multiple effective spacings are employed.

The plotted position of the data does not represent the characteristics of the material immediately below the point of measurement, but of a complex volume between the potential electrode and its proximity to the current pole. An example is shown in the enclosed figure.

These arrays are materially influenced by near surface variations in oxidation and superficial cover, and of course, as their resolution and penetration are inter-related, an increase in one results in a decrease in the other.

Decay Forms

The IPR-8 receivers used in this survey are capable of providing precise decay curve shape information. This facility was extensively used at Mt. Lindsay. However, some remarks on the theory of interpretation of this information should be made. Very briefly, any mineral assemblage will store induced energy in a way determined by the minerals which make up the assemblage and the mode of their occurrence - such as grain size etc. Fine grained assemblages, because of their greater surface area, will store more energy, and because of their sharper edges will store it more rapidly than coarser grained assemblages. Thus fine grained assemblages will be characterised by rapid charge and decay characteristics, and coarse grained varieties by long decay times. EIP surveys such as carried out at Mt Lindsay will, however, emphasise the mineral assemblage seen near surface, or if "deep" the decay form will tend to take on the characteristics of the material between the body and the surface, particularly if that material is resistive and chargeable. Therefore one must not necessarily expect to see significant EIP curve shape changes over the more deeply buried chargeable bodies at Mt. Lindsay as the environment there is both highly resistive and has a high chargeability background.

Limited MIP tests were carried out over several conductors. These certainly show material differences between the decay

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forms within the chargeable material. The magnetic or inductive method of recording chargeability and the decay form thereof not only examines the external galvanic effect of the discharge of stored energy within the body, but also the internal decay forms. Material changes were noted at Mt. Lindsay, however, these tests were not extensive enough to be considered diagnostic. Generally though, where $M_1 \gg M_6$, fine grained material is inferred, and where $M_6 \gg M_1$, coarse grained material is inferred. The electrical continuity or otherwise of the material is ascertained from an inspection of the resistivity data.

Line by Line Data Review

A line by line description is given below, the salient features being discussed, and where possible a geological interpretation is given. The physical meaning of the geophysical responses observed is also suggested.

Line 1 - The background chargeability level ranges between 35 and 50 mv/V but averages about 40 mv/V. Superimposed on this background, four quite distinct anomalies were defined.

At 1875N a narrow zone having a width of less than half the 50 metres potential dipole is estimated to have a maximum depth of the order of 20 to 25 metres. In the vicinity of the

chargeable response, the resistivity decreased from about 900 ohm-metres to 300 ohm-metres inferring weak conduction within the chargeable host.

The asymmetry of curve form suggests a steep south dip, assuming sharp boundaries to the chargeable body.

The correlative on line 2 appears to be at 1700N. However the response here is non-conductive and of lower magnitude.

At 1725N an anomaly of some 45 mv/V was defined over the 35 mv/V background to the immediate north. The peak response shows a marked asymmetry in decay form, M_5 being $1.5 M_1$. This suggests a near surface coarseness of grain size. The maximum depth to the top of the chargeable zone is not greater than 70 metres and probably considerably less. Again the asymmetry of the profile form suggests a steep south dip. Against the high 2000 ohm-metres apparent resistivities recorded south of 1690N the apparent resistivity falls to about 200 ohm-metres. This infers some conduction within the host material, but itself cannot be considered highly "conductive" as the absolute value is only 0.003 mhos/metre. The general region in which the chargeability high is situated is associated with a broad increase in magnetic background of some 300 gammas. However, should this

be due to magnetite it is not considered to be the source of the induced polarization response. The form of the magnetic data suggests the source comes within 10 metres of surface at about 1660N

The correlative on line 2 is between 1500N and 1575N, where a much reduced amplitude response was recorded within a broad high background of 50 to 60 mv/V south of 1625N.

The third anomaly of significance was recorded centred at 1475N which is considered to have a slightly conductive source some 80 to 100 metres in width. The decay form shows a long time constant of the same order as seen at 1725N. The maximum depth is difficult to assess due to the high background to the north and the asymmetry of the profile form suggests a south dip. A slight increase in magnetic response was recorded centred slightly south of the maximum induced polarization response, however, the magnitude and form clearly show that the magnetite is not the source of the chargeability anomaly.

The most southerly response was centred at 1275N and is associated with a decrease in resistivity. No dip can be assessed due to the asymmetry of the potential field, however, the source is considered to be shallow and within 30 metres

015

of surface. M_1 is some 1.08 M_5 showing some asymmetry in curve form. The near surface grain size therefore is suggested as only slightly coarser than normal.

This zone has no correlative on line 2, but merges into the high induced polarization background on that line.

Data was run south on this line to 1125m N, but due to asymmetry of electrode position, together with the relative uncertainty as to its position, precluded resistivity data being calculated. Chargeability data was recorded - but not drafted for the above reason.

Line 2 This line is considerably longer than Line 1

but where they overlap a clear correlation between the resistivity profiles is seen, which defines the strike.

The correlation between lines is as follows:

Line 1	1525N	1725N	1925N	← refers to Resistivity
Line 2	1410N	1550N	1750N	← refers to chargeability

The data was obtained using two gradient set-ups, the overlap being between 1200N and 1500N.

The chargeability background ranges between 25 and 35 mv/V on the southern current dipole and over the section of the line covered by the northern current dipole, backgrounds remain a high 35 mv/V, but some values in excess of 60 mv/V were recorded.

The resistivity data can be broken up into a number of distinct zones as follows:

I - South of 350N the resistivities are a uniformly low 200 to 300 ohm-metres with chargeability levels being from 35 to 40 mv/V. The magnetic response over this section is a relatively low 62,000 to 62,200 gammas with very little relief.

II - From 350N to 1125N the general background is 500 to 600 ohm-metres within individual resistivity zones of up to 1000 ohm-metres within this background.

III - 1125N to 1500N background resistivities of about 1000 ohm-metres with relatively high associated chargeability levels.

IV - North of 1550N a gradual rise in apparent resistivity from 200 ohm-metres to 1500 ohm-metres with a sympathetic increase in background induced polarization effect from about 30 mv/V to in excess of 60 mv/V

Between 350N and 1400N the magnetic background remains at about 62,000 gammas, but north of this point an increase was noted which is in sympathy with the increased resistivity and chargeability noted above.

Within the chargeability background listed above, there

are very few truly significant responses. The most substantial of these are described below together with other salient features.

At 475N a doubling of apparent resistivity coincides with an 800 gamma above background magnetic response. A very slight (4 mv/V) increase in chargeability at this point is probably due to the magnetite concentration at this point. Pyrrhotite is not considered the source of either response. The magnetite comes within 10 metres of surface at this point.

Between 650N and 800N an increase in magnetic response of some 200 to 300 gammas was recorded with two near surface sources giving anomalies of 600 to 800 gammas at 675N and 806N respectively.

Other resistivity highs at 1025N and 1150N are also coincident with material increases in magnetic responses.

Two chargeability anomalies were located within the overlap zone between the two current dipoles. There is an anomaly displacement away from the current dipole which explains the non-coincidence of these two responses. The two sources are centred at about 1300N and between 1500N and 1550N.

018

The former is only a 10 to 12 mv/V response, from a disseminated source, while the latter is over 25 mv/V on or in close proximity to a marked change in resistivity from over 2000 ohm-metres in the south to less than 300 ohm-metres in the north.

A wide zone of high magnetic response of up to 600 gammas is coincident with the IP response. However, the main magnetic response of 1500 gammas is coincident with a 2000 ohm-metre response at 1410N.

A small but significant response of 12 mv/V was defined at 1700N which is related to one seen on the previous line.

At 1875N a broad induced polarization anomaly of 15 mv/V coincident with a decrease in resistivity to 300 ohm-metres from 800 - 1000 ohm-metres was recorded. The maximum depth is difficult to estimated, but the anomaly shape suggests not greater than 40 metres. The width is less than 15 metres. The absolute levels of the apparent resistivity of 300 ohm-metres does not suggest conduction.

The ambient magnetic field between 2000N and 2400N is some 1000 gammas above that to the immediate south. A portion of this no doubt contributes to the high background response,

019

but the main causative material is considered to be either graphite or sulphides in disseminated form. The low amplitude induced polarization responses at 2050N, 2175N and 2350N are coincident in all cases with increased magnetic responses from near surface sources.

Line 3 - This line can be generally correlated with line 2 on a basis on the apparent resistivity data, although in detail there are considerable differences. The zones referred to below are as per those seen on the previous line.

I - South of about 250N the resistivity background is a low 200 to 300 ohm-metres with a low 35 millivolts/volt chargeability background. Similarly the magnetic background remains a low 62,000 gammas on this section.

II - Between 250N and 1150N the induced polarization background remains at about 30 to 35 mv/V, while the background resistivity is about 400 to 500 ohm-metres with the more magnetically responsive sections being generally the more resistive. From a base level of 62,200 gammas the magnetic responses reach up to 600 to 800 gammas in this section.

III - Between about 1150N and 1600N the resistivities reach

020

over 1000 ohm-metres and fall rapidly north of 1600N. The recorded induced polarization response is 10 to 20 mv/V above that seen to the immediate south or north.

V - North of 1700N lows in the magnetic, resistivity and chargeability data all rise significantly northwards to the end of the line at 2375N with the more magnetically responsive sections being generally more resistive.

There are in fact very few induced polarization anomalies of major significance south of 1150N in sections I and II. Two minor responses of 12 to 14 mv/V at 275N and 025N are considered to be from broad near surface sources having little or no conduction within the source material.

However, within section III between 1300N and 1410N a zone of highly chargeable material showing no significant conduction within the host rock was observed. The source is shallow, being not greater than 20 metres to the top and there is little or no correlation with magnetics. The normalised decay curve shows no change in response between M_1 , M_3 and M_5 inferring a normal grain size in the causative source material. As the magnetic data over this section shows no response, a non-magnetic source such as sulphide or graphite is inferred. This response is not so substantial on the

021

northern current dipole overlap. However, it is still significant.

At 1575N a 12 mv/V anomaly having no sign of conduction was recorded. The source is considered to be of marginal interest only.

Between the two induced polarization responses described above, a most substantial magnetic response in excess of 3000 gammas was recorded from a source between 1450N and 1575N. The resistivity over this section is a high 1000 ohm-metres inferring the magnetic source to be non-conductive. Although the background chargeability is a high 40 mv/V the magnetic response finds no direct reflection in the chargeability data. The source therefore is considered to be non-electrically continuous magnetite.

A 20 mv/V above background response centred at 1725N is assessed to come from a source having a width of less than 25 metres at a depth not greater than 25 metres. This anomaly can be traced east across lines 2 and 1, and is centred within a generally conductive area, but is not itself significantly conductive. A very slight 200 gamma magnetic response was coincident with this IP anomaly. This indicates a pyrrhotite source, or more likely, a host containing some magnetite.

022

A minor 10 mv/V induced polarization response from a shallow, narrow source at 1860N was recorded coincident with a material reduction in apparent resistivity from about 700 ohm-metres to about 150 ohm-metres. Although the magnetic data shows some increase over this zone, the source is considered to be either graphite or sulphides showing some electrical continuity.

A substantial magnetic response in excess of 2000 gammas above background was recorded between 1925N and 2000N coincident with a resistivity high and relatively low chargeability background. It is quite significant that the magnetic source does not produce any significant induced polarization response whatsoever.

A well defined chargeability response of 20 to 30 mv/V above background was recorded centred at 2060N on the edge of a significant resistivity low. The source is considered to be less than 20 metres in width and to be at a maximum depth of 25 metres. The decay form shows $M_5 = 1.11 M_1$. This infers a somewhat larger than normal grain size near surface. A minor 150 gamma magnetic signature infers the presence of either pyrrhotite or magnetite.

023

Centred at 2200N a 10 mv/V anomaly was defined against the high apparent chargeability background of about 50 mv/V, low magnetic response and some reduction in background resistivity, inferring either a graphitic or sulphide source. The absolute value of the resistivity is a high 700 ohm-metres, the zone cannot therefore be considered conductive.

Line 4 - This line was run between 075S and 1525N. Within the section measured, two zones can clearly be defined, both of which can clearly be related to the immediate east.

I - Between 050S and 350N the apparent resistivity background is about 150 ohm-metres while the chargeability background remains at about 30 mv/V.

II - Between 350N and 1250N the apparent resistivity background rises to about 400 ohm-metres. The magnetic response rises over 500 gammas in the centre of this unit. (Each of the above zones relates to those defined on previous lines).

Within section I a highly significant induced polarization response at 075N is considered to come from a steeply dipping source some 20 metres in width whose maximum depth is not in excess of 30 metres. This anomaly is coincident with a material fall in the recorded resistivity from about

024

150 ohm-metres to less than 40 ohm-metres. A six slice scan of the decay curve carried out over the anomaly peak shows practically no distortion in the decay curve, therefore the entirely normal decay form infers a normal grain size distribution near surface.

Generally higher magnetic responses were recorded over the chargeability high, however, a marked high of about 1000 gammas occurs just south of the peak with a minor response of 200 gammas to the immediate north. Both of these responses are near surface and occur within chert horizons. The relationship between high magnetic response and high resistivity on lines to the immediate east may be due to cherts carrying magnetite. However, on this line no increase in resistivity was recorded over the magnetically disturbed horizon.

On the transition between sections I and II a 15 mv/V chargeability response was recorded centred at 325N. The source is considered to be narrow and shallow and was not observed to have any associated magnetic response.

An increase in chargeability background between 700N and 1025N from 30 mv/V to 40 mv/V, can be broadly connected with a sympathetic increase in magnetic response from 62,000 gammas to 62,600 gammas. Within this zone the only chargeability response worthy of mention was located at

1025N where a response of 10 mv/V coincident with a minor resistivity depression was observed.

A substantial magnetic high between 1225N and 1350N of some 2000 gammas is coincident with an increase in recorded resistivity of from 150 ohm-metres to in excess of 1200 ohm-metres. If anything, the recorded chargeability background over this zone decreased, clearly demonstrating that the causative magnetite does not exhibit a marked induced polarization response. This magnetic response is assessed to come within 20 metres of surface within this zone.

Immediately to the north of the magnetic response and resistivity high, a marked chargeability anomaly was recorded at 1400N. The asymmetry of the profile form suggests a moderate to steep south dip from a source whose width is of the order of 25 metres and whose maximum depth is not greater than 35 metres. A six slice scan of the decay form shows it to be entirely normal over this anomaly. The near surface grain size is therefore a normal grain size distribution. Significantly, there is only background magnetic response over the chargeability high.

Line 5 - This line was read with two current dipoles, with an overlap between 1325N and 1525N.

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The profile form can be correlated with Line 4 in some detail, (see chargeability and resistivity contour maps). Generally, however, the sections are as follows:

I - Between about 100S and 375N the resistivity has a background of about 70 ohm-metres to 100 ohm-metres, with the induced polarization background being about 30 mv/V. Over this section the magnetic profile shows a background of between 62,300 gammas as compared to the immediate south of 025S.

II - North of 400N to as far north as 2825N the background resistivities remain 600 ohm-metres and 800 ohm-metres. However, north of about 2150N the apparent chargeabilities increase from 30 mv/V observed to the south, to in excess of 50 mv/V. The correlation with line 3 over the northern current dipole is difficult. This zone is characterized by material magnetic variations.

IIIA - Between 2100N and 2850N the chargeability rises to 70 mv/V (see above) and the resistivity remains at about the 800 ohm-metre level.

A chargeable zone of some 20 mv/V above the background was recorded between 00 and 100N, coincident with somewhat lower

027

apparent resistivities. This zone is the correlative of that recorded on the previously described line at 075N. The maximum depth to the top of this zone is estimated to be a maximum 25 metres. Slightly higher magnetic response was recorded over this zone, indicating the source contains magnetite. This, however, is not the causative material.

Various minor chargeability responses were recorded between 400N and 1200N all of which can be correlated with features on line 4. Similarly many of the resistivity features can also be clearly identified on the lines to the east and west.

The associated major resistivity low and minor chargeability anomaly on line 4 at about 1200N is seen as a more pronounced feature on this line at 1225N. At this position the apparent resistivity decreases from about 700 ohm-metres to less than 100 ohm-metres, while the chargeability increases marginally by some 10 mv/V. The decay curve shows only a normal form, inferring that the near-surface material has a normal grain size distribution.

On the overlap zone between the northern and southern current dipoles a substantial 25 mv/V chargeability anomaly was located on both set-ups at 1425N. The asymmetry of profile form suggests a steep north dip to this 40 metre wide source which is estimated to have a maximum depth of

028

25 metres. The very slight depression in the apparent resistivity profile suggests only a slight conduction in the source while the decay form is normal, M_1 being approximately equal to M_5 . There is no associated magnetic response, ruling out magnetite as a possible source.

Higher than background chargeabilities were observed at 2225N and between 2325N and 2450N, by about 15 mv/V. In both cases there was no change in the observed background resistivities, inferring either a disseminated, or if massive, electrically discontinuous source. The maximum depths are judged to be of the order of 25 to 40 metres. Over this section there is an inverse relationship between the magnetic response and the chargeability, although the absolute level remains about 1000 gammas above what can be considered to be background. Thus, magnetite certainly makes a contribution to the increased chargeability background, although the above-background chargeabilities are due to either sulphides or graphite.

Centred at about 2575N a 15 to 20 mv/V induced polarization anomaly is associated with a 50% depression in the apparent resistivity profile. This is also accompanied by a decrease to background in the magnetic field inferring that the

029

chargeabilities are due to sulphides or graphite and not magnetite. A very substantial induced polarization response in excess of 100 mv/V was recorded between 2850N and 2975N. As estimated from the curve shape on the southern flank of this anomaly, the maximum depth is from 10 to 25 metres at most. The apparent resistivity recorded over this section decreased to 300 ohm-metres from a background of about 900 ohm-metres to about 1000 ohm-metres. Unfortunately the magnetic data does not traverse this chargeable zone, but the southern margin shows a sharp drop off in the regional background as the anomaly is approached. This zone is either graphite or sulphide in origin, and the six slice scan shows that $M_6 = 1.6 M_1$, inferring a slightly larger than normal grain size near surface.

Line 6 - Only the section between 025N and 1525N was surveyed on this line from the southern current dipole. On this line both the chargeability and resistivity patterns correlate well with the previously described line.

Section I - South of 300N shows the characteristically low apparent resistivities (70 to 100 ohm-metres) recorded on previous lines with a low chargeability background of 30 mv/V. However, in contrast with the previously studied lines, this section shows considerably greater magnetic activity than observed to the east. North of about 300N

030

resistivities average about 400 ohm-metres but show considerable variation from 60 ohm-metres to 1000 ohm-metres, while the magnetic response over this section similarly shows up to 1000 gamma variation from the local 62,000 gammas base. This section shows an increasing chargeability background from about 30 mv/V in the south to over 50 mv/V at 1200N, but there are very few actual chargeability anomalies as such superimposed on this high base level.

Within section I, a substantial induced polarization response of in excess of 30 mv/V, open to the south, was defined south of 100N. The maximum width is 40 metres and the maximum depth is assessed to be 25 metres. Although there is some depression in the apparent resistivity profile, this is minimal, and the source is therefore not considered to be truly conductive. The chargeability response is clearly associated with a minor, 200 gamma increase in the local magnetic field. Thus the source could well be pyrrhotite although sulphides with magnetite is a more likely interpretation. A six slice scan on the decay curve showed $M_6 = 1.25 M_1$. The grain size is therefore inferred to be coarser than normal near surface.

On a sharp change in resistivity between sections I and II a significant 20 mv/V anomaly was defined. This response is considered to come from a source at a maximum depth of

031

25 metres, and having a width of less than 20 metres situated in close proximity to a major rock type change. Although a slight increase in magnetic response was noted over this anomaly, the source is considered to be either graphite or pyrrhotite in origin. A six slice scan carried out on the decay curve at this point shows a very marked distortion, M_6 being equal to $1.4 M_1$. The source material, at least near surface, is therefore abnormally coarse grained and/or intrinsically conductive. This marks this anomaly as of particular interest for this reason.

A broad zone of increased chargeability was recorded between 1100N and 1225N associated with a 60% depression in the observed apparent resistivities. The absolute level of 250 ohm-metres does not, however, suggest significant conduction within this zone. The decay form shows only normal decay form, while the magnetic data shows a broad high over this zone. The source therefore, in part, is considered to be magnetite, but for the most part, however, sulphides or/and graphite is considered to make up the bulk of the source.

The prominent resistivity low referred to on the previous lines was defined at 1325N on this line. The chargeability rises somewhat at 1375N.

032

On this line, as on lines to the east, the more highly magnetic horizons tend to follow the more resistive rock types.

Line 7 - A broadly similar resistivity and chargeability pattern was observed on the southern section of this line as was observed on line 6. The two main zones described (I and II) on the southern current dipole were also seen here, only somewhat less distinctly. The overlap between the northern and southern current dipoles was excellent, but with the predictable difference in base levels.

Section I was recorded between about 00 and 300N. Here the recorded apparent resistivities were as low as 20 ohm-metres but average perhaps 70 ohm-metres. Base level chargeabilities were about 30 mv/V as usual, while the magnetic data showed a level of about 62,200 gammas.

South of 025N resistivities rise rapidly over quite magnetic concentrations. This may indicate the presence of non-magnetic sediments south of this point.

Section II was seen north of about 300N and the 700 ohm-metre resistivity base level became about 1000 ohm-metres on the northern current dipole. The regional base level on the

033

northern current dipole is about 20 mv/V higher than on the southern dipole.

In section IIA north of about 2400N the apparent chargeabilities rose to just under 100 mv/V marking this section out to have different characteristics to those to the immediate south.

A well defined chargeability anomaly of some 25 mv/V was defined at 075N which may be related to that defined at 050N on line 6. The resistivity is reduced to less than 20 ohm-metres over this section while a six slice scan of the decay curve shows only slightly longer decay times than normal.

The magnetic field shows an inverse relationship to chargeability inferring the source to be either sulphide or graphite with little or no magnetite present. The asymmetry of the profile form suggests a moderate north dip assuming a homogeneous source while the width of the body is judged not to exceed 30 metres, and the maximum depth to the top of the chargeable material is assessed to be of the order of 25 metres.

No other significant anomalous responses were recorded until 1275N where a significant well defined 20 to 25 mv/V anomaly associated with a very material decrease in resistivity from 1000 ohm-metres to 40 ohm-metres was recorded. The width is assessed to be not greater than 40 metres while the maximum depth is thought to be no greater than 35 metres. The dip is

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impossible to gauge. A six slice scan shows the anomaly to have a long time constant, M_6 being equal to about $1.3 M_1$. The grain size of the surface material is therefore considered to be extremely coarse, and as the resistivity is low, massive sulphides are the suggested source. The magnetic response infers the major source of the induced polarization response not to be magnetite.

A broad zone of 20 mv/V above background was defined at 1750N. The maximum width of the source is 75 metres while the maximum depth is assessed to be no greater than 35 metres. The asymmetry of the profile form suggests a south dip. There is no sign of any reduction in apparent resistivity and as the decay shows only a slightly longer than normal time constant the source is assessed to be disseminated sulphides or graphite.

A small 7 mv/V response at 2275N from a narrow source is associated with a material reduction in resistivity to 400 ohm-metres from about 1000 ohm-metres. There is an inverse relationship between chargeability and magnetic field, therefore the source is considered to be graphite or sulphide in origin, within a host showing weak conduction.

Between about 2475N and 2775N a wide zone of high chargeability of up to 35 mv/V was recorded. There is a very slight fall in resistivity over the peak value at 2625N. However, the source is considered to be of a disseminated nature, although

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somewhat coarser grained than normal, M_5 being equal to $1.15 M_1$. Although there is some magnetic response over this anomaly the magnitude infers that it is not the source.

Line 8 - The resistivity and chargeability profiles of line 7 are similar to those observed between stations 1200N and 2800N on this line. There are a number of substantial induced polarization anomalies of significance worthy of careful ground follow-up.

A substantial 50 mv/V anomaly centred at 1075N is associated with an 80% decrease in apparent resistivity and shows an inverse relationship to the recorded magnetic field. The width of the source is guesstimated to be of the order of 25 metres or less and the maximum depth to the top of the chargeable material is not greater than 25 metres. The decay curve showed only normal form. The suggested source material is either sulphide or graphite disseminated within a somewhat more conductive rock unit than the surrounding resistive rock types.

A narrow source having a maximum width and depth of less than 30 metres and showing weak conduction within the source was defined at 1375N. A normal decay form was recorded. There is a positive correlation with a 2000 gamma magnetic response. The source material therefore contains either pyrrhotite and/

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or magnetite and is therefore an anomaly of prime interest.

At 1775N in close proximity to a rock type change, an induced polarization response of 25 mv/V was recorded. The asymmetry of the profile suggests steep south dip.

At 2125N a 17 mv/V response is associated with a depression in the resistivity profile. The maximum depth to the top of this chargeable body is estimated to be about 25 to 30 metres. As there is no positive correlation with the magnetic field, the source is suggested to be either graphite or sulphide.

A broad above background response of some 20 mv/V was recorded between 2500N and 2675N. The maximum depth (on the northern flank) to the top of this chargeable body is 25 metres. There is an associated 50% depression in the apparent resistivity centred at 2625N.

Between 3175N and 3350N a 50 mv/V above background induced polarization response was found to be associated with a substantial fall in apparent resistivity from a background of 2000 ohm-metres to a mere 30 ohm-metres. This is associated with a substantial depression in the magnetic profile over this section. The favoured conductive-chargeable source

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material is either sulphide and/or graphite in a massive electrically continuous form. This anomaly is recommended for follow-up.

A second substantial response of 50 mv/V was recorded at 3425N from a narrow source at a maximum depth of less than 25 metres. The high apparent resistivities of 2000 ohm-metres, however, indicate the source to be disseminated rather than massive. There is no positive correlation with the magnetic data and therefore the source material is considered to consist mainly of either pyrite or graphite.

Line 9 - The resistivity and chargeability profiles show only general similarities between lines 8 and 9. These correlations have been incorporated into Plates 2 and 3.

On the southernmost current dipole, the recorded resistivity shows great variation between 100 ohm-metres and 2000 ohm-metres, while the background chargeability recorded was about 30 to 35 mv/V.

A minor chargeability response of 7 mv/V or so was recorded at about 490N and is associated with a remarkable fall in apparent resistivity of 95% to just over 100 ohm-metres. The source could be a weakly mineralised shear or conductive unit.

038

Two moderate chargeability responses of 20 and 30 mv/V were recorded at 800N and 900N from rock units having apparent resistivities in excess of 2000 ohm-metres. The sources of these are obviously disseminated or electrically discontinuous sulphides and/or graphite, as there is a decrease in the observed magnetic field over this section.

A substantial 40 to 50 mv/V anomaly above the 40 mv/V background was recorded between 1050N and 1200N from a source inferred to be highly resistive as judged by the apparent resistivities of up to 2000 ohm-metres. Although the magnetic field is high over this anomaly, the high response extends north and south of the highest chargeabilities. Although magnetite probably contributes to the causative material, disseminated sulphides and/or graphite are considered the most likely source. The decay curve shows $M_1 > M_5$ which infers a finer grain size distribution than normal.

At 1925N a narrow and relatively conductive and chargeable source estimated to have a maximum depth and width of 25 metres was recorded. The absolute resistivity of 200 ohm-metres shows the zone to be only marginally conductive. The magnetic field was recorded to be lower over this anomaly.

Minor responses from disseminated or electrically discontinuous

sources were recorded at 1825N and 2025N. Both zones are associated with background magnetic fields only.

A substantial 40 mv/V response at 2675N is associated with 50% depression in the apparent resistivity. The maximum depth is estimated to be not greater than 50 metres while the maximum width is of the order of 80 metres. The asymmetry of the profile form strongly suggests a steep south dip. An examination of the decay curve shows that M_5 is somewhat less than M_1 , inferring a slightly finer grain size than average. The source is considered to be either graphite or sulphide in more finely than usual grain size near surface. Although magnetite may make a minor contribution to the observed chargeability, the distinct low seen over the chargeability anomaly clearly indicates the source not to be magnetite.

A further substantial response was recorded centred at 3360N, where a chargeability in excess of 140 mv/V was recorded coincident with a 90% drop in the recorded resistivity to about 150 ohm-metres. As the edges of the source are not sharp, the maximum depth is extremely difficult to estimate but it is not deeper than 80 metres, and probably considerably less. The width is of the order of 150 metres. The decay form is normal and the magnetic response over this zone is background only, although to the immediate south the recorded magnetic field reached over 2000 gammas above background.

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Line 10 - A short section of line 10 was surveyed between about 100N and 800N. There is a clear correlation between this line and line 9, especially the resistivity profile. The correlation is shown in Plates 2 and 3, but in summary is as follows:

Line 10	325N	525N	675N	775N
Line 9	400N	525N	600N	700N

Two moderate to small induced polarization responses were recorded at 575N and 775N, each with an associated resistivity low. In both cases the magnetic field tended to be lower over the chargeable zone than on either side of the IP response. In both cases the maximum width was of the order of 40 metres and the maximum depth less than 25 metres.

Line 11 - South of the road between 00 and 900S, a pole-dipole array was used to investigate the electrical properties. The spacing employed was 50 metres, with $n = \frac{1}{2}$, 1, 2 and 3 between 00 and 400S and $n = 2$ and 3 between 450S and 900S.

Between about 150S and 250S a highly chargeable zone in excess of 90 mv/V as against the near-surface background of 20 mv/V was recorded. The maximum depth is less than 25 metres while the source is highly conductive with apparent resistivities being of the order of 1 ohm-metre. Actual resistivities would

in fact be considerably lower due to near surface resistive cover. This could well be the source area for a turair anomaly.

A second zone of very high chargeability was defined between 550S and 600S which comes within 25 metres of surface. The width and attitude of the chargeable zone is unknown, but the apparent resistivities of less than 15 ohm-metres show this to be a highly conductive zone capable of being the source of the turair anomaly detected in this region.

Both anomalies occur in magnetically undisturbed zones and show a slightly larger than normal time constant. Graphitic and/or pyritic shales are the most likely source of these two conductive chargeable zones.

North of the road between 00 and 3500N some three gradient arrays were employed to investigate the potential field. A number of distinct anomalies were defined.

At 275N a distinct resistivity low and a minor chargeability high are assessed to come from a zone less than 25 metres in depth and less than 25 metres wide. As this anomaly occurs within a magnetically undisturbed zone, the source may be either disseminated graphite and/or sulphide in a weakly conducting host.

At ^{675N}~~657N~~ a broad 25 mv/V induced polarization response was recorded from a highly resistive zone some 50 metres south of a highly conductive section, but having background chargeability only. The source of the chargeability is coincident with generally lower magnetic relief than to the immediate north and south, which is some 3000 gammas higher. However, within the magnetic low, a distinct narrow, shallow magnetic anomaly was defined at 680N which may represent magnetite or pyrrhotite within the sulphide and/or graphite source of the chargeability anomaly. The maximum depth to the chargeable zone is estimated to be about 50 metres while the width is not greater than the spacing used, namely 50 metres.

The asymmetry of the profile form suggests a steep to moderate north dip. However, should oxidation increase the resistivity (as has often been noted in the region), the resistivity low at 725N may well represent the more conductive lower section of the source.

A well defined 50 metres wide chargeable source was defined at 875N. The maximum depth is considered to be of the order of 25 metres to the conductive source. The observed resistivity over the body is 275 ohm-metres or so, as compared with over 3300 ohm-metres to the immediate south. The absolute level, however, suggests only moderate conduction.

The asymmetry of the profile form suggests a north dip.

Between 1000N and 1150N a significant increase in all three parameters was noted. The maximum depth to the source of the chargeability response is estimated to be less than 20 metres. The 2000 gamma magnetic anomaly is coincident with the 35 mv/V above background chargeability, therefore magnetite certainly makes a contribution to the induced polarization anomaly. However, the magnitude suggests the presence of additional sulphide or graphite material. The normal decay forms registered suggest a normal grain size distribution near surface. The near electrode position of this section makes the attitude difficult to assess. However, a steep south dip is inferred from the asymmetry of the anomaly.

Centred at 1275N, a 30 to 40 mv/V response is interpreted as coming from a south dipping 75 metre wide disseminated sulphide and/or graphite body having a maximum depth of 25 metres.

A distinct 15 to 20 mv/V chargeability response was recorded centred at 2040N between a distinct change in chargeability background from about 30 mv/V to the south, to 45 mv/V or so to the north. The resistivity is somewhat reduced over this response, but the absolute level is of the order of

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1000 ohm-metres. Therefore only very weak conduction within an essentially disseminated host is the suggested source. The magnetic field increases to the north over the increased chargeability background. Therefore the magnetite or pyrrhotite, in part, must contribute to this background. This anomaly probably represents the "end effect" of the Mt. Lindsay lode, but is in no way as spectacular a response as seen on line 12.

A broad zone of increased chargeability was defined between about 2550N and 2750N. The resistivity low at 2650N is minimal and does not mark the source as conductive. As there is little or no magnetic response the body is assessed to have either a graphite or sulphide source. The width and depth are difficult to estimate, as the edges of this source are obviously not sharp. The northern edge is, however, judged to be no deeper than 50 metres, and probably considerably shallower.

A very distinct source was defined by a 25 to 30 mv/V response at 2975N. The asymmetry of profile form suggests a south dipping, 35 metre wide body, having a maximum depth of 25 metres. The magnetic field in this vicinity shows an almost dipole form which is often seen over pyrrhotite deposits. This, however, could also be due to the near surface magnetite distribution.

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A broad zone whose asymmetry of profile suggests a steep north dip, extends from 3175N to 3375N, a width of over 300 metres and also shows a broad zone of lower than background resistivity. The maximum depth is difficult to estimate, however, in the south it is considered not to be greater than 40 metres and probably considerably less. Within the body the chargeabilities recorded are in excess of 100 mv/V, while the decay form infers at least a normal grain size distribution near surface. Although the recorded apparent resistivities infer some conduction within the source, an electrically continuous source is not interpreted, as the absolute values are a high 400 ohm-metres.'

The magnetic data shows a general low over the anomaly but within it, low frequency magnetic responses are interpreted as coming from narrow, near surface segregations of magnetite. Graphite or sulphide, not magnetite, is the interpreted source material.

Line 12 - Two sections of this line were surveyed using moving source arrays as follows:

Between 800S/00 and 1000N/2200N

Three array at a = 25 metres and 50 metres

Pole-dipole at a = 50 metres and n = 2

South of the road a number of distinct chargeability sources

were located by the three array moving source arrays employed. Unfortunately positioning of the multiple sources is difficult when a number of sources lie within the resolution of the array. A careful study of the multiple responses of the current pole and potential dipole suggests the following positions and characteristics for the sources.

At 200S a highly chargeable zone having a maximum depth to the top of the chargeable material of 20 metres was defined. This zone is also one of the most conductive located on the Mt. Lindsay grid. The actual intrinsic resistivities are estimated to be less than 1 ohm-metre. The anomaly is almost certainly a major source for the turair anomaly located at this point. Although the background magnetics were slightly higher than to the south, there is no distinct correlation between this anomaly and a disturbed magnetic field. The source is therefore considered to be either a conductive zone carrying either graphite or sulphides. The width of the zone is difficult to assess, but the suggested width is no greater than the minimum effective dipole used, namely, 25 metres. The decay form shows that M_1 , M_3 and M_5 are equal, inferring a normal grain size distribution near surface.

A second quite distinct zone was defined at about 390S. However, the magnitude of the chargeability of 80 mv/V is about half that seen at 200S. In addition, although the

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resistivity is still relatively low, it is some 10 fold higher than that recorded at 200S. There is a distinct magnetic response to the south at 350S. This response could in part be due to either magnetite or pyrrhotite in close proximity to the main body of the chargeable material interpreted as being centred at about 390S.

A third significant chargeability response of the same order was located at about 500S. Again the maximum depth to the top of the chargeable body is estimated to be less than 25 metres. Although the resistivity is somewhat reduced over this section, it is still higher than seen on the two previously described zones. The magnetic field is quite undisturbed south of 425S, therefore, the source is either graphite or sulphide, and not magnetite or pyrrhotite.

Two further responses were recorded from sources at about 725S and 825S from relatively resistive sources which cause no distortions to the local magnetic field. The depths of these sources are both less than 25 metres and both could be either sulphides or graphite.

North of the road, some four main zones of chargeability were defined on the present survey.

The first major response was recorded centred at about 1125N with an interpreted maximum depth of less than 10 to 12 metres. The importance appears to increase with depth. The apparent resistivities are a low 200 ohm-metres as compared with the background of 1000 to 2000 ohm-metres or so. However, unless these are very narrow "conductive" zones which cannot be resolved by the array, the sulphide or graphite source material must be considered electrically discontinuous for the most part. A distinct magnetic response of over 1500 gammas occurs within this vicinity and may represent magnetite or pyrrhotite within, or in close proximity, to the magnetic response. This marks this zone as one of prime interest, and careful follow-up is recommended. The decay curve shows M_5 only slightly larger than M_1 over this zone. However, an MIP test carried out at 1125N revealed $-M_6$ some twice $-M_1$ on a six slice scan inferring a coarser grain size than normal to the source material.

A chargeable zone centred between 1475N and 1500N of some 40 to 50 mv/V above the observed background, is interpreted as coming from a source whose maximum depth is estimated to be about 25 metres. The quantity of sulphides present is interpreted as increasing with depth. Some increase in the magnetic field was noted over this response, inferring the presence within the host material of either magnetite and/or pyrrhotite. The effectively shorter spacings infer narrow zones of reduced resistivity within the source, but the whole

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is considered not to be electrically continuous. Slightly higher M_5 values with respect to M_1 were recorded on an EIP scan inferring slightly coarser grain size near surface. However, an MIP scan at this point infers a more disseminated fine grained nature to the source material at depth.

On the southern and northern flanks of a broad zone of lower than background apparent resistivity and chargeability between about 1700N and 2050N, two small but well defined chargeability anomalies were recorded at 1750N and 2000N respectively. Each is associated with slightly lower apparent resistivity than background, and their maximum depths are interpreted as being 25 metres and 40 metres respectively.

By far the most spectacular combined induced polarization and resistivity anomaly was defined on line 12 centred at about 2140N. The chargeability recorded on the lesser spacing was 67 mv/V and on the greatest spacing just under 70 mv/V, indicating an increase in importance with depth. The maximum depth as interpreted from the chargeability data was less than the minimum spacing used, namely, 25 metres, and the width of the induced polarization zone is estimated to be less than 20 metres.

The apparent resistivities drop from the order of 8000 ohm

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Page - forty seven

metres to the immediate south to less than 10 ohm-metres within the chargeable material. After allowing for the inferred resistive surface layer, the actual resistivity within the chargeable material is estimated to be considerably less than 1 ohm-metre. Providing this body has strike continuity, it should have given an excellent turair response.

A very sharp high frequency magnetic response was recorded over the induced polarization anomaly. This is interpreted as coming from within a few metres of surface, however, it lies within a broad higher response, which indicates the presence of magnetic minerals such as pyrrhotite and/or magnetite.

A study of the EIP decay form over the anomalous response shows only normal decay curves. An MIP test over this zone between 2050N and 2125N gave the following information:

Station	M ₁	M ₂	M ₃	M ₄	M ₅	M ₆
2050N	-59	-75	-90	-100	-100+	-100+
2075N	- 8	-11	-135	-16.5	- 19	- 21
2100N	-18	-23	-29	-35	- 40	- 43
2125N	-28	-36	-50	-59	- 62	- 70

Although incomplete, this data infers two sources, one at or south of 2050N, and one at or north of 2125N. Both show

a very strong distortion in the internal decay current, which in the case of 2125N is particularly strong, M_6 being about three times M_1 . The inference therefore, is clearly for a conductive coarse grained source material, most likely sulphides with magnetite and/or pyrrhotite. At 2050N the grain size is not as coarse, but still coarser than normal, but disseminated or electrically discontinuous.

In all, these electrical characteristics are similar to the EIP and MIP tests carried out over massive pyrrhotite in the Renison Mine area.

Although clear comparisons between lines when run with very different electrical configurations, are difficult, the following correlations are suggested:

<u>Feature</u>	<u>Line 11</u>	<u>Line 12</u>
Resistivity high	1075N	1075N
IP high	1275N	1275N
Resistivity/IP high	1440N	1500N
Broad resistivity low	1800/1950N	1700N/2050N
Resistivity high	1975N	2075N
IP/Cond anomaly	2040N	2040N

Line 13 - The southern portion of this line was surveyed using a pole-dipole with a = 25 metres and n = 1, 2 and 3 between

052

300S and 100N.

Within a moderately resistive (1000 ohm-metres) background, a highly conductive and chargeable zone was defined centred at 030N, the depth to the top of which is estimated to be less than 10 metres. The width of the zone is considered to be of the order of 10 metres or so, and the actual resistivity less than 0.1 ohm-metres. This is an obvious source for the turair conductor located in this vicinity.

This response is considered a prime target as it has all the characteristics of the type mineralisation, including a narrow magnetic signature of some 1500 gammas or so.

To the south of 100S, a marked increase in background chargeability was recorded with increased spacing. This horizontal layering suggests oxidation near surface, or, more likely, an alluvium cover above a disseminated sulphide or graphite bearing rock type.

North of the baseline (00) two gradient arrays were employed to investigate the induced polarization and resistivity characteristics between about 100N and 2400N. Superimposed on the 30 mv/V chargeability background, a number of well defined induced polarization anomalies were recorded. The background resistivities for the most part varied between

1000 and 2000 ohm-metres north of 200N and considerably less than this to the south of this point (see also above).

A narrow 35 mv/V induced polarization response within a 400 ohm-metre "low" was recorded at 125N. The source is considered shallow, and of a disseminated nature.

Between 150N and 250N a broad induced polarization response of about 35 mv/V was recorded from material having an electrical resistance of about 1000 ohm-metres. This anomaly is coincident with relatively low magnetic fields.

A small above background IP response was coincident with 8000 ohm-metres resistivity at 375N. Again a lower than average magnetic field was recorded in the vicinity of this response.

A substantial induced polarization response of 35 to 40 mv/V above the local 30 mv/V background was recorded centred at about 915N. The interpreted width is about 80 metres and the maximum depth, 30 to 35 metres. Although there is a depression in the apparent resistivity in this section, the absolute level of over 1000 ohm-metres suggests a disseminated source. This anomaly lies within a general low on the magnetic field. However, within this low, a number of shallow, but significant responses were recorded. The source is interpreted

to consist of disseminated sulphides or graphite.

Two 40 mv/V to 50 mv/V anomalies associated with high resistivity were defined at 1075N and 1175N respectively. In both cases the maximum depth appears to be of the order of 25 to 35 metres.

At 1425N a 25 mv/V anomaly associated with no change in the highly resistive background of 2000 ohm-metres was found to be in a magnetically disturbed area. The interpreted source is disseminated sulphide and/or graphite carrying some magnetite and/or pyrrhotite. The maximum depth and width of the source are interpreted to be 35 metres and 25 metres respectively.

A marked depression to 700 ohm-metres in the 2000 ohm-metres background at 1675N is accompanied by an increase in chargeability to 56 mv/V from the 30 mv/V background. This response is probably the western correlative of that seen on line 12 at 1750N. The width of the source is estimated to be not greater than 30 metres, and the depth about 30 to 40 metres or less.

A response of similar characteristics, magnitude and depth was located at 1875N and may be equivalent to that seen on line 12 at 2000N.

055

The most substantial response seen north of the baseline (00) was defined at 2025N. At this point an anomaly of some 50 mv/V above background was located with a coincident fall in the observed resistivity to 500 ohm-metres. As a very substantial 3000 to 5000 gammas magnetic anomaly was located at this point, the source must include magnetite and/or appreciable quantities of pyrrhotite. The magnetic response is shallow, certainly within 10 metres of surface, while the maximum depth of the induced polarization anomaly is assessed to be 35 to 40 metres. This anomaly probably represents the eastern extension of the Mt. Lindsay lode, and as such holds some interest.

A second induced polarization and resistivity feature having almost identical characteristics centred at 2140N. Although the magnetic field shows the presence of magnetite or pyrrhotite, the magnitude of the distortion is considerably less than that seen at 2025N. This anomaly is recommended for careful follow-up.

A third response of similar magnitude was defined at 2275N, immediately to the south of a very sharp and marked increase in resistivity which obviously marks a major change in rock type. As this response also has a positive correlation with an increase in magnetic field, it also should receive careful attention as a potential lode.

Line 14 - Pole-dipole at $a = 25$ metres and $n = 2$, and three array with $a = 25$ and 50 metres, was used to log the electrical characteristics of line 14 between about 800S and the baseline (00) and between about 1150N and 2100N.

Centred at about 040S a highly chargeable zone having a highly conductive source, was shown to lie within some 10 metres of surface. The estimated internal resistivity is less than 0.5 ohm-metres, and as such could form part of the turair conductor located in the region. The magnetic field is relatively low over this section, therefore a sulphide or graphite source is suggested.

An MIP test carried out in the area shows only normal decay from within the polarizable body. The suggested source is therefore disseminated, probably graphite.

A second highly chargeable (in excess of 160 mv/V) and conductive (less than 0.1 ohm-metres) source was defined at 210S. It too has the characteristics of a turair conductor. Little or no distortion in the magnetic field over this zone strongly suggests a non-magnetic source such as graphite and/or sulphides.

Two narrow highly chargeable and conductive bodies lying within 25 metres of surface were defined at 425S and 550S ✓

057

respectively. The conductivity of these zones is some 10% of those previously described, and thus would not form turair conductors. Although the background magnetic field is stronger over this zone, no specific magnetic response was noted from the chargeable material. An MIP scan does suggest "Renison type" material to be present.

At 675S a 90 mv/V induced polarization response was recorded from a source interpreted to be less than 15 metres deep. Although more conductive than the rock to the immediate north and south, the source is nevertheless considered to be disseminated.

An MIP scan carried out over this zone shows a distinct distortion in the decay curve - M_6 being almost three times M_1 . This clearly indicates a coarse internal grain size of the "Renison type". This anomaly is recommended for careful follow-up including an extension of the magnetometer survey over this region.

The apparent resistivity shows considerable variation north of the baseline. Moving source arrays are more subject to near surface distortions in resistivity and chargeability and this accounts for the variation measured and the considerably lower background chargeability recorded over this line. A number of low amplitude, but nevertheless significant

058

responses were however recorded.

At 1340N on the northern flank of a broad resistivity low recorded between about 1200N and 1350N, a minor but definite chargeability anomaly was defined, having a depth to source of less than 25 metres. The nature of the response at the close spacing used strongly suggests an increase in importance with depth. No magnetic disturbance was recorded in this portion of the line, therefore the source must either be sulphide or graphite within a weakly conducting host rock.

At about 1810N a twice background response of 45 mv/V was recorded from a weakly conductive host unit judged to have a maximum depth of 25 metres. The recorded magnetic field is low in the vicinity of this response, so the sulphide or graphite source does not contain magnetite. This anomaly would appear to be the correlative of that seen on line 12 at about 2000N.

The most substantial combined IP and conductivity response north of the baseline (00) was recorded from a source at about 20 metres below 2010N. The source increases in importance with depth and has an inferred south dip. The recorded apparent resistivity associated with the induced polarization response reaches 10 ohm-metres which indicates an internal resistivity of less than 1 ohm-metre. The

059

associated magnetic field infers the presence of either magnetite or pyrrhotite. This zone is the western extension of the Mt. Lindsay lode.

Line 15 - The main feature noted on the southernmost of the two current dipoles utilised to investigate the resistivity of the underlying rock units on this line, is the dramatic change in apparent resistivity which occurs at 400N. South of this point the background is about 100 ohm-metres and north of this point 7000 ohm-metres. A very major rock type change obviously occurs at this point. Between 225N and 350N within a relative chargeability low, a substantial increase in the local magnetic field was noted. Obviously the conductive rock types at this location carry appreciable amounts of magnetite.

South of 150N to the end of the surveyed line at 025S the recorded chargeabilities increased to over 60 mv/V from the base level of about 20 mv/V. Towards the end of the line the resistivity fell to 30 ohm-metres from a base of above 200 ohm-metres at 100N. Graphitic sediments are suggested as the source of these observations.

On the contact between the two rock types at 400N referred to above, a 25 mv/V above background chargeability response superimposed on a resistivity low, was recorded. As there is

060

no associated magnetic field, the source is either graphite or sulphide. To the immediate north, within the resistive rock unit, somewhat higher chargeabilities of 20 mv/V were observed. The causative material is obviously of a disseminated nature.

A 30 mv/V above background anomaly was defined at 850N within a 3000 ohm-metres resistivity zone. The maximum depth to the top of the chargeable body is 20 metres and the estimated width about 45 to 50 metres. The magnetic field is disturbed in the vicinity of this anomaly. Therefore near surface magnetite and/or pyrrhotite make a contribution to the observed anomaly. However, the bulk of the source is considered to consist of disseminated graphite and/or pyrite.

A substantial 50 to 60 mv/V anomaly gave an almost identical profile form on each of the two current dipoles employed, where they overlap between 1000N and 1200N. The maximum depth to the source is some 40 metres normal to the local slope at 1125N, and the maximum width is less than 50 metres. The resistivity shows a 90% depression over the zone to about 400 ohm-metres. The magnetic data shows a distinct negative anomaly of 3000 gammas. This could well be due to a reversed field which is often observed within pyrrhotite, although the magnitude is somewhat larger. This possibility marks

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this zone as one of special interest, therefore careful follow-up is suggested.

A 20 to 25 mv/V response over background was defined at 1240N from a highly resistive source. There is no real association with any anomalous magnetic response, therefore the source is considered either disseminated graphite or sulphide.

A very significant response of about 90 mv/V was defined at 1775N from a source interpreted to be no deeper than 10 metres and whose maximum width is 20 metres. There is a slight magnetic response, while the resistivity decreases from a background of 2000- 3000 ohm-metres to 600 ohm-metres over the anomaly. This anomaly is considered of prime interest.

A second similar response of 70 mv/V was recorded from a narrow source at a shallow depth at 1875N. The apparent resistivity is some 400 ohm-metres while there is a clear correlation with 1500 gammas distortion in the total magnetic field.

A 20 mv/V anomaly interpreted as coming from a 20 metre wide source at 2025N at a maximum depth of 20 metres is associated with a 5000 gamma magnetic anomaly in the total field. This is marked in the magnetic profiles as being the "main lode"

However, based on a basic knowledge of the deposit, this anomaly would only rate further investigation as a secondary target.

Line 17 - The main feature observed on the three gradient arrays employed to survey this line between 1000S and 2000N, is the sharp decrease in the apparent resistivity profiles seen south of 300N, and again south of 200S. The background induced polarization levels between 1000S and about 1200N remain within the $40 \text{ mv/V} \pm 5 \text{ mv/V}$ level, while to the north of this point they decline to about 20 mv/V . It is perhaps significant that the magnetic field remains relatively undisturbed south of the major resistivity change at 300N. These features were recorded on lines to the extreme east of the surveyed grid.

A broad decline in apparent resistivity from about 60 to 70 ohm-metres between 750S and 900S were accompanied by a slight increase in chargeability by about 15 mv/V . This is considered to be formational and not of major interest, however, narrow conductive zones within such a broad zone could well produce a minor turair response.

The recorded magnetic field over this induced polarization anomaly clearly shows a 150 gamma increase in level. However,

063

although magnetite clearly makes a contribution to the IP response observed, it is not thought to be wholly responsible for it.

A 35 mv/V induced polarization response at 525S coincident with a 50% depression in the apparent resistivity and showing no distortion in the local magnetic field, is interpreted as coming from a source having a maximum width of 30 metres, a maximum depth of 25 metres, a probably steep south dip and being comprised of essentially disseminated graphite and/or sulphides.

Two 30 mv/V induced polarization responses were recorded at 225S and 360S, both coincident with higher than local background resistivity. The sources are considered therefore to be disseminated or electrically discontinuous graphite or sulphides, which in the case of 225S contain appreciable quantities of magnetite as shown by a 3000 gamma coincident rise in the magnetic field.

A major induced polarization response from a highly conductive source was recorded centred at 250N. The chargeability and conductivity were both high to moderate, therefore little can be said as to their decay characteristics. However, it is thought to sub-outcrop and have a maximum width of less than 15 metres. The magnetic field shows a

064

peak value some 50 metres to the south of the maximum IP response. However, the general form of both anomalies suggests this area to be worthy of careful follow-up as the source is obviously conductive, chargeable material, showing some magnetic response. This anomaly is clearly positioned on the major change in resistivity referred to above. In addition, it clearly correlates with the somewhat less significant response on line 15 at 375N.

Minor responses at 825N and 975N are not considered of major interest, although the latter does show anomalous magnetic field, whose source is shallow and coincident with the chargeable response.

Line 19 - This line was surveyed between 300S and 1200N. Although observations to 1325N were recorded, they are considered unreliable due to the proximity and position of the northern current pole. A rapid transition in apparent resistivities from about 100 ohm-metres to 1500 ohm-metres takes place between 050S and 100N. South of the change, the magnetic field remains relatively undisturbed, a feature noted on many of the lines to the east. The background chargeabilities range between 20 and 30 mv/V, and show a decline from south to north.

Slightly more conductive conditions coincident with a doubling

of chargeability background occurs between 200S and the end of the surveyed line. This is considered purely formational.

At 325N a 15 mv/V anomaly was recorded from a source barely more conductive than the 1500 ohm-metres background. The chargeable material is therefore considered to be disseminated in nature.

At 475N a 25 mv/V anomaly is interpreted as coming from a source whose maximum width and depth are of the order of 20 to 25 metres respectively.

The resistivity profile infers the host to be slightly more conductive than local background. However, the 1500 ohm-metres apparent resistivity clearly infers a disseminated source.

Although lines 17 and 19 are not strictly comparable in form, this response may be equivalent to that recorded at 250N on line 17 (not as shown on contour map).

Smaller induced polarization responses at 575N and 725N are considered of marginal interest only.

A major increase in chargeability was recorded north of 1275N.

066

However, the proximity of the northern current pole throws some doubt on the validity of the magnitude of this response. The source is shallow and certainly of disseminated nature. Careful surface observations are recommended in the area.

CONCLUSIONS

- 1 - The rapid reconnaissance gradient array survey was successful in delineating zones of interest for further study. However, the large current dipoles required for efficient cover and the consequently large (50 metres) potential required to investigate the potential field, did not allow as clear a resolution of maximum depth and width for each zone of interest as the author would have liked.
- 2 - In certain areas, particularly south of the baseline (00(the resistivities were too low for the effective employment of large current dipole gradient arrays. These areas were less efficiently surveyed using multiple spaced moving source arrays which successfully located the source of the turair electromagnetic anomalies in this area.
- 3 - The 30 to 40 mv/V background chargeabilities recorded over most of the area are considered high, but not unusual in the region. Often, however, backgrounds of up to 50 mv/V

067

were recorded over extensive areas, and these are considered anomalously high, and it is suggested that these are due to finely disseminated graphite and/or pyrite.

- 4 - A wide variety of induced polarization responses were recorded in the area. Most show some reduction in apparent resistivity relative to background over the maximum induced polarization response. However, for the most part the absolute level of apparent resistivity remained high, and a disseminated source was inferred.

Only very few anomalies showed substantial conduction expected within Renison type mineralisation, including a number along the Mt. Lindsay lode. Typically these also show a marked increase in magnetic field over the anomaly, the magnitude of which is often difficult to explain by the presence of pyrrhotite alone.

- 5 - Most induced polarization responses recorded on the Mt. Lindsay grid showed an inverse relationship to local magnetic field and often significant increases in magnetic field were accompanied by increased apparent resistivity. This suggests the presence of silicification within the magnetite, or the presence of a resistive magnetite carrying rock. Significantly magnetite in chert has been recorded within the Mt. Lindsay grid area and also at Misty Valley.

- 068
- 6 - As always those zones having the obvious characteristics typical of the Renison type mineralisation should be investigated first. These include low apparent resistivities of less than 10 ohm-metres, chargeabilities in excess of twice background and an accompanying distortion in the magnetic field in excess of 400 gammas. However, anomalies having characteristics bordering on these are also suggested for follow-up on a priority basis.
- 7 - The resistivity and chargeability contour maps do not represent a unique solution, as the lines are not at frequent enough intervals to allow this. However, for the more substantial induced polarization anomalies and the most material resistivity changes, the interpretation is considered reliable. The more pronounced features should assist in the construction of a reliable geological map, while the geological mapping should also be able to confirm or modify the attempts to identify strikes by profile matching, which was the basis for these contour interpretations.
- 8 - The significance of the limited magnetic induced polarization scans carried out over zones of interest. These assumed the the source was immediately under the point of scan. Unfortunately a dipping source may well result in a significant shift of the EIP response on which the scan

was positioned. However, significantly long time decays were recorded in a number of zones, not least among them the Mt. Lindsay lode. Further tests are strongly recommended to ascertain the significance of measuring the internal decay form as an aid to distinguishing the potentially economic zones of interest from those that are not, in the Renison region.

RECOMMENDATIONS

- 1 - Based on an examination of the induced polarization, apparent relative resistivity and the total magnetic field data, the most significant induced polarization responses defined on this reconnaissance survey are as listed below. An order of priority is given and it is suggested that the remarks as to the limitations of depth, width and relative magnitude made earlier in this report should be borne in mind in the follow-up work.

Induced Polarization Anomalies of Significance

<u>Line</u>	<u>Station</u>	<u>Width</u>	<u>Max. Depth</u>	<u>Magnetic Correlation</u>	<u>Priority</u>
1	1875N	25 m	20 m.	No	B
1	1725N	40 m	70 m	Yes	B
1	1475N	40 m	?	Yes	C
1	1275N	?	30 m	No	C

Line	Station	Width	Max. Depth	Magnetic Correlation	Priority
2	1500/ 1550N	100 m?	50 m?	Yes	B
3	1300/ 1410N	110 m	20 m	No	A
3	1575N	25 m		No	C
3	1725N	25 m	25 m	No	B
3	1860N	20 m	25 m?	No	B
3	^{20 60 N} 1920N	20 m	25 m	No	B
3	2200N	70 m	40 m	No	C
4	075N	25 m	20 m	No	A
4	325N	25 m	35 m	No	B
5	00/100N	100 m	25 m	Yes	C
5	1225N	15 m?	25 m	No	B
5	1425N	40 m	25 m	No	B
5	2225N	45 m	25 m	No	B
5	2575N	50 m	40 m	No	C
5	2850/ 2975N	125 m	10 - 15m	No	A
6	050N	40 m	25 m	Yes	A
6	275N	20 m	25 m	No	A
6	1100/ 1225N	125m	40 m	No	B
7	075N	30 m	25 m	No	A
7	1275N	40 m	35 m	No	A
7	1750N	75 m	35 m	No	C
7	2275N	15 m?	20 m?	No	C

Line	Station	Width	Max. Depth	Magnetic Correlation	Priority
7	2475/ 2775N	300m	25 m	No	B
8	1075N	25m	25 m	No	A
8	1375N	25m	30 m	Yes	AA
8	1775N	40m	25 m	No	B
8	2500/ 2675N	175m	25 m	No	C
8	3200/ 3350N	150m	35 m	No	A
8	3425N	25m	25 m	No	B
9	490N	25m	25 m	No	C
9	800N	30m	25 m	No	C
9	900N	40m	25 m	No	C
9	1050/ 1200N	150m	40 m?	Yes	B
9	1925N	25m	25 m	No	B
9	2675N	70m	50 m	No	A
9	3360N	150m	80 m	No	A
10	575N	40m	25 m	No	C
10	775N	40m	25 m	No	C
11	250S	?	25 m	No	B
11	575S	?	25 m	No	B
11	275N	25m	25 m	No	C
11	675N	50m	50 m	Yes	B
11	875N	50m	25 m	No	C
11	1125N	60m	25 m	Yes	C

Line	Station	Width	Max. Depth	Magnetic Correlation	Priority
11	1275N	75m	25 m	No	B
11	2040N	25m	25 m	No	C
11	2550/ 2750N	200m	?	No	B
11	2975N	25m	25 m	Yes	A
11	3175/ 3375N	300m	40 m	No	A
12	206S	?	20 m	No	A
12	390S	?	25 m	Yes?	A
12	500S	?	25 m	No	B
12	1125N	?	10-15 m	Yes	A
12	1500N	?	25 m	Yes	A
13	030N	10m	10 m	Yes	A
13	915N	80m	30 m	Yes	C
13	1425N	35m	25 m	Yes	C
13	2025N	30m?	35-40 m	Yes	A
13	2140N	?	30 m	Yes	A
13	2275N	35m	25 m	Yes	A
14	040S	?	10 m	No	B
14	210S	?	10 m	No	B
14	425S	?	25 m	No	C
14	550S	?	25 m	No	C
14	675S	?	25 m	?	A
14	1340N	?	25 m	No	C
14	1810N	?	25 m	No	B

073

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Page - seventy

Line	Station	Width	Max. Depth	Magnetic Correlation	Priority
14	2010N	?	20 m	Yes	A
15	410N	?	25 m	No	C
15	1125N	50m	40 m	Negative	A
15	1240N	35m	30 m	No	C
15	1775N	20m	10 m	Slight	A
15	1875N	20m	10 m	Yes	A
15	2025N	20m	20 m	Yes	B
17	525S	30m	25 m	No	B
17	225S	35m	25 m	Yes	B
17	360S	35m	25 m	No	C
17	250N	15m	10 m?	Yes	A
19	325N	20m	25 m	?	C
19	475N	20m	25 m	?	B
19	1275N	?	15 m	?	B?

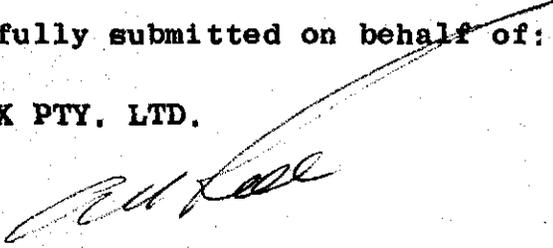
2 - A screening of the above is suggested using geochemical sampling on a close spacing over the limits of the anomaly, as well as such detailed geological mapping as the limited outcrop allows.

3 - Prior to expensive examination by diamond drilling, consideration should be given to local detailing of those zones considered to be of potential economic interest as judged by the follow-up ground investigations

recommended in (2) above. Because, with the exception of those areas surveyed by moving source arrays, it should be recognised that this was a reconnaissance survey, and limitations as to relative magnitude, position and maximum depth naturally result. Further work would fix position, width, maximum depth and magnitude of response with far greater accuracy, and would materially help in the delineation of major zones of interest for further examination by diamond drilling.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.


A.W. HOWLAND-ROSE, MSc, DIC, AMAusIMM, FGS.

GEOPHYSICIST

075

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SECTION II
APPENDICES 'IP' and 'IPR-8'
PLATES 1 TO 3 ✓

OPEN FILE

076

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APPENDIX 'I.P.'

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INTRODUCTION

For the benefit of those who are unfamiliar with the Induced Polarization method in general, or with the pulse-type method in particular, a few introductory remarks will be directed on the Induced Polarization, or overvoltage, phenomenon. Those who wish a fuller treatment of the subject are directed to Seigel (1962), which paper also includes an extensive list of references.

Induced Polarization in its broadest sense means a separation of charge to form an effective dipolar (polarised) distribution of electrical charges throughout a medium under the action of an applied electric field. When current is caused to pass across the interface between electrolyte and a metallic conducting body, double layers of charge are built up at the interface, in the phenomenon known to electrochemists as "overvoltage". This is the phenomenon which can be utilised for the detection of metallic conducting, rock-forming, minerals such as most sulphides, arsenides, a few oxides and, unfortunately, graphite. In addition, effective dipolar charge distribution occurs to some extent in all rocks, due to ion-sorting in the fine capillaries in which the current is passing.

078
Page - two

Induced Polarization responses may therefore arise from metallic or non-metallic agencies. Fortunately, the latter generally falls within fairly low and narrow limits. for almost all rock types, although there is still no reliable criterion for differentiating overvoltage responses from graphite and metallic sulphides, or for distinguishing between the responses of one type of sulphide and another. Despite these limitations the Induced Polarization method has amply demonstrated its value in mineral exploration since its initial development as a useful exploration tool in 1948 (ed. Wait, 1959).

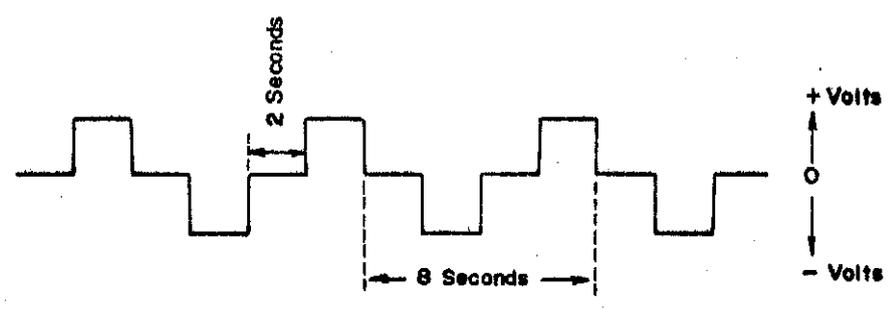
DESCRIPTION OF METHOD AND EQUIPMENT

For the present programme the pulse or time domain system was employed, using a Scintrex Induced Polarization unit. The standard current-wave form with the unit is two seconds on-time and two seconds off-time. (see Figure 1). This unit features the Newmont type self-triggered receiver which operates remote from the current transmitting equipment. Three fundamental quantities are measured with this unit - the chargeability of 'M' measurement, the 'L' measurement and the resistivity.

The receiver integrates the area under the decay curve during the time interval from 0.45 seconds to 1.1. seconds

079

MEASUREMENTS TAKEN



Energising frequency is a square wave having a frequency of 0.125 cps.

FIELD MEASUREMENTS MADE

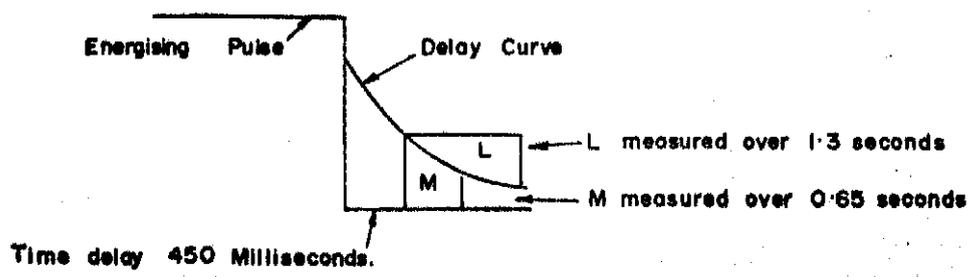


Fig. 1

080

Page - three

after termination of the primary current pulse. This integral normalised with respect to its corresponding primary voltage is the chargeability or 'M' measurement, that is, the fundamental Induced Polarization characteristic. It is in units of milliseconds. The Induced Polarization phenomena is dependent on the existence of electronically conducting material within the matrix of ionically conducting material. The chargeability is therefore a measure of the presence of electronically conducting material within the ground being tested.

The second quantity measured is the area over the transient decay curve between 0.45 seconds and 1.75 seconds of the current off-time. This measurement is designated the 'L' measurement and is also in units of milliseconds. The ratio L/M gives a curve factor related to the shape of the transient voltage curve, and is a measure of the rate of decay of the transient voltage. This is of secondary diagnostic value in that the rate of decay of the transient voltage is partially a function of particle size. A large L/M ratio reflects a short time constant, commonly associated with finely disseminated sulphide or graphite, whereas a small L/M ratio reflects the longer time constants associated with the larger sized metallic particles.

Page - four

The L/M ratio is also effective in determining the presence of electromagnetic coupling effects. With the Scintrex Induced Polarization unit, electromagnetic coupling effects are essentially eliminated by an 0.45 second delay-time following termination of the primary current pulse before measurement of the transient voltage commences. However, in extremely low resistivity areas coupling may occur. Under these conditions the presence of electromagnetic coupling can distort the Induced Polarization response, and it is extremely important to know when this occurs. The presence of such coupling is immediately recognizable from the L/M ratios.

Resistivity measurements are also made as an integral part of all Induced Polarization measurement using the Scintrex Induced Polarization unit. The resistivity values are of primary importance in determining subsurface geological features such as contact zones, faulting, etc., and are of assistance in mapping the geology in general.

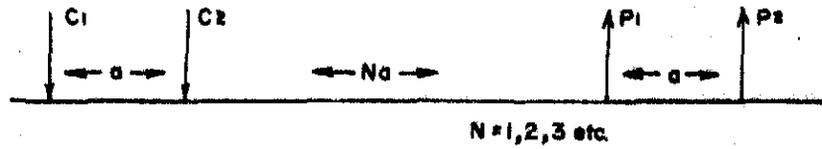
Electrode geometries (see Figure 2) utilised in obtaining field measurements are important and no one electrode array is applicable for all conditions. In areas where a low resistivity oxidised surface layer overlies a much higher resistivity freshrock, a high degree of

082

COMMONLY USED ELECTRODE ARRAYS

CLOSE - COUPLED ARRAYS

DIPOLE - DIPOLE



POLE - DIPOLE



GRADIENT ARRAY

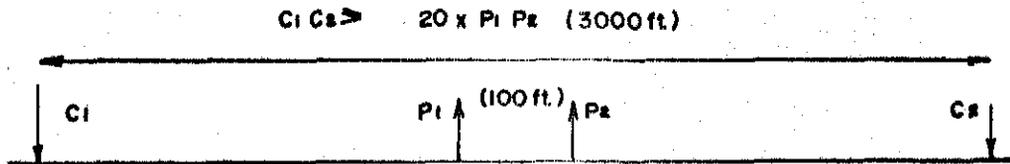


Fig. 2

083
Page - five

masking occurs using any of the close-coupled arrays, such as pole-dipole or dipole-dipole. An electrode spacing many times greater than the depth to freshrock must be used in order to obtain responses reasonably representative of the freshrock. With such large electrode spacings the physical properties are effectively averaged over so large a volume that we lose the ability to detect moderate sized bodies of polarizable material. However, under these conditions the gradient array is both feasible and desirable in that it minimises the effects of masking and at the same time has a high degree of resolution for small targets.

In the present areas of investigation, abnormal induced polarization responses may be expected to arise from the electronically conducting sulphide minerals such as pyrite, pyrrhotite, chalcopyrite and pentlandite, plus graphite and magnetite. The response from magnetite has been found to be quite variable and somewhat unpredictable, reflecting the great variation in the mode of electrical conduction in this material. It is not always possible to differentiate between these potential sources of high chargeability from the Induced Polarization and resistivity data alone. Complementary geophysical, geochemical and geological data enable a more complete interpretation to be made of the Induced Polarization data.

Page - six

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"Overvoltage Research and Geophysical Applications" editor J.R. Wait, Pergamon Press, London, 1959.

085

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APPENDIX IPR-8

I INTRODUCTION

The basic equipment required for an Induced Polarization survey consists of a transmitter, a receiver, wire and electrodes.

Most time domain induced polarization transmitters transmit square waves with equal "on" and "off" times. Polarity is automatically changed between the pulses. The waveform shown below indicates how the current is usually transmitted. The pulse times range from 1 to 8 seconds.

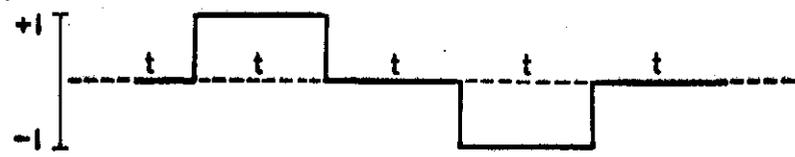


FIGURE 1A

The transmitter is powered by batteries (portable type units or a motor driven generator. Scintrex manufactures various time domain induced polarization transmitters ranging in power from 25 watts to 15 kW. The choice of a transmitter depends on various factors such as: the electrode spacings to be employed, contact resistance and the resistivity of the subsurface. The IPR-8 receiver is designed for use with any time domain induced polarization transmitter.

The IPR-8 time domain induced polarization receiver is of the state-of-the-art design, packaged in a rugged and portable manner. Using integration and automatic normalization, it measures the characteristics of an induced polarization decay curve set up by overvoltage and other effects occurring in rocks. When induced polarization effects (such as due to metallic-non metallic interfaces in rocks) occur, the waveform received at the receiver is not the same square wave as transmitted by the transmitter. The waveform shown below indicates the sort of wave distortion which is caused by the induced polarization phenomena.

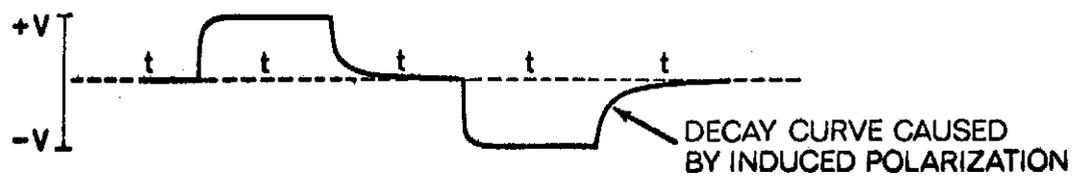


FIGURE 1B



087
IISPECIFICATIONS

The IPR-8 has the following specifications:

Input Impedance	3 megohms
Primary Voltage (Vp) Range	300 microvolts full scale to 40 volts full scale in 10 ranges
Accuracy of Vp Measurement	$\pm 3\%$ of full scale
Vs/Vp Ranges	20 and 100 mV/V full scale
Vs/Vp Accuracy	$\pm 3\%$ of full scale
Primary SP Buckout Range	± 1 volt
Accuracy of SP Measurement	$\pm 3\%$, ± 5 mV
Automatic SP Tracking Range	6 x Vp, maximum ± 1 volt
Continuity Meter Reading	0 - 500 k ohms
50 or 60 Hz Powerline Rejection	-50 db (300x)*
Low Pass Filter	6 db/octave with $f_c = 20$ Hz and 12 db/octave with $f_c = 36$ Hz
Required Stability of Transmitter Timing	Need only exceed measuring program selected (1 or 2 seconds)
Operating Temperature Range	-30°C to +60°C
Dimensions	320 mm x 135 mm x 160 mm
Weight, Complete with Lid and Batteries	3.6 kg
Power Supply	4 D cells - Eveready No. 1050 or equivalent; estimated battery life 2 months intermittent duty at 25°C 1 Alkaline cell Eveready No. E91 or equivalent; estimated life 1 year

* 50 or 60 Hz depending on power system.



III QUANTITIES MEASURED BY THE IPR-8

Figure 2 shows the different parameters measured by the IPR-8. The usual measurements are V_p , the received primary voltage and "M", a parameter related to the transient curve. The V_p measurement is used in resistivity calculations while M is the chargeability (induced polarization) parameter. In addition, absolute values of the self-potential (SP) can be measured.

In all cases, the M quantity measured by the IPR-8 is the mean value of the transient voltage over a selected time interval to which the following normalizations have been applied:

- normalization for the length of the integration interval
- normalization for the primary steady state voltage (V_p)
- normalization for curve shape
- normalization for number of pulses

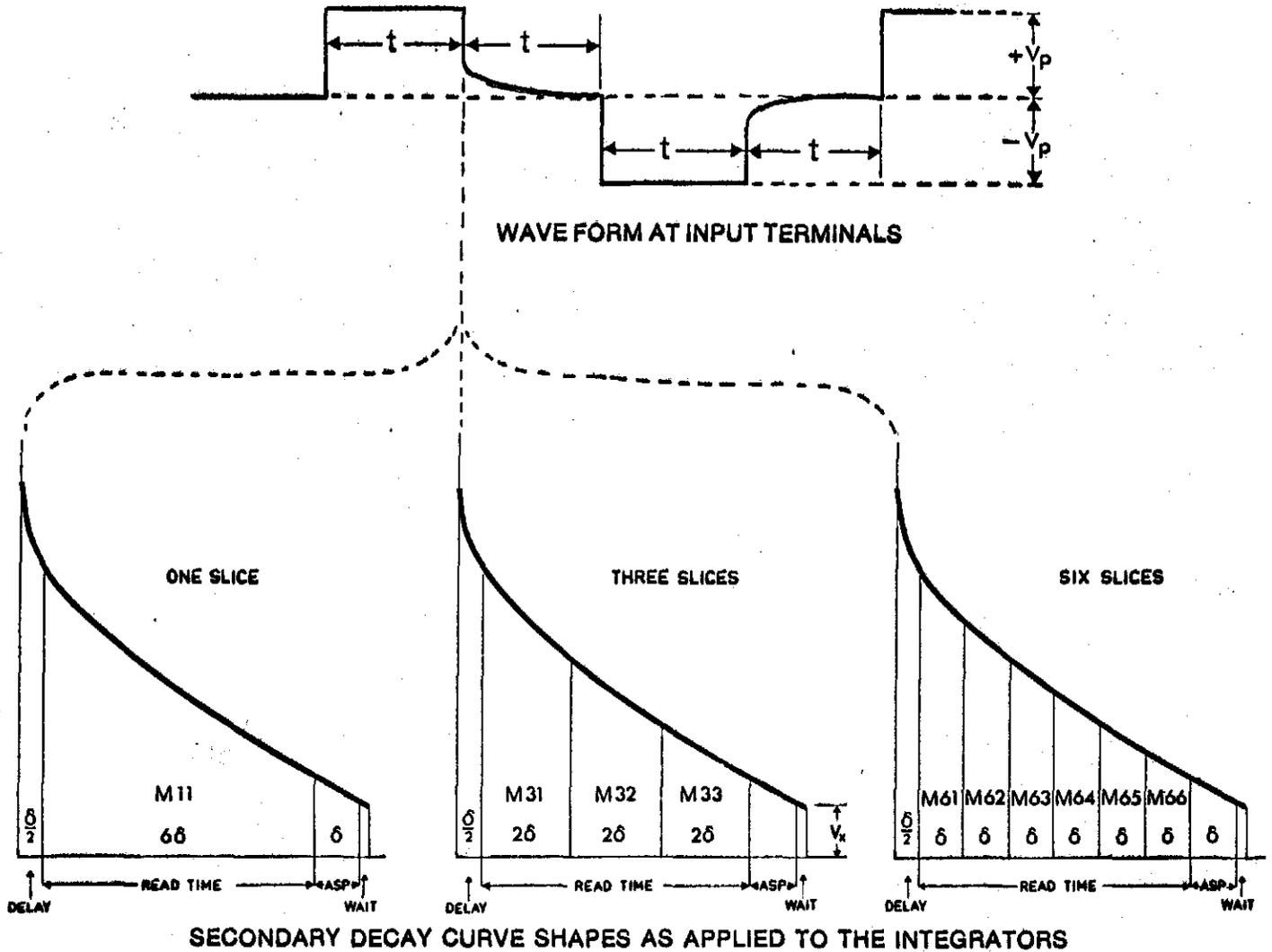
The units of the quantities measured are, therefore, dimensionless and are normally expressed in "millivolts per volt".

In the various modes of operation the transient voltage following the interruption of the primary current pulse is either integrated over one long period of time or sliced into either 3 or 6 slices. By using 6 slices, a good record of the decay curve shape can be obtained. The 3 slice mode gives some curve shape information and provides an economical standard mode in which to operate. The centre slice of this mode is reasonably close to the measurement made by the Scintrex IPR-7 and other receivers of the "Newmont Type", while the first and last slices can be used for a rapid check of curve shape. A more precise relationship is, however, presented later in this section.

Figure 2 shows the actual times used. For the receiver to operate, the transmitter timing may be any time period of one second or greater (i.e. $t \geq 1$ second) although transmitter and receiver timings of 2 seconds are considered normal for most surveys. Equal on and off timing assures the best noise rejection as the signal is averaged over the longest possible time, and the automatic self-potential adjustment is made closest to the reading time.

With the receiver set at $t = 1$ second, the decay ($\delta/2$) from the current-off time to the commencement of the measurement is 65 milliseconds and the slice width (δ) is 130 milliseconds. With the receiver set at $t = 2$ seconds the delay is 130 milliseconds and the slice width is 260 milliseconds. Fuller information on the programs is available from the tables in Figure 2.





t sec.	delta	delay time	waiting time	M 11				M 31			M 32			M 33			length
				from	to	mean	length	from	to	mean	from	to	mean	from	to	mean	
1	130	65	25	65	845	455	780	65	325	195	325	585	455	585	845	715	260
2	260	130	50	130	1690	910	1560	130	650	390	650	1170	910	1170	1690	1430	520

t sec.	M 61			M 62			M 63			M 64			M 65			M 66			length
	from	to	mean	from	to	mean	from	to	mean	from	to	mean	from	to	mean	from	to	mean	
1	65	195	130	195	325	260	325	455	390	455	585	520	585	715	650	715	845	780	130
2	130	390	260	390	650	520	650	910	780	910	1170	1040	1170	1430	1300	1430	1690	1560	260

FIGURE 2
PARAMETERS MEASURED WITH TIMES OF RECEIVER PROGRAM
IN MILLISECONDS.

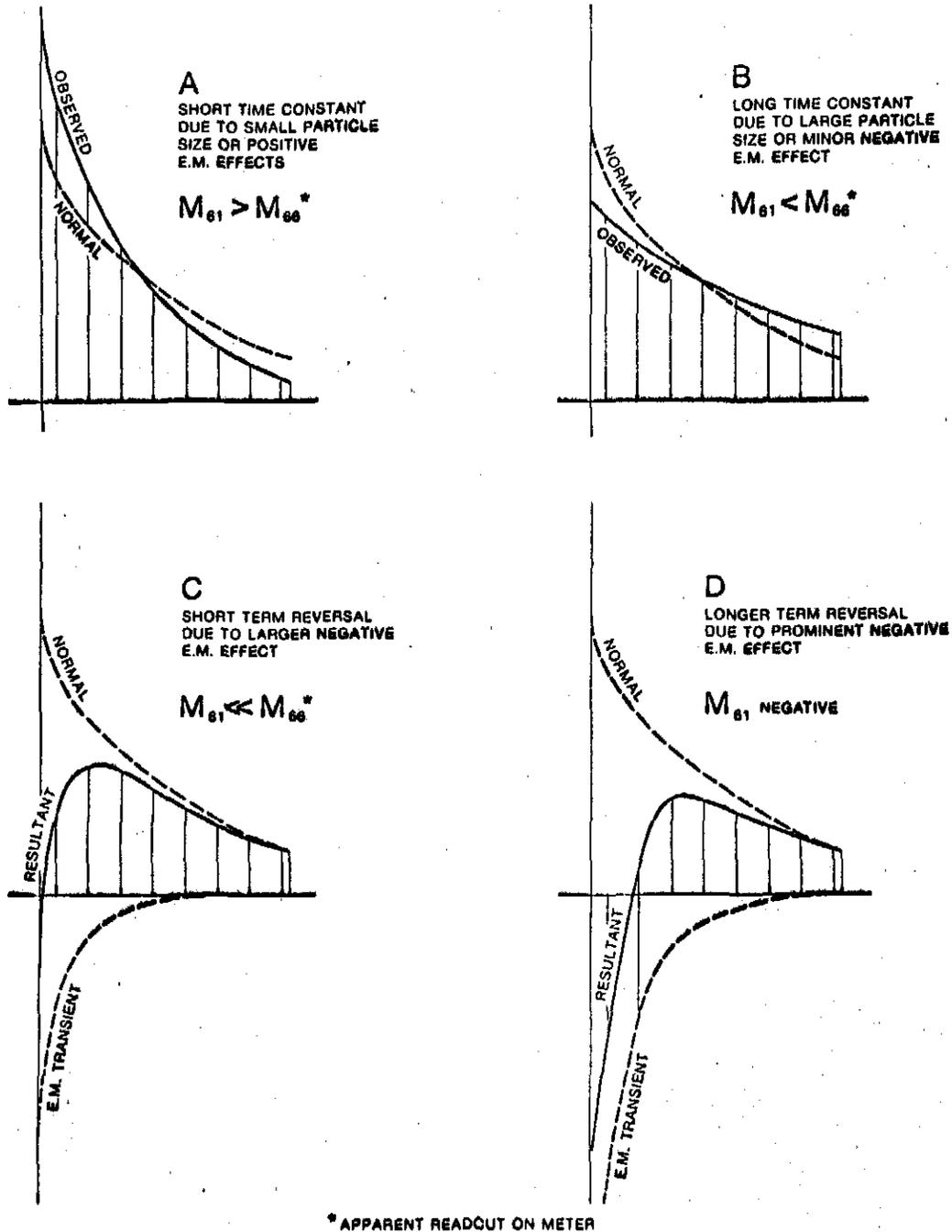


FIGURE 3

THE SIGNIFICANCE OF CURVE SHAPE INFORMATION GAINED USING 6 SLICE READINGS.

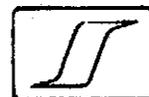
Each integration is normalized with respect to the Standard Induced Polarization Decay Curve which has been established by Newmont Exploration Limited. (ref. Dolan and McLaughlin in bibliography) This is achieved by choosing the sensitivities of the integrators so, that if the curve shape is normal, all slices within a given mode show the same amplitude of measurement. A further normalization is built in for the slice width, be it full, one-third or one-sixth of the total integration period. The net effect is that the reading will be the same regardless of the slice measured, providing that a standard transient decay curve form is present and that the same measuring cycle is used for transmitter and receiver (1 second or 2 seconds). Any departure from this standard curve form will be immediately obvious to the operator, without performing any calculations. For instance, a steeper decay will give a higher reading on earlier slices than on later slices. Reconstruction of the actual decay curve is easily effected by using the correction factors given in Table 1.

The shape of a time domain induced polarization decay curve can be altered by electromagnetic or interline coupling, by variations in the average size or degree of interconnection of the metallic particles in the bedrock or by other I.P. sources. Figure 3 illustrates the advantage of breaking the decay curve into slices. Utilizing only one wide slice, there is no indication of the shape of the decay curve. Positive electromagnetic coupling effects or small particle size may give rise to an abnormally short time constant (Case A) which, for multi-slice modes will be indicated by higher normalized readings of the earlier slices with respect to the later slices. An increase in the later slices over the earlier ones (Case B) may imply a longer time constant due to a minor negative EM transient or I.P. responses from large metallic particles, etc. Cases C and D, where the values of the initial slices are considerably reduced or are even negative, show the effect of negative EM transients of increasing amplitude.

A system of symbols has been created to indicate each of the measurable slices.

The general symbol is M_{txy} where:

- t is the timing chosen (i.e. 1 or 2 seconds)
- x is the number of slices in the mode chosen (i.e. 1, 3 or 6)
- y is the number of the slice referred to (i.e. 1, 2, 3, 4, 5 or 6)



Wherever two subscripts only are given, eg. M_{32} , it is understood to apply equally for $t = 1$ sec. or $t = 2$ sec.

A chargeability reading is defined by the following formula:

$$M = \frac{V_s \cdot 1000}{V_p} \quad \text{in mV/V}$$

where $V_s = \frac{t_1 \int^{t_2} V_s dt}{t_r} + V_x$

and $t_1 =$ time at beginning of slice

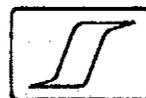
$t_2 =$ time at end of slice

$V_x =$ residual transient voltage at the end of the automatic self potential correction

$t_r = t_2 - t_1$, i.e. the integrating period

Chargeability values, uncorrected for curve shape, can be easily calculated if required. Normalizations for all slices are made using the M_{232} value as reference. In other words, there is no curve shape normalization applied to this slice; the M_{232} readout is, therefore, directly as measured. The same statement holds for the M_{132} slice, however, its value is one-half the value for M_{232} provided that the transmitter timing matches the receiver timing.

To restore the true transient curve shape (M true), the observed M readings (M read) are multiplied by the factors in Table 1.



093

TABLE 1

$$M_{\text{true}} = M_{\text{read}} \cdot k_1$$

Slice	k_1
M ₁₁	1.09
M ₃₁	1.47
M ₃₂	1.00
M ₃₃	0.81
M ₆₁	1.68
M ₆₂	1.27
M ₆₃	1.06
M ₆₄	0.94
M ₆₅	0.85
M ₆₆	0.78

← NORMAL

For the ideal "normal" I.P. transient curve form $M_{2xy} = 2M_{1xy}$ where M_{2xy} is for a 2-second on-off transmitter cycle and M_{1xy} is for a 1-second on-off cycle. The relationship between readings taken with differing transmitter and receiver timings is more complicated, particularly if the curve shapes are not normal.

Table 1 still applies for the case where the transmitting times are longer than the receiving times in order to reconstruct the relative curve shape.



094

Relationship between IPR-8 and
"Newmont Type" Receiver Measurements

The "Newmont Type" receivers (eg. Scintrex IPR-7) integrate the area under the transient curve from 0.45 seconds to 1.1 seconds. This is then multiplied internally by an instrumental factor to obtain the chargeability M in milliseconds.

For a normal decay curve form, the approximate relationship between the IPR-8 measurements and the Newmont Type chargeability is given by M_{232} (in mV/V) = M_N (in milliseconds) • 0.7.





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GEOPHYSICAL CONSULTANTS AND CONTRACTORS

February, 1974

THE MAGNETIC INDUCED POLARIZATION METHOD

by

Graham Linford, Ph.D.

I - THE METHOD

Magnetic induced polarization (MIP) is essentially a completely new geophysical method, that gives in general, a more fundamental measurement than electrical induced polarization (EIP), and eliminates or minimizes most of the present problems with EIP in extreme conditions. In this respect, its advantages are such that it should revolutionize exploration procedures in these extreme electrical conditions.

To understand the basic concept of MIP and its advantages, it is simplest to consider current flow in the time domain (pulse) as illustrated in Figure 1. Firstly, beginning with EIP (Figure 1a), the primary current I_p flowing in the ground, produces within a chargeable body, opposing induced current dipoles. The constant relating the primary current to the opposing induced current dipole, is the chargeability of the body.

When the primary current is switched off, these induced current dipoles discharge in return current loops forming secondary currents. It is noteworthy that returning currents have the same direction as the primary current while the interior current inside the chargeable body formed by the induced current dipoles, is in the opposite direction.

With EIP we measure the electrical potential drop due to the current flow at the surface with two potential electrodes. When the primary current is on, the primary voltage drop V_p is measured, and when off, the secondary voltage drop V_s due to the secondary current is measured; the apparent chargeability M is the constant relating V_p and

ILLUSTRATION OF CURRENT FLOW WITH M.I.P & E.I.P

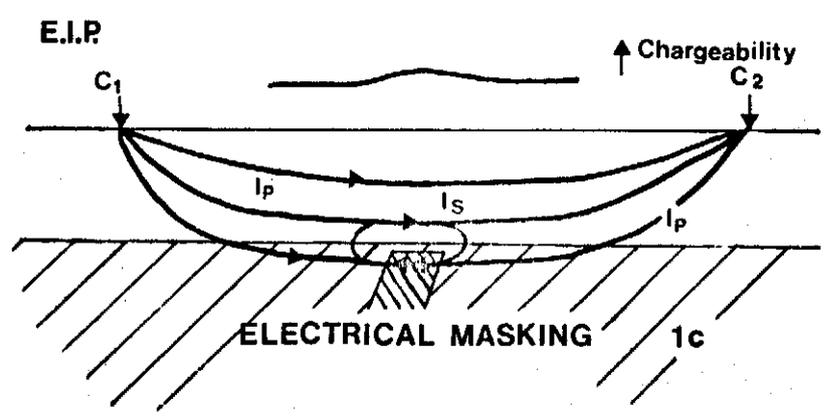
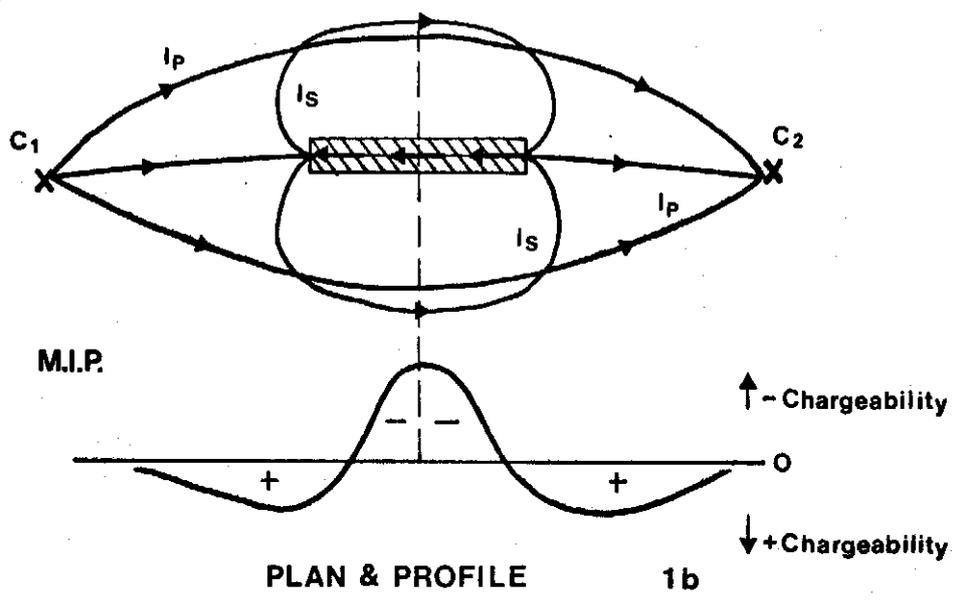
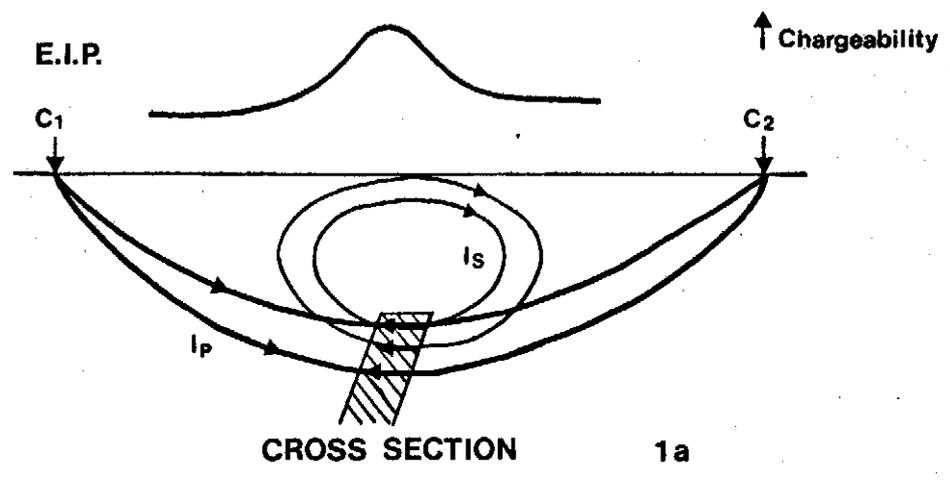


FIGURE 1

097

V_s . The maximum chargeability is observed immediately above the body where the return current is strongest.

With MIP exactly the same current electrodes as EIP are used, but instead, if there is a preferred horizon they are normally placed on line with it. In Figure 1b, a plan view, the primary current I_p produces opposing induced current dipoles in the chargeable body. When the primary current is switched off, the interior current dipoles which form essentially a line current, discharge as the return current loops on either side of the chargeable body.

When the primary current is on, its associated primary magnetic field H_p is recorded, and when off, the secondary magnetic field due to polarization currents in the ground. If a profile is surveyed across the body, the return currents on either side of it, produce positive chargeability, but over the body, the concentrated interior polarization current dominates and a negative chargeability is observed. Present convention, is to plot negative chargeability up and positive down, so an anomalous profile as shown in Figure 1b is produced.

Thus in contrast to EIP which only measures the electrical voltage due to the return currents, MIP measures the magnetic responses due to the fundamental polarization current within the chargeable body and its return currents. Being able to measure the negative magnetic field due to the polarization current within the chargeable body a far more fundamental measurement with associated characteristics is obtained.

From the above outline, the advantages of MIP over EIP become immediately evident:

With EIP electrical masking is a major problem where the overburden and/or weathered rock is highly conducting in comparison to the second layer or fresh rock within which the chargeable material of interest occurs. Here, the return current is short-circuited immediately within the bottom of the conducting layer, and little or no return current reaches the surface, as shown in Figure 1c.

This short-circuiting of the return current occurs regardless of what power is pumped into the ground or even if the current electrodes are put down drill-holes.

With MIP the same thing occurs with the return current, but we can still measure the magnetic field due to polarization currents at depth, i.e. the negative interior current flow and the return currents on either side, so that the basic anomalous response remains.

Another electrical problem is in regions with a highly resistive surface layer, such as sand. Here little potential electrode contact can be achieved resulting in little return current near the surface and capacitive coupling. With MIP, the detecting magnetometer needs of course no ground contact, thus eliminating the problem.

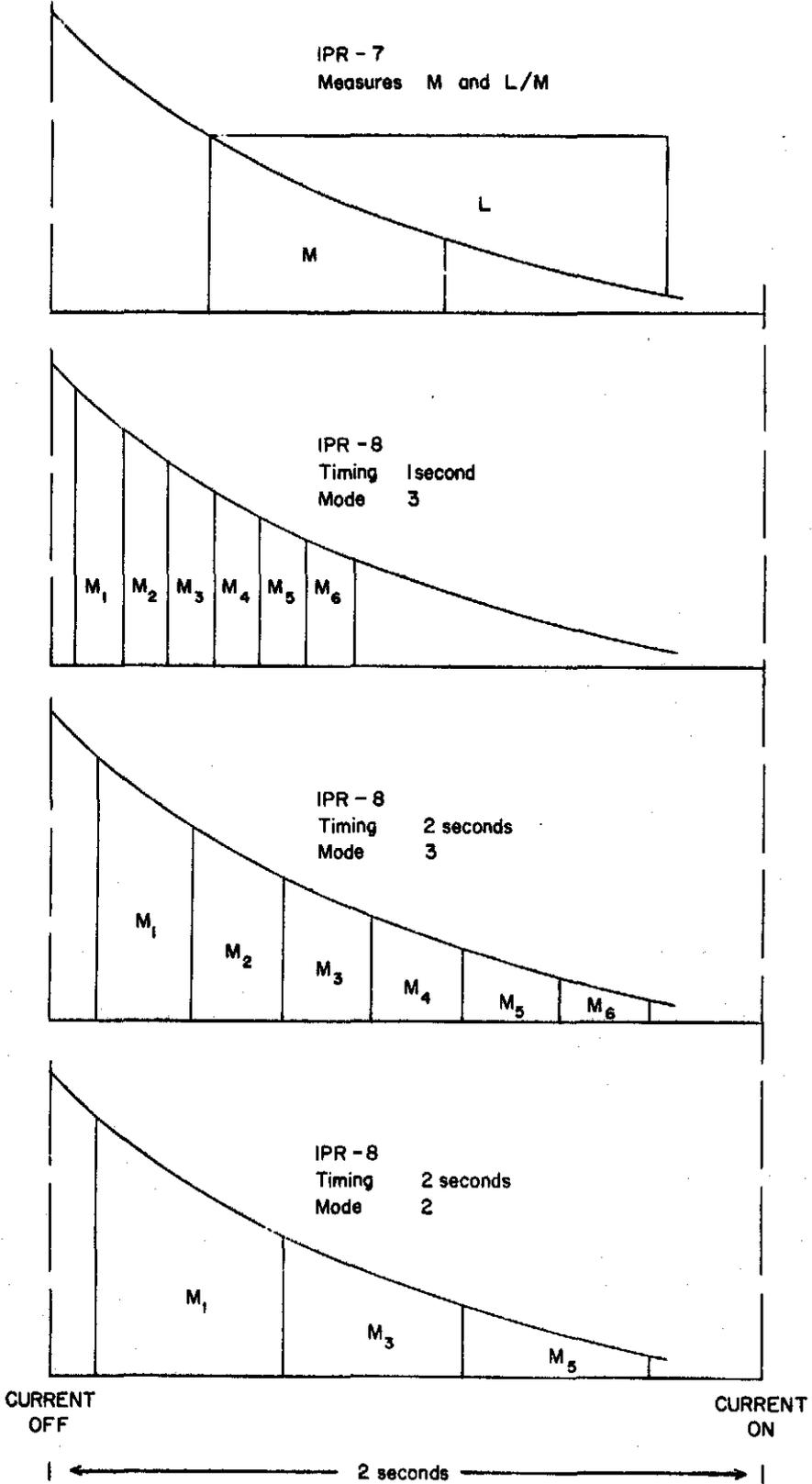
EIP is basically a surface phenomenon depending on the number of chargeable particles so that it emphasizes disseminated rather than massive sulphides. MIP in contrast is an interior current measuring system and so will emphasize massive sulphides in the presence of disseminated sulphides, because of the larger interior currents.

The final advantage of MIP is that we measure the characteristics of the interior polarization current rather than its return current. That is, a more fundamental measurement is achieved, and unique decay curve characteristics of the interior current are obtained. With EIP these characteristics are distorted or filtered by the medium through which it passes so that most of this detail is lost.

II - INSTRUMENTATION

A Scintrex MFM-3 fluxgate magnetometer with a sensitivity of 5 milligammas is used to measure the magnetic field with the ambient magnetic field being biased out. The resultant time dependent signal that represents the varying magnetic field due to the inducing and induced currents as well as any geomagnetic fluctuation, is connected to the IPR-8 receiver. The IPR-8 has its own buck-out for the geomagnetic variations.

The primary current into the ground is a standard two seconds on-off wave form. Using the IPR-8 receiver, the primary magnetic field H_p due to the primary current I_p flow in the ground is measured. When this is switched off, the decaying secondary current produces a secondary magnetic H_s . The IPR-8 receiver can measure up to six slices in the decay curve produced by the secondary magnetic field as shown in Figure 2. Each slice is normalized for a standard decay curve and the primary magnetic field, to give the chargeability parameter. The important application of decay curve information is where various minerals have different decay rates. This is often spoken of in terms of changing rates or frequency components. With the IPR-8 the multiple channel readout provides an immediate field indication of an anomalous curve shape. The various slices of the decay curve are equivalent to a frequency sweep.



MEASUREMENT OF DECAY CURVE
2 SECOND PULSE

FIGURE 2

101
III - FIELD PROCEDURE

A longitudinal current array is normally applied so that the primary current is passed along the long axis or strike direction of sulphide bodies likely to be encountered in the survey area. A fixed current electrode configuration is employed with current electrodes separated by $2A$ where A is the minimum length of bodies desired to locate in the survey area. If there is one well defined horizon of interest then the current electrodes are normally placed reasonably on this line. The cable joining the current electrodes may be the shortest distance between them, or when a single well-defined horizon of interest is present, then the current is layed in a U shape avoiding the horizon. In this way the magnetic field from the cable will not obscure polarization responses arising from a deposit on the favourable horizon.

With a current electrode separation of $2A$, a block about $2A$ long x A wide may be covered. This is not a rigid limitation however, and they may be exceeded somewhat providing the magnetic field has an adequate strength.

The horizontal magnetic field at right angles to the current flow is measured, that is, along the direction of the survey line. The distance between stations may vary between 30 and 60 metres depending on the size of body of interest and its depth.

The following parameters are used:

The normalised magnetic field H_N is calculated from the primary magnetic field H_p by dividing it by the magnetic field that would be observed for the given current if a uniform medium existed. That is, if uniform conductivity existed in the ground, the value of H_N would be 1.00 at all locations. This parameter is a dimensionless quantity and is expressed in a percentage.

The chargeability M is expressed in terms of milligammas per gamma, being the ratio of the secondary magnetic field for a particular slice divided by the primary magnetic field.

The normalised secondary magnetic field H_S is the H_p value times chargeability M divided by the primary current I_p , ($H_p M / I_p$) and is expressed in milligammas per ampere, for each slice of M measured. The sign convention for presentation of the MIP chargeability is, where the polarization response observed is due to the fundamental polarization current within the chargeable body, the sign of the chargeability is negative, and where the return current response dominates, the chargeability response is positive. That is, the sign is as observed with the IPR-8 receiver.

CASE HISTORIES

Sherlock Bay - Western Australia

MIP test work was carried out over this nickel-copper sulphide deposit where earlier electrical induced polarization in 1971 had shown a serious electrical masking problem. The survey area is over, in part, tidal mud flats and the rock beneath the surface layers is relatively fresh. The land is flat and covered by alluvial sand gravel to a variable depth averaging about 12 metres. The rock is weathered but fresh rock is encountered about 30 metres subsurface. The nickel copper sulphide deposit is contained within volcanic and mafic intrusive rocks forming part of the Archean Pilbara block of NWW Australia.

The ore is quartz magnetite-amphibole-chlorite sulphide schist enclosed with an ophiolite sequence. Drilling has intersected mineralization in two contiguous zones with a total length of about 5000 ft., an average of at least 50 ft., and an almost vertical depth of about 3000 ft. The average grade of nickel is .5% with a nickel:copper of 5 : 1. There is .6% chalcopyrite and 5% magnetite and 4% pyrite.

103

The Sherlock Bay Figure 3 presents the time domain MIP results on Line 68E and the EIP gradient array results on Lines 40E and 68E. The geology shown at the surface is based on the drill intersections expolated from 300 ft. and 2000 ft. subsurface. There is a small displacement but this is due to the ore body snaking vertically.

Line 40E is a genuine EIP case history showing a weak IP anomaly. To the east this weak anomaly is gradually lost because of increased electrical masking and on Line 68E, the EIP chargeability and resistivity are almost uniform illustrating the classic masking problem.

With the MIP on Line 68E a well defined anomalous chargeability response is shown about 26N over the known mineralization. This profile illustrates that the electrical masking problem due to a conducting overburden can be eliminated with the MIP method, and meaningful and resolving H_N and M data can be obtained in areas where previously with EIP little useful information was received.

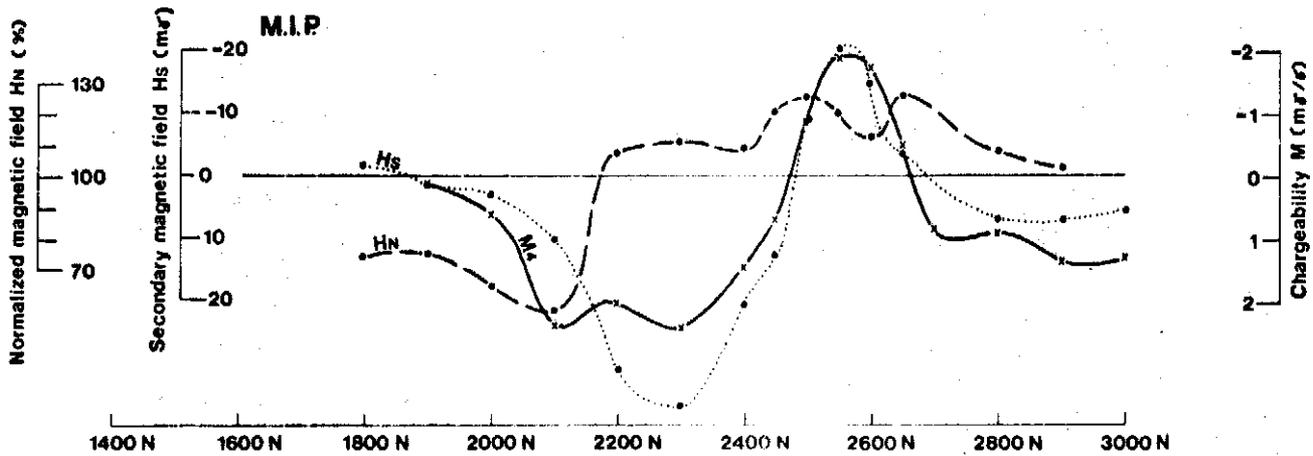
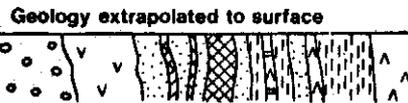
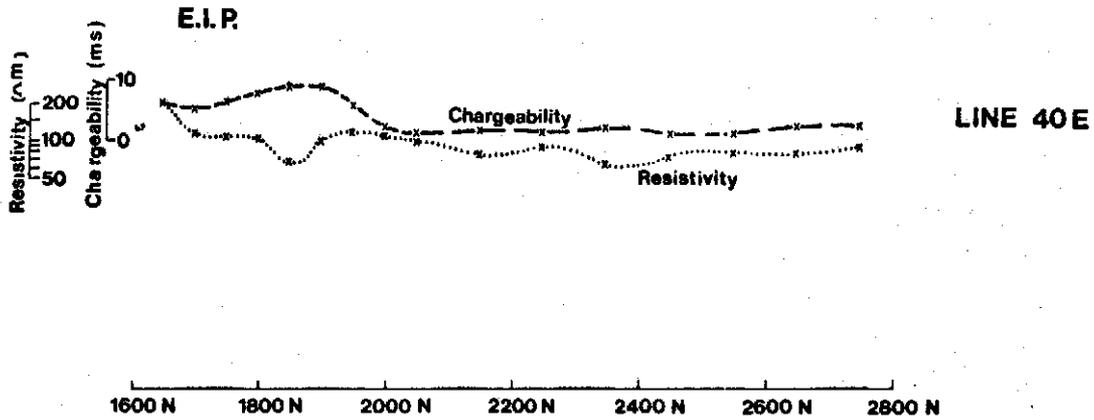
Jan Shoot - Kambalda, Western Australia

Figure 4 presents the MIP profile and geological cross-section over this small ore body. Its strike length is 400 ft. and the geology of the area is complex; the massive nickel sulphides are in talc carbonate and are surrounded by graphitic and sulphidic sediments.

The MIP data shows two significant chargeability anomalies at 4N and 0.5N over the nickel sulphides. The normalized magnetic field indicates that little primary current is flowing through the ore bodies. Most of the primary current is flowing in conducting sedimentary bands to the north.

These results merely illustrate the application of the method in a simple case history, there being no real geophysical problem in this area.

SHERLOCK BAY M.I.P TESTS



- Ni-Cu sulphides
- Graywacke, siltstone, quartzite
- Andesite flow
- Andesite tuff
- Rhyolite tuff

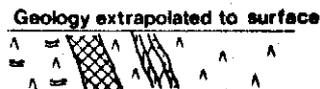


FIGURE 2

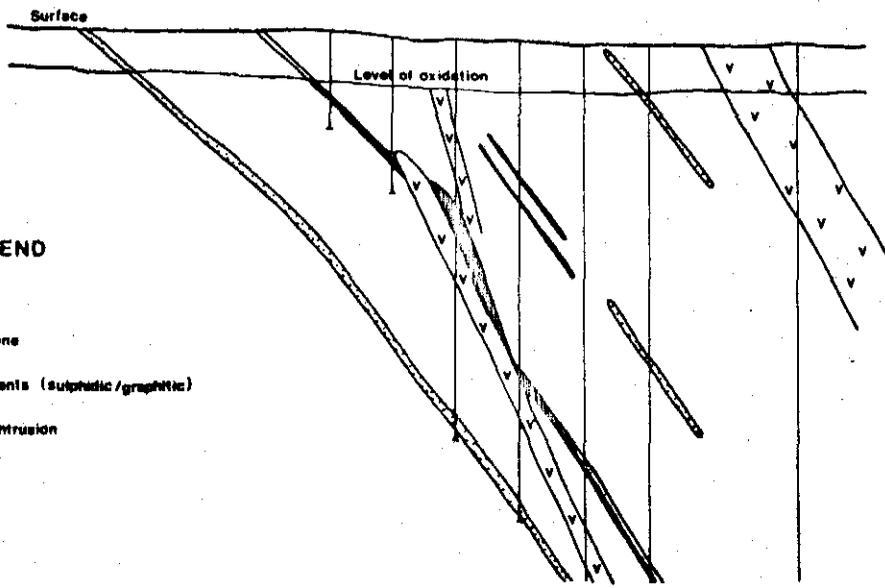
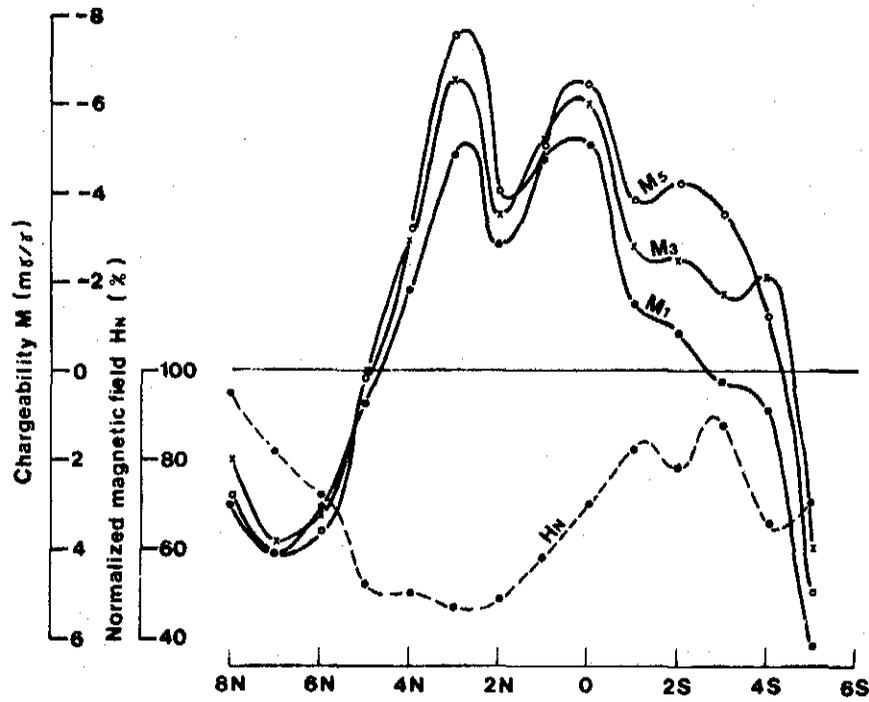
105

548106

JAN SHOOT-COGGAN GRID

M.I.P TESTS

TIME DOMAIN : $t = 2$ second pulse
 $C_1 C_2 = 800'$



LEGEND

-  Ore zone
-  Sediments (sulphidic/graphitic)
-  Mafic intrusion

FIGURE 4

Lake Lefroy - Hunt Shoot - Western Australia

Figure 5 shows a general plan of the Hunt Shoot at Lake Lefroy, Western Australia and the surveyed MIP profile and geological section from drilling.

Massive and disseminated nickel ore occur on or about the faulted contact between the ultramafic and basalt. The lake sediments are 10 - 15 ft. thick and the level of oxidation is 90 - 100 ft. The three ore bodies are shown in plan which by and large plunge 20 - 30 degrees to the south-east. The two western bodies do not sub-outcrop while the one about 101500W is sub-outcropping.

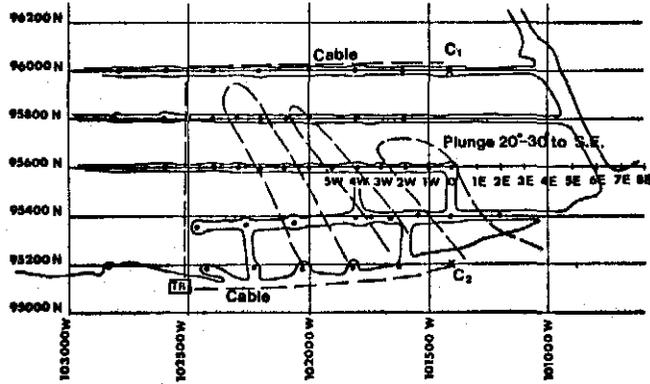
This is an extreme geophysical environment, the lake sediments having a resistivity of about 0.1 ohm.metres, while the oxidized rock probably increases to a few ohm.metres. The resistivity of the ultramafic within several hundred feet of the surface is about 800 ohm.metres. Nickel sulphide ore at Kambalda usually has a resistivity of 0.01 ohm.metres or less.

An 800 ft. array was set up with electrodes on the surface.

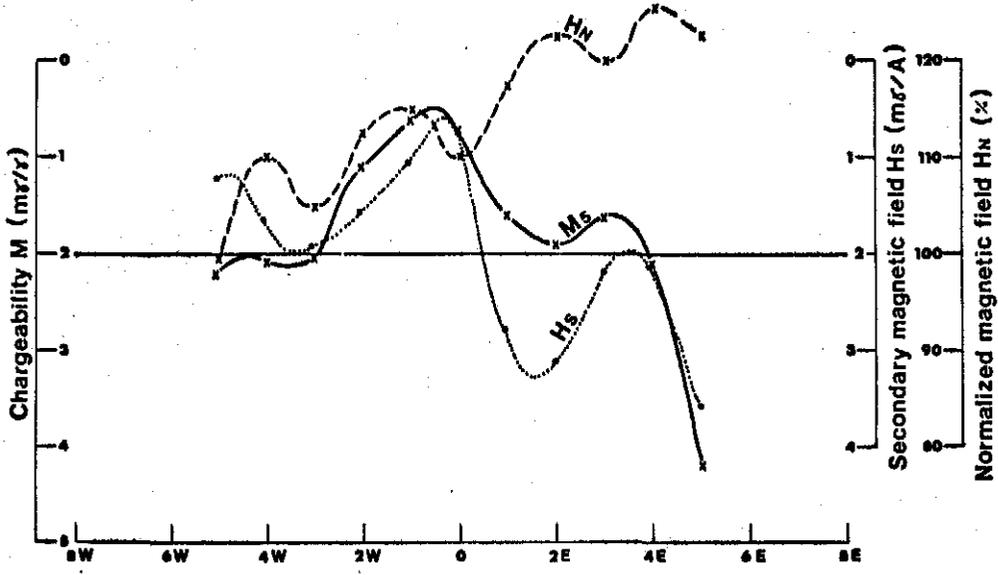
A standard 2 second pulse was applied and using mode 2 and timing 2. Extremely good magnetic signals were obtained because of the low resistivities and consequently high currents. This is in contrast to EIP where low resistivities mean low voltages and noisy signals.

A major MIP anomaly between 00 and 1W is shown, that extends to 3W and corresponds to the sub-outcropping disseminated ore body. A weak MIP anomaly is shown at 4.5W which corresponds to massive ore 300 ft. subsurface. Another very weak MIP response is evident at 3.2E. This area as yet has not been drilled, but it could be related to sulphides being on line with the general structure. The secondary field, which indicates where the polarization current is flowing, clearly shows the three zones.

LAKE LEFROY M.I.P. TEST PART OF HUNT SHOOT



2 SECOND PULSE



CROSS SECTION 95600 N

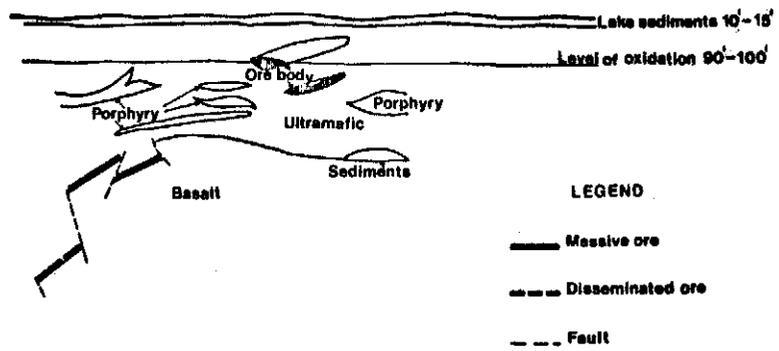


FIGURE 6

108

M and H_s have a general background level of 2. The anomalous values do not go negative although they do decrease towards zero. The return polarization currents, which are short-circuiting immediately above the ore zones, are producing the dominant component. There are probably various other sources of currents. We are seeing the superimposed magnetic response of the fundamental polarization current within the ore bodies on this background level.

Summarizing, the Lake Lefroy results show that MIP can operate in a region with a highly conducting overburden, and produce significant anomalies.

SUMMARY

Three Western Australian case histories are presented and two of these clearly show the ability of MIP to obtain significant anomalies in low resistivity areas where previously no useful EIP results were possible, thus opening the door to a new era in exploration in low resistivity environments.

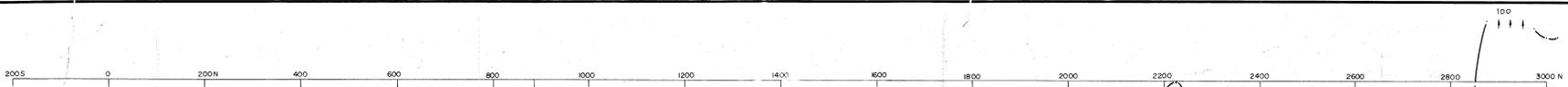
Other case histories with MIP will be made available shortly that illustrate its ability: (1) to emphasize massive sulphides in the presence of disseminated; (2) to operate successfully in a region with 40 ft. of sand cover, (3) to clearly differentiate between graphitic shales and various metallic sulphide sources.

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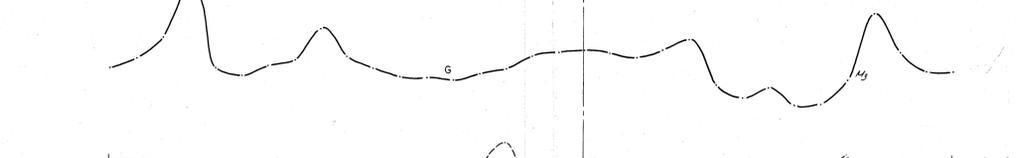
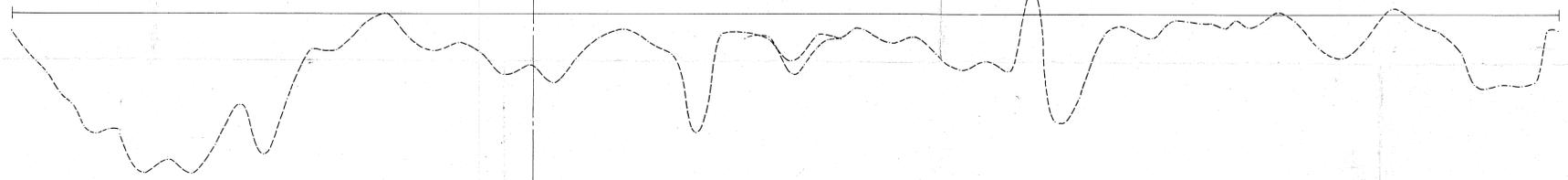
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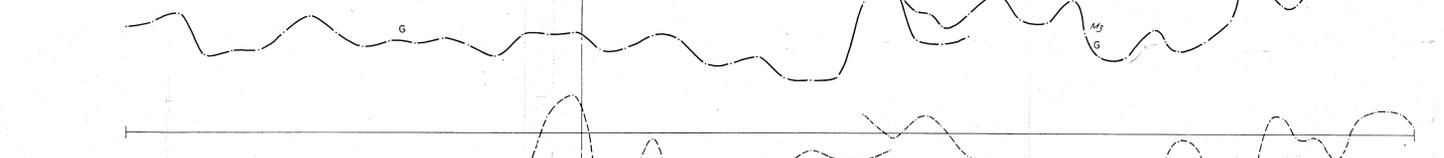
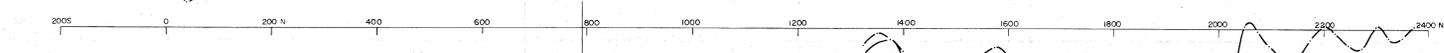
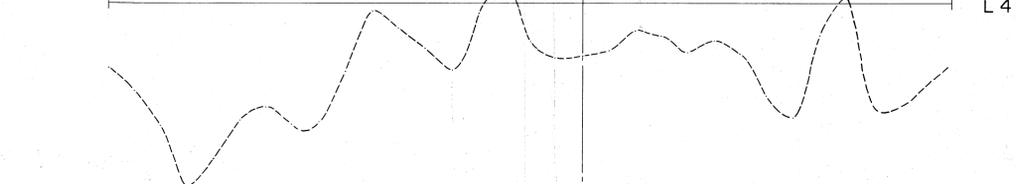
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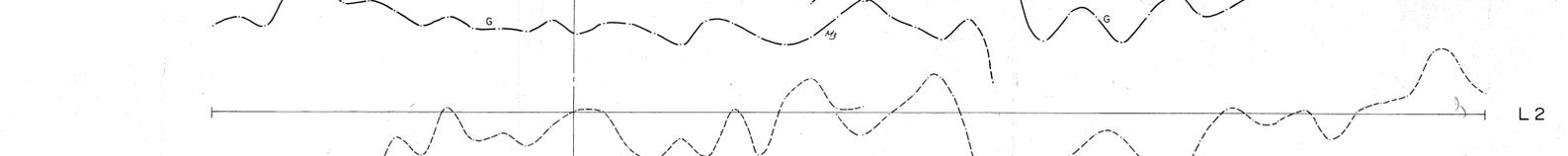
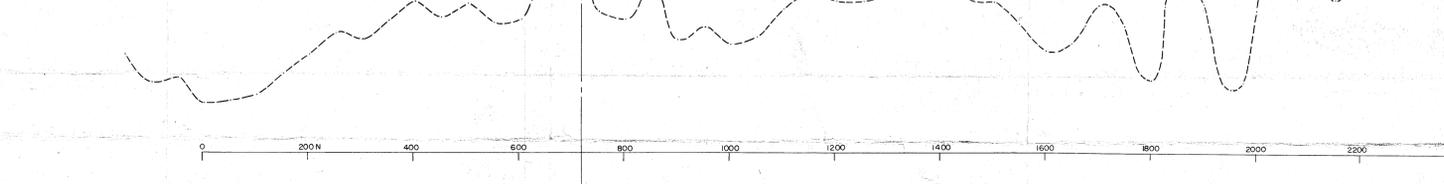
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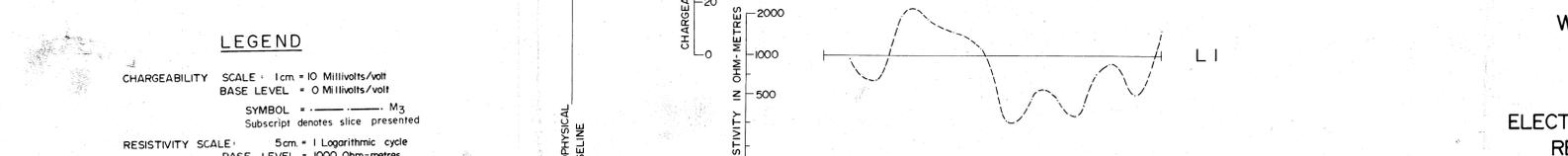
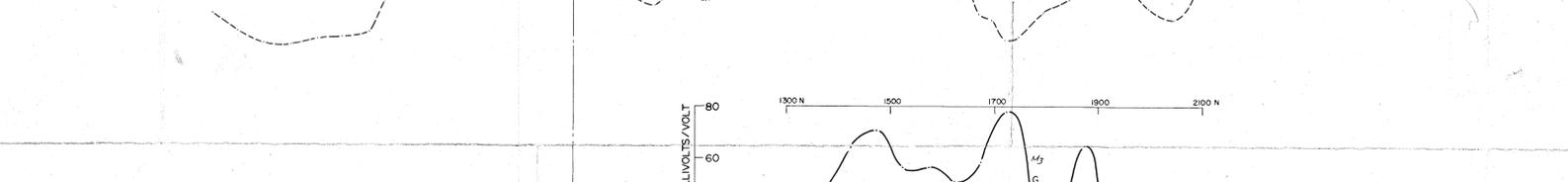
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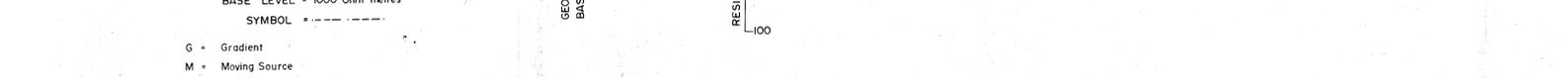
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L 2



L 1



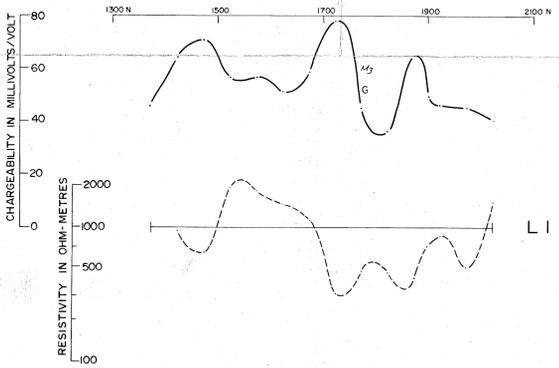
LEGEND

CHARGEABILITY SCALE: 1cm = 10 Millivolts/volt
 BASE LEVEL: 0 Millivolts/volt
 SYMBOL: — M₃
 Subscript denotes slice presented

RESISTIVITY SCALE: 5cm = 1 Logarithmic cycle
 BASE LEVEL: 1000 Ohm-metres
 SYMBOL: - - - - -

G = Gradient
 M = Moving Source

GEOPHYSICAL
BASELINE



RENISON LIMITED

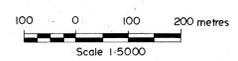
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ELECTRICAL INDUCED POLARIZATION
RECONNAISSANCE SURVEY
DATA PROFILES



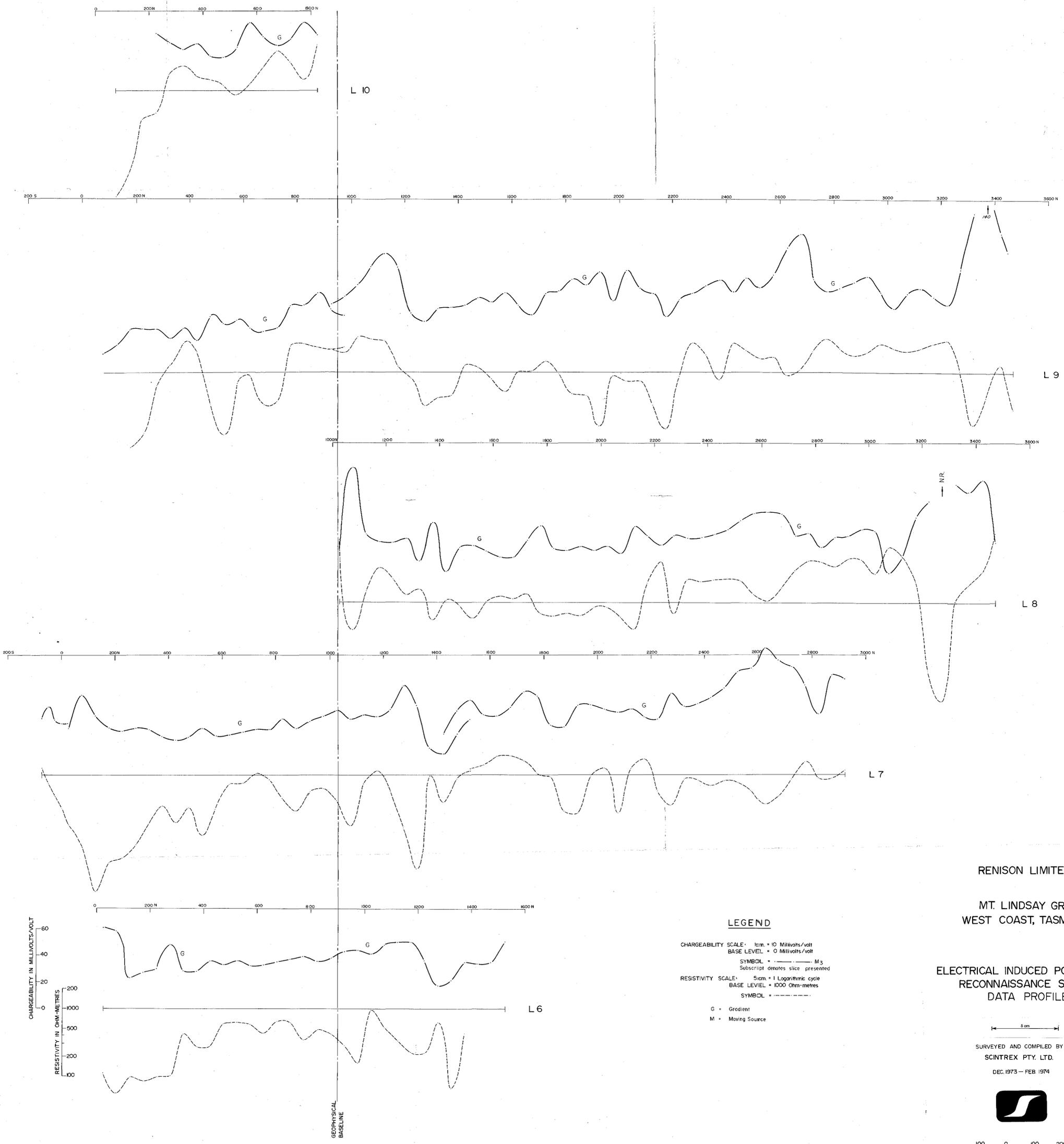
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JOB No. TAS. 019B SHEET 1 of 4 PLATE 1

548110



LEGEND

CHARGEABILITY SCALE: 1cm = 10 Millivolts/volt
 BASE LEVEL = 0 Millivolts/volt
 SYMBOL * M₃
 Subscript denotes slice presented

RESISTIVITY SCALE: 5cm = 1 Logarithmic cycle
 BASE LEVEL = 1000 Ohm-metres
 SYMBOL * - - - - -

G = Gradient
 M = Moving Source

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 MT. LINDSAY GRID
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**ELECTRICAL INDUCED POLARIZATION
 RECONNAISSANCE SURVEY
 DATA PROFILES**

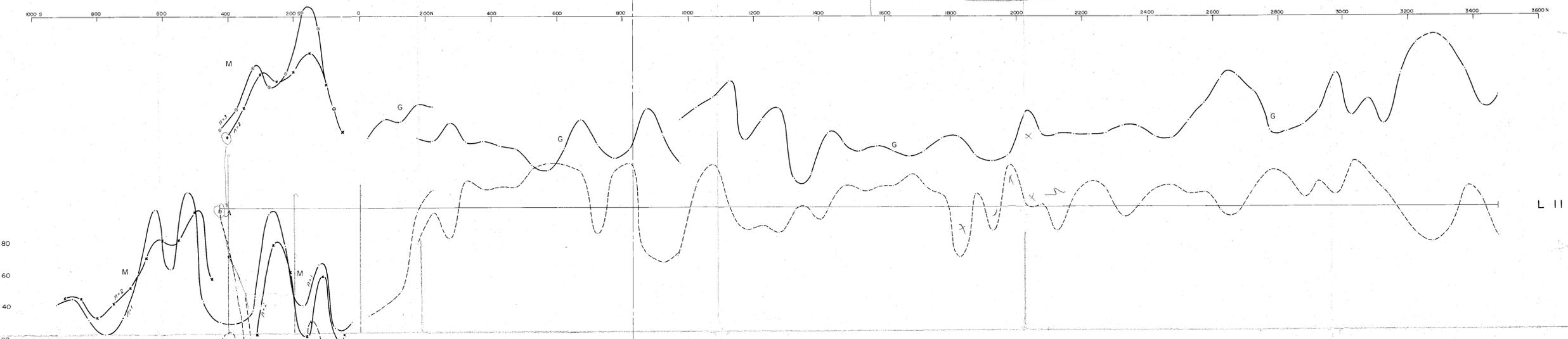
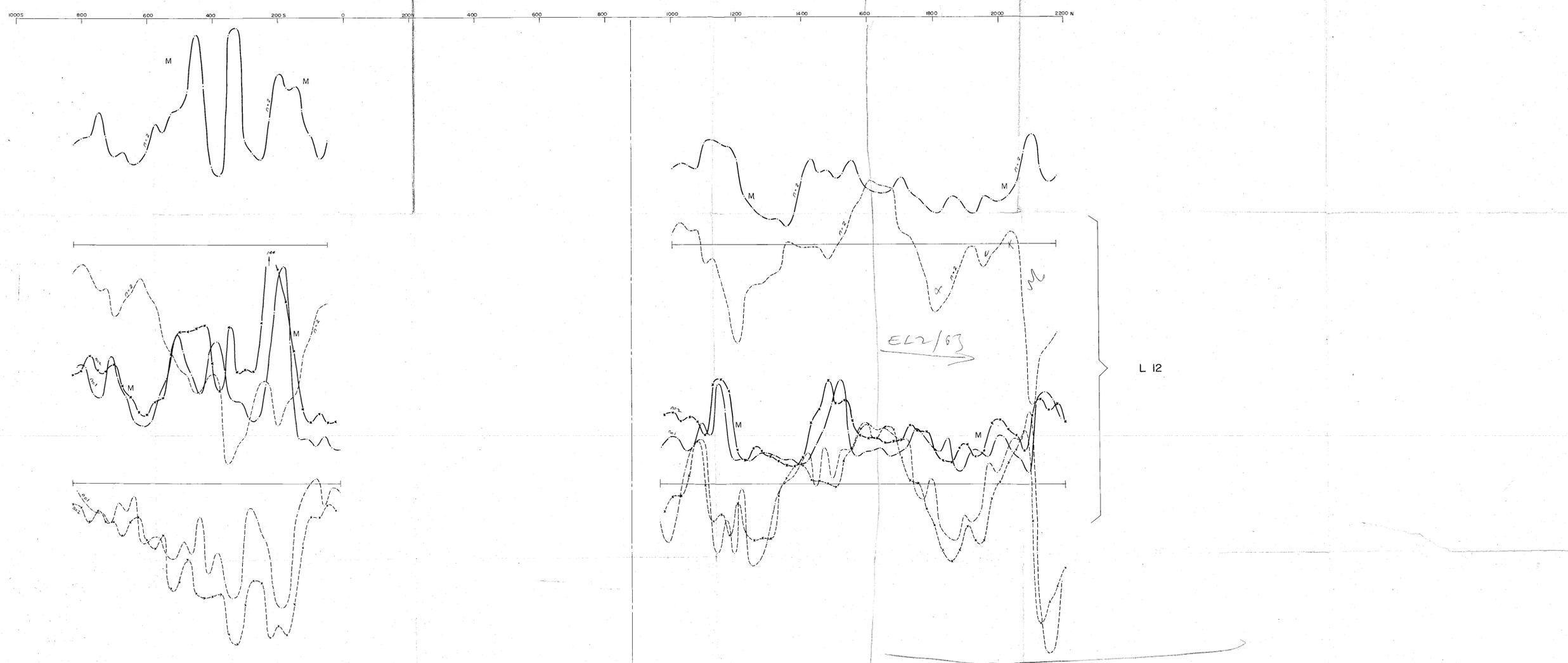
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74-1064
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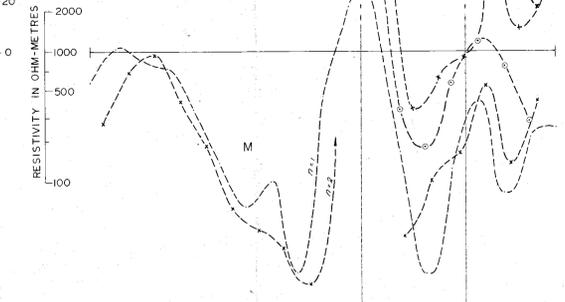


100 0 100 200 metres
 Scale 1:5000

JOB No. TAS. 019 B SHEET 2 of 4 PLATE I



CHARGEABILITY IN MILLIVOLTS/VOLT



RESISTIVITY IN OHM-METRES

GEOLOGICAL BASELINE

LEGEND

- CHARGEABILITY SCALE: 1cm = 10 Millivolts/volt
- BASE LEVEL: 0 Millivolts/volt
- SYMBOL: M3
- Subscript denotes slice presented
- RESISTIVITY SCALE: 5cm = 1 Logarithmic cycle
- BASE LEVEL: 1000 Ohm-metres
- SYMBOL: ---
- G = Gradient
- M = Moving Source

RENISON LIMITED
 MT. LINDSAY GRID
 WEST COAST, TASMANIA

ELECTRICAL INDUCED POLARIZATION
 RECONNAISSANCE SURVEY
 DATA PROFILES

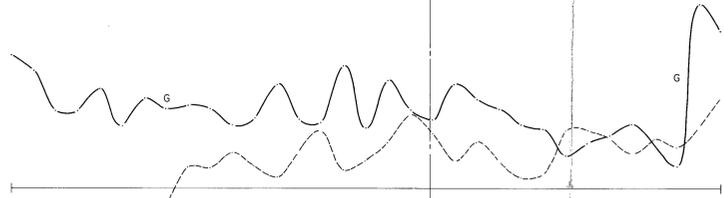


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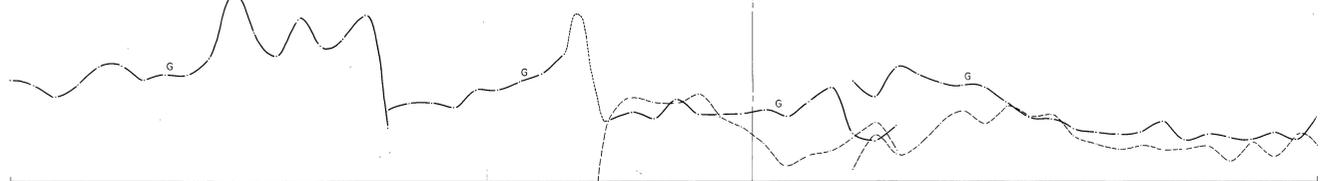
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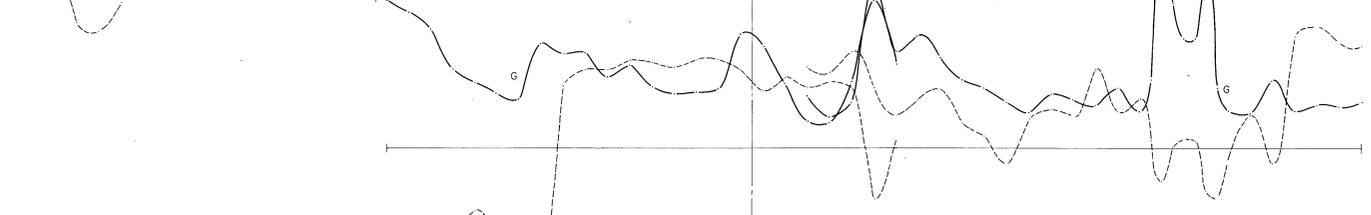
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1000S 800 600 400 200S 0 200N 400 600 800 1000 1200 1400 1600 1800 2000N

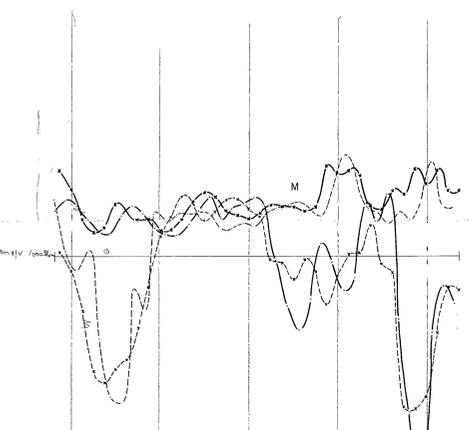
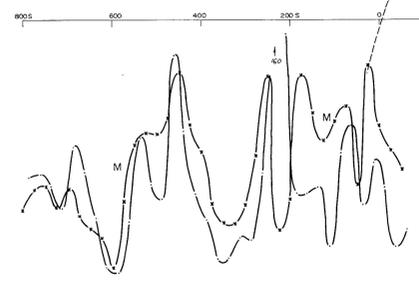


L 17

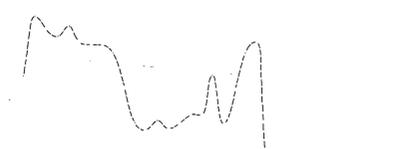
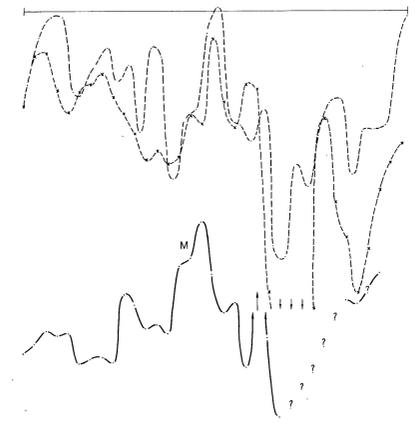
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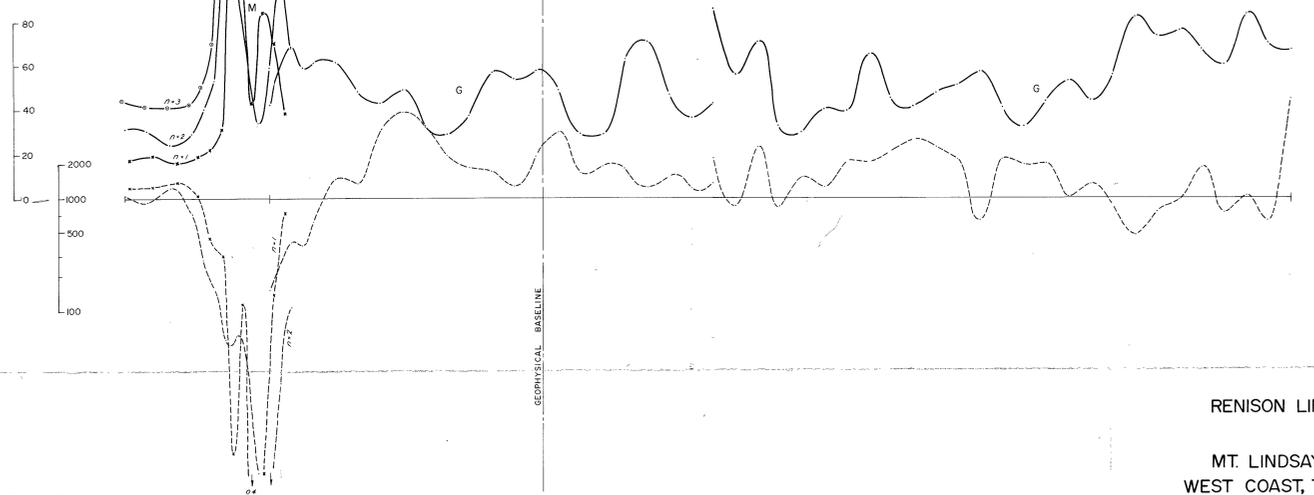
L 15



L 14



400S 200S 0 200N 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400N



L 13

LEGEND

CHARGEABILITY SCALE: 1cm = 10 Millivolts/volt
BASE LEVEL: + O Millivolts/volt
SYMBOL: * = Millivolts/volt
Subscript denotes slice presented
RESISTIVITY SCALE: 5cm = 1 Logarithmic cycle
BASE LEVEL: 1000 Ohm-metres
SYMBOL: ---

G = Gradient
M = Moving Source

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ELECTRICAL INDUCED POLARIZATION
RECONNAISSANCE SURVEY
DATA PROFILES



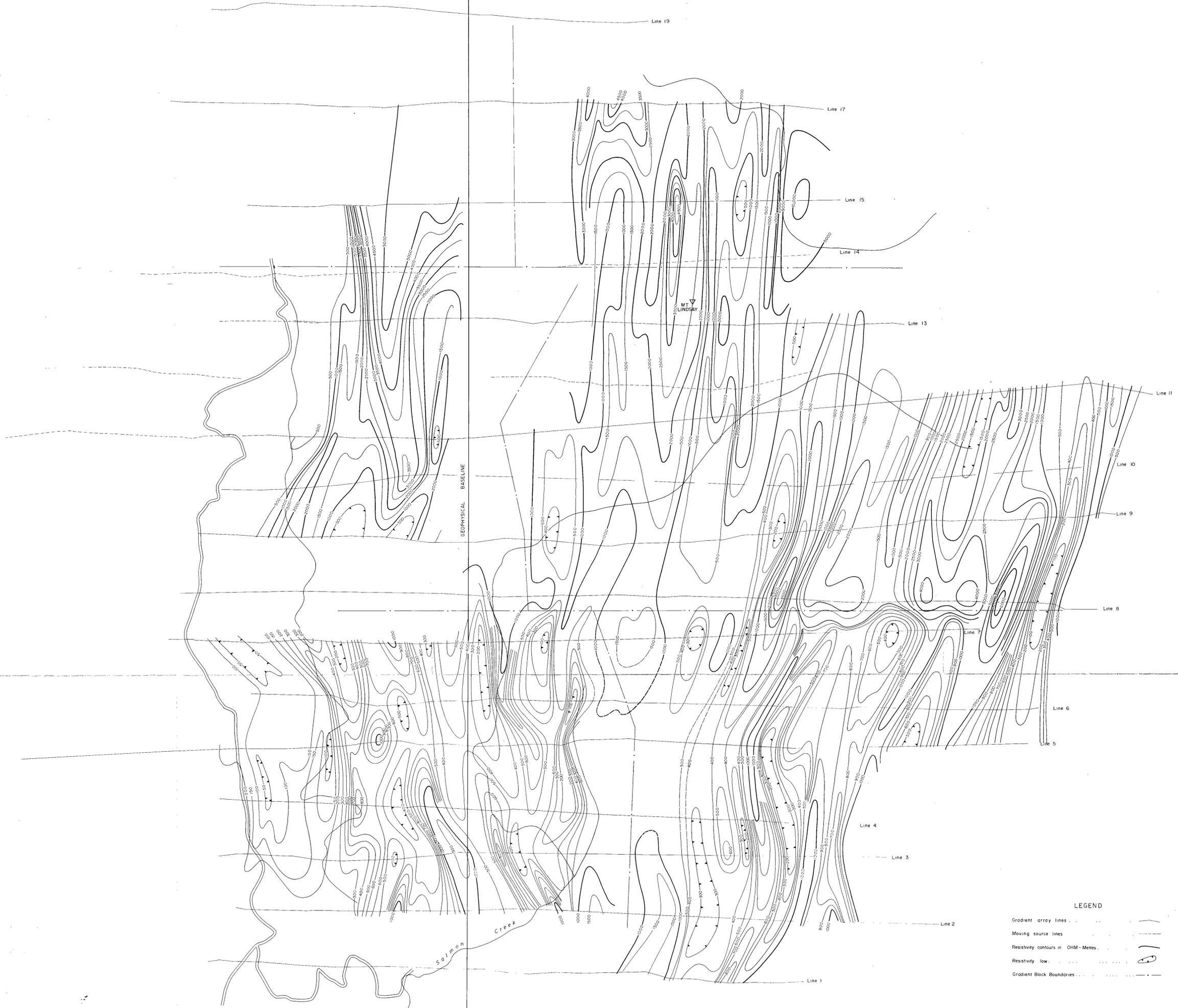
SURVEYED AND COMPILED BY
SCINTREX PTY LTD
DEC 1973 - FEB 1974
548113



100 0 100 200metres
Scale 1:5000

JOB No. TAS. 019 B SHEET 4 of 4 PLATE I

74-1064
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ELECTRICAL INDUCED POLARIZATION
RECONNAISSANCE SURVEY
APPARENT RESISTIVITY CONTOUR
MAP

5m
SURVEYED AND COMPILED BY
SCINTREX PTY LTD

DEC 1973 - FEB 1974

548114



100 0 100 200 metres
Scale 1:5000

- LEGEND
- Gradient array lines
 - Moving source lines
 - Resistivity contours in Ohm-Metres
 - Resistivity low
 - Gradient Block Boundaries

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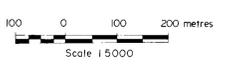
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ELECTRICAL INDUCED POLARIZATION
RECONNAISSANCE SURVEY
APPARENT CHARGEABILITY CONTOUR
MAP



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JOB No. TAS 019 B SHEET 1 of 1 PLATE 3

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- LEGEND**
- Gradient array lines
 - Moving source lines
 - Chargeability contours in Millivolts / volt
 - Chargeability low
 - Gradient Block Boundaries