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A REPORT ON GRADIENT ARRAY EIP RECONNAISSANCE SURVEY OVER THE HARMAN RIVER GRID NEAR ZEEHAN, TASMANIA ON BEHALF OF RENISON LIMITED

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SUMMARY

Over the 48 kilometres of grid covered by the gradient array electrical induced polarization survey at Harman River, some seven areas of anomalous induced polarization have been located which have been designated zones A to G. The most extensive is zone C which dominates the south-western section of the grid and is certainly of formational graphitic (and/or sulphide) shale origin. Within this zone resistivities of as low as 3 ohm-metres have been located coincident with very high chargeability. Such zones have been assessed as being of primary geophysical interest on a basis of their superficial likeness to the pyrrhotite-tin veins of the Renison deposits.

A realistic assessment of the economic merit of the anomalous induced polarization can only be made when additional geo-parameters such as magnetic field, geochemistry and detailed geology are considered.

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INTRODUCTION

At the request of Mr. L.A. Newnham, Chief Geologist for Renison Limited, Scintrex Pty. Ltd. carried out a gradient array reconnaissance survey over the Harman River grid.

The survey was undertaken over some 19¼ double and 6½ single operator days between 14th January and 23rd February, 1980. The crew leader was Scintrex senior operator Mr. B. Ekstrom assisted by Mr. M. Joseph,B.Sc. (second operator) and field hands A. Hudson and I. Newby and operator P. List.

Organisation and field supervision was undertaken by Mr. A. Ross, Senior Exploration Geologist for Renison, while the author visited the area during the course of the survey.

This survey was one of the few carried out in Tasmania which was wholly helicopter supported. The crew was lifted in and out of the area daily, and the heavy 10/15 kilowatt motor generator was moved from set-up to set-up by helicopter. The use of the helicopter and the minimal travelling time undoubtedly led to the excellent production achieved on the survey.

In all, about 2000 stations were read from 10 gradient array set-ups involving some 48 kilometres of line. Very limited moving source follow-up was carried out also.

METHOD

Brief comments on the method are appended to this report.

EQUIPMENT AND OPERATION

A Scintrex 10/15 kilowatt transmitter was employed to energise the large gradient array spreads employed in the reconnaissance survey. The currents employed ranged between 3.5 to 5 amps at high voltages. The minimum output voltage required to achieve good data was employed due to possible leakage from the energising cables.

The energising pulse employed was a two second on, two second off, reverse and repeat square wave. The reading programme consisted of a 2 second programme read on a *single* slice under the decay curve, with three slices being taken at regular intervals and in areas of particular interest.

The current dipoles employed are as set out below:-

2400W and 2100E on 24N

200W and 3000E on 18N

2400W and 3000E on 18N

2500W and 700E on 12N

300W and 2900E on 12N

3400W and 200W on 6N

1000W and 2200E on 6N

2100W and 500W on 6N

100E and 1000E on 20N

As can be seen the current dipole ranged from 3.2 kilometres to 5.4 kilometres with a 1.6 kilometres dipole being employed to read sections of lines 4N, 6N and 8N where extremely low current densities were encountered. The potential dipole employed was 25 metres, read at 25 metre intervals with closer spacings being taken over particularly sharp changes in chargeability or resistivity.

DATA PRESENTATION

The gradient array data has been contoured on the standard 1:5000 Renison survey sheets D1/4 and D1/2 of the Corrina sheet.

Profiles are presented at the standard 1:2000 horizontal scale, with vertical scales being 1 centimetre = 2 millivolts/volt for chargeability and a 5 centimetre log cycle for resistivity expressed in ohm-metres.

DISCUSSION OF RESULTS

The data is first discussed in terms of the significant anomalous induced polarization areas, and then in terms of overall form.

The comments made refer wholly to the geophyiscal data as such. Those chargeable horizons which show very low resistivities, high chargeabilities and slow decay forms are considered to be the most significnat based on the argument that the classic pyrrhotite-tin veins show this type of response. As with all geophysical data the real merit of any anomaly depends on the correlation of the geophysical data with geochemistry, geology, and in this case, additional geophyiscal information such as magnetic field data.

Significant Anomalies

These are reviewed by region, generally from north to south. Each anomaly is identified alphabetically on both profiles and on the contour interpretation of the data.

ZONE 'A'

Line 26N .... A broad increase in the chargeability from backgrounds of about 12 millivolts/volt ±2 millivolts/volt in the west and 6 millivolts/volt ±3 millivolts/volt in the east was noted between about 1125W and 1325W. Two specific maxima of 16 millivolts/volt were recorded at 1238W and 1188W. There is no significant change in the observed apparent resistivity of 3500 ohm-metres, thus the source is disseminated in nature, and a gradual build-up from zero against background to the maximum value makes a judgement of the maximum depth to source difficult. On anomaly form this is estimated at 100 metres which is certainly excessive. Over the maximum the decay form is slow (ΔMn=+5%), inferring a coarse grained source.

Line 24N .... On line 24N some 400 metres south of 26N, a sharp, distinct anomaly of 24 millivolts/volt above the 4 millivolts/volt background to the west and 18 millivolts/volt on the 8 millivolts/volt background to the east was recorded. On this line the anomaly has a shallow depth to source of no greater than 40 metres, with two quite distinct sources inferred at 1312W and 1350W. Again high 3000 ohm-metres resistivities were recorded which show little if any change from background. While the chargeability response is significantly narrower than on line 26N, lesser responses of 10 millivolts/volt and 8 millivolts/volt at 1250W and 1150W *may* be 'fishtail' effects from the same body. The decay form is again slow at +6%, inferring slightly coarser than normal grain size for the causative material.

On *line 22N* no significant responses were recorded, however, slightly higher than background (4 millivolts/volt) values of 8 to 10 millivolts/volt between about 1125W and 1200W *may?* represent the southern strike extension of zone A.

ZONE 'B'

A single line anomaly centred at about 940W on line 20N of about 24 millivolts/volt above the average background of 10 millivolts/volt is accompanied by a distinct *increase* in resistivity from the 1000 ohm-metres background to 3000 ohm-metres. The source is interpreted as being narrow, certainly less than 20 metres wide, and has a maximum depth to source of 20 metres (perhaps less, the potential dipole being the limit of resolution for depth). The decay form at 967W is normal, while the decay form within the maximum chargeability value is about +4.5%, inferring a *slightly* coarser than normal grain size to the source.

ZONE 'C'

This zone consists of a wedge shaped zone of high to very high chargeability which increases in width from zero on line 18N, and about 3000 metres centred at about 1800W in the north, to 1000 to 3500W on the most southerly line run (4N). While the contouring has been done for best fit, namely, normal to the grid lines, the 400 metres(±) interline spacing does not allow interline correlation between individual events.

Some of the lowest apparent resistivities recorded in the area (to 10 ohm-metres) have been recorded within the centre section of zone 'C'. A particularly low resistivity zone runs from 1700W on line 14N, 1500W ±200 metres on line 12N, 1300W on line 10N, 1200W on line 8N, 1350W on line 6N to cross line 4N at 1600W ±300 metres. Since these low resistivity values are invariably accompanied by high to very high chargeability, they are caused by massive interconnected graphite and/or sulphide beraing sediments. In general there is an inverse relationship between the amplitudes of the chargeability and resistivity.

In view of the individual nature of the anomalies within the large area of the grid covered by Zone 'C', the section covered by this zone is discussed on a line by line basis from north to south.

Line 18N ... Two rather low amplitude responses recorded on this line at 1400W and 1640W±60 metres have been designated C2 and C1 respectively. The amplitude is about 10 millivolts/volt above the 8 millivolts/volt background. The associated resistivity, while *on average* being slightly lower than background, is still high at 3000 ohm-metres(±) in absolute terms. Thus the source is wholly disseminated on this line. These two anomalies are considered to be the correlatives of C3 and C4 on line 16N described below.

Line 16N ... Within a broad decrease in resistivity from over 6000 ohm-metres to the west, and 1000 to 2000 ohm-metres to the east, a broad zone of 50 millivolts/volt chargeabilities was recorded from 1000 ohm-metres resistivities. On the extreme western (C3) and eastern (C4) margins, chargeabilities rise to over

200 millivolts/volt and 100 millivolts/volt respectively, and are coincident with resistivity lows of 200 ohm-metres and 250 ohm-metres respectively. The interpreted sources are massive, interconnected sulphide/graphite at maximum depths of the order of 40 metres. The high chargeability between zones C3 and C4 is due to disseminated graphite and/or sulphides. The decay form noted at 1960W, to the west of the above, is very slightly faster than normal (ΔMn = -1.0%), while readings at 1850W gave decay forms of +5.4%, at 1787W (within the disseminated central zone) decay form was +3.8%, and at 1662.5W on C4 the anomaly shows a slow decay form of +8%. Thus it would appear that the causative material is slightly coarser than normal.

To the immediate west of the above, a sharp anomaly C5 was defined at 1890W of 34 millivolts/volt, but is associated with *higher* resistivities of 4000 ohm-metres. The source therefore is disseminated and is inferred from the profile form to have a maximum depth of the order of 40 metres.

Line 14N ... As with zone 'C' on line 16N, the western margin is signified by a dramatic drop in resistivity from over 5000 ohm-metres to the immediate west of the chargeability high to an average value of about 1000 ohm-metres. Within this level, however, resistivities as low as 100 ohm-metres (±) were recorded. The chargeability rises from the west to over 50 millivolts/volt at 1885W to form anomaly C6. The decay form within the source is not known, but at 1912W the decay form is +12%, which infers a very slow decay form. The resistivity is a low 100 ohm-metres which clearly infers significant conduction within the source.

Between about 1850W and 1600W chargeabilities remain within the 40 to 60 millivolts/volt range while resistivities average less than 1000 ohm-metres. The sub-zone C7 therefore consists of disseminated to weakly interconnected sulphides and/or graphite. On the flanks of this broad feature the maximum depth to source is inferred to be of the order of 40 to 60 metres, however, no estimate of depth to source can be made in the central sector.

Two lesser maxima of 38 millivolts/volt and 34 millivolts/volt were located at 1485W and 1540W. Again an essentially disseminated source is interpreted at depths of the order of 30 metres.

Line 12N ... The zone of higher induced polarization was contained between 1795W in the west and 1260W in the east. Within these limits the chargeabilities are, for the most part, between 50 and 100 millivolts/volt. The resistivity data remains for the most part below 1000 ohm-metres, but distinct resistivity lows of 250 ohm-metres at 1720W, 20 ohm-metres at 1535W, 60 ohm-metres at 1400W and 120 ohm-metres at 1360W were recorded. The chargeability data gives maxima of 68 millivolts/volt at 1750W, 72 millivolts/volt at 1675W, 120 millivolts/volt at 1550W, 74 millivolts/volt at 1462W and 82 millivolts/volt at 1387W. These maxima merely represent local segregations of graphite and/or sulphides within the overall zone C10 rather than individual anomalies. A number of decay curves were monitored which gave slow decay forms, inferring coarser than average grain sizes for the causative sulphides or graphite. These show ΔMn values of +4% at 1787W, +8% at 1762W, +11% at 1650W, +17% at 1387W and +37% at 1237W, just east of the main C10 zone, but still in anomalous values. This data would appear to indicate a coarsening of grain size from west to east over the chargeable source on this line. The maximum depth can only be guesstimated on the extreme western flank where it is assessed to be of the order of 60 metres($\pm$).

Line 10N ... The main section of zone 'C' on this line (designated C11) was sharply defined between 1700W and 1250W as a 50 millivolts/volt to 100 millivolts/volt response associated with resistivities which for the most part are less than 1000 ohm-metres. These features contrast with backgrounds of 11 millivolts/volt and 10,000 ohm-metres to the west and 18 millivotls/volt and 1000 ohm-metres to the east. The whole section between the limits given above is anomalous, and no real definition is possible within this zone except that local maxima represent local segregations of the sulphide/graphite source. The depth to source can be gauged only on the flanks wehre the maximum depth is assessed to be in the range of 50 metres $\pm$10 metres.

West of the main chargeable horizon which makes up C11, a discrete chargeability response (C12) of 16 millivolts/volt on the 10 millivolts/volt background was recorded at 1812W which is interpreted as coming from a source assessed to be of the order of 50 metres $\pm$10 metres deep. The local resistivity background is a high 11,000 ohm-metres with the resistivity over the anomaly being 14,000 ohm-metres. The source is obviously disseminated in nature, and the decay form data indicates a normal grain size, $\Delta Mn = 0$.

A very similar response was recorded to the east of the main zone C11 at 1150W. Here a 20 millivolts/volt above the 16 millivolts/volt background response was defined from material which shows a slight increase in resistivity above the 800 ohm-metres local background.

Line 8N ... On line 8N the anomalous response from zone 'C' (C14) extends from

2380W in the west to 1140W in the east.

The resistivities are so low in the central section that on this line (and lines 6N and 4N) an array having a much shorter 1.6 kilometre current dipole had to be employed. On this line the data extended from about 1100W to 1600W.

The whole section is characterised by high chargeability with a number of distinct maxima such as 121 millivolts/volt at 1487W and 94 millivolts/volt at 1562W. Overall the chargeability remains between 50 millivolts/volt and 100 millivolts/volt, inferring a most chargeable rock suite. A number of notable resistivity lows of 30 ohm-metres at 1260W and 20 ohm-metres at 1450W may infer conduction within the chargeable material. There is no way of differentiating potential economic zones from within this unit as the whole section is highly anomalous.

Line 6N ... A very similar state of affirs was seen on line 6N where highly anomalous chargeability values were recorded from about 2560W to about 1080W. Distinct chargeability maxima of greater than 100 millivolts/volt were recorded at 2465W, 2285W, 2045W, 1940W, 1740W and inferred between about 1400W and 1300W, while the recorded resistivity reached about 3 ohm-metres, which indicates the existence between these coordinates of massive interconnecting sulphides and/or graphite. The chargeability demonstrates the presence of graphite and/or sulphides exceeding 5% over the *entire* section. Only at 2437W was a decay form taken, and here the ΔMn at +13% indicates a very coarse grained source, at least at that site.

Line 4N ... On this the most southerly line surveyed, the most extensive zones of anomalous chargeability were defined. Here, zone 'C' extends from 2920W to 1180W. In fact the anomalous induced polarization extends to the end of the line at 3500W, but between 2920W and 3500W the resistivities are much higher and for this reason it has been classified as a separate zone, zone 'D'. Over the sector defined as zone 'C', the apparent resistivities are the lowest recorded in the area, rarely rising above 1000 ohm-metres.

In detail, the resistivity falls to about 400 ohm-metres at 2915W and less than 20 ohm-metres at 2880W. The associated chargeabilities are a high 70 millivolts/ volt, clearly inferring a chargeable and well interconnected source. This response must be due to a 'massive' graphite and/or sulphide source. One point of interest at this site is that the chargeability is *higher* over the flank of the resistivity low at 80 millivolts/volt to the west and 120 millivolts/volt to the east. This could be due to the fact that massive, electrically continuous material has *less surface area* and thus less chargeability.

Between about 2860W and 2300W the resistivity remained just about 1000 ohm-metres, while the chargeability varied about the 50 millivolts/volt level. A distinct local peak of about 140 millivolts/volt above 70/40 millivolts/volt local background was defined at about 2785W. The maximum depth to source based on profile form would be about 40 metres, however, as the zone probably represents a gradual increase in chargeable material rather than a discrete source, this depth estimate could be excessive.

Centred at about 2220W a broad decline in apparent resistivity was noted to 250 ohm-metres allied to a broad increase in the already high background level of 50 to 60 millivolts/volt to over 100 millivolts/volt centred at 2240W. These features represent gradual changes in electrical properties not abrupt changes.

Between 1930W and about 1440W the level of resistivity varies about the 50 to 60 ohm-metres level, while the chargeability varies from low levels of 40 millivolts/volt to 80 millivolts/volt. Again formational variation is the source of the observed changes.

From 1440W to about 1230W the base resistivity shows a gradual increase from the 50 ohm-metres ($\pm$) level to 600 ohm-metres with a gradual fall in chargeability to 30 millivolts/volt from 60 millivolts/volt.

The eastern end of zone 'C' on this line is marked at 1190W by an abrupt fall in resistivity to 20 ohm-metres and a sharp rise in chargeability to 62 millivolts/volt. This discrete anomaly has a single event source whose interepeted maximum depth is 25 metres. The source is obviously interconnected graphite and/or sulphides and is considered of primary interest.

The decay forms noted over zone 'C' on this line are slow, examples are:-

Station	ΔMn	Inferred grain size
1837.5W	+40%	very coarse
1887.5W	+37.5%	very coarse
1937.5W	+11.7%	coarse
2087.5W	+13%	coarse
2387W	+12%	coarse
2587.5W	+15%	coarse
2662.5W	+8%	slightly coarser
2775W	+10%	slightly coarser

2925W	+12%	coarse

These data clearly indicate that the source of the chargeable material has a coarser than average grain size which may be due to individual grains being coarse, or alternatively agglomerates of smaller grains giving an *effectively* large grain size.

This zone is open to the south.

ZONE 'D'

On the western extremities of lines 6N and 4N high induced polarization readings were recorded from material having significantly higher associated resistivities than those observed within zone 'C'. On line 6N there is a distinct 'low' background break of 20 millivolts/volt (±) between about 2550W and 2800W, but between zones 'D' and 'C' on line 4N, although there is a relative low of 30 to 40 millivolts/volt between *about* 3000W and 3300W, the chargeability level must be considered to be anomalous.

Line 6N ... Some four distinct chargeability maxima were observed on this line, which may? relate to much more substantial maxima on line 4N about 400 metres to the south. All are associated with high to very high apparent resistivities ranging from 4000 ohm-metres to 10,000 ohm-metres.

Sub-zone 'D1' was located at 2788W as a 10 millivolts/volt above the 20 millivolts/volt background. The maximum depth to source is about 20 metres, and the source is disseminated.

Sub-zone 'D2' is centred at 2860W and is about 13 millivolts/volt on a 27 millivolts/volt local background, again within high 10,000 ohm-metres resistivities. The maximum depth to source is assessed at 40 metres.

Sub-zone 'D3' was centred at 2950W and is a 12 millivolts/volt response within an 8000 ohm-metres background. The maximum depth to source is about 35 metres. Again the inferred source is disseminated sulphides within a resistive host.

Sub-zone 'D4' is centred at 3000W where a 14 millivolts/volt above the 28 millivolts/volt background response is interpreted as being caused by a source at a maximum depth of about 25 metres. The source is assessed to be disseminated.

In all the above where decay curve data was acquired, it gave near normal decay forms which infers an 'average' grain size to the causative source. All anomalies are considered of tertiary interest at best.

Line 4N ... The profile form over the section designated as zone 'D' on this line (i.e. west of 3100W) shows little if any clear correlation with the presumed along strike zone 'D' on line 6N.

A distinct anomaly designated 'D5' of some 26 millivolts/volt above the 28 millivolts/volt(±) background was defined at 3175W from rocks whose resistivity is of the order of 9000 ohm-metres. The maximum depth to source is assessed to be of the order of 40 metres. Near normal decay forms were observed.

Subzone 'D7' is a significant 170 millivolts/volt response centred at 3335W accompanied by a distinct decrease in resistivity to 400 ohm-metres(±). The source therefore, while not being conductive as such, is significantly less resistive than the enclosing rocks. Thus as some conduction within the source is inferred, the source may be in part 'massive'.

Sub-zone 'D8' defined at 3465W gives a 50 millivolts/volt above the 40 millivolts/volt background response. A lower resistivity of 3500 ohm-metres as against 9000 ohm-metres was recorded over this anomaly, inferring weak interconnection between the source grains and/or a less resistive host to the chargeable material. A decay form nearby infers a slightly slower than normal decay with ΔMn being +11%.

ZONE 'E'

A significant series of moderate chargeability highs was located on line 22N with no clear correlation on either lines 24N or 20N.

'E1' was seen as a 22 millivolts/volt response over a 6 millivolts/volt background centred at 270W with no appreciable change in the background resistivity of 1000 ohm-metres($\pm$). A second relatively minor source was inferred as a shoulder at 225W. The source(s) therefore are inferred to be at 270W (and 225W) and are inferred to be disseminated in origin. Sub-zone 'E2' was seen as two maxima of 22 millivolts/volt and 18 millivolts/volt at 160W and 125W respectively. Again no appreciable change in resistivity infers a disseminated origin, while the curve shape infers a depth of the order of 30 metres($\pm$). A single sharp 33 millivolts/volt maximum at 088W again with no distortion in the apparent resistivity, is designated zone 'E3'. The maximum depth is 15 metres and the source is a narrow near surface disseminated zone. The most easterly anomaly, sub-zone 'E4', was seen at 037W as a substantial 30 millivolts/volt above the 18 millivolts/volt background. No distortion in the resistivity again infers a wholly disseminated source. The maximum depth to source inferred is about 30 to 35 metres.

The decay forms measured over this zone indicate a normal decay over 'E4', 'E3'; a slightly slower decay over 'E2', and normal decays over 'E1'.

ZONE 'F'

A series of single line chargeability responses was defined on line 20N, and not seen definitely on the lines to the immediate north or south. In detail the two significant responses occur on an array overlap between #4 and #3. The western response was defined at 460E where a 23 millivolts/volt above background anomaly was defined from rocks whose apparent resistivites show no contrast with the less polarizable section. The absolute magnitude of the lower resistivity is about 300 ohm-metres, a fairly low level. The maximum depth to source is estimated at about 40 to 50 metres.

Maximum ('F2') defined on array #3 (which confirms 'F1' also) was seen as a 71 millivolts/volt maximum at 630E and a 76 millivolt/volt maximum at 590E. A slight decrease in apparent resistivity for the 600 to 750 ohm-metres background to 250 ohm-metres was noted centred within 'F2' at 600E, coincident with lower 58½ millivolts/volt reading. The interpretation of the source is that weakly interconnected sulphides and/or graphite were defined from about 580E to 650E at a maximum depth of 30 metres.

The decay form within 'F1' and 'F2' is near normal (ΔMn = +3%).

ZONE 'G'

Two distinct anomalies, both open to the south, make up the core of this anomalous zone. The most eastern response, 'G1', is seen over three lines. On *line 4N* a distinct maximum of 66 millivolts/volt is accompanied by resistivities of the order of 1500 ohm-metres which show no change in background. The assessed maximum depth to source is of the order of 80 metres and is almost certainly excessive. On *line 6N* the anomaly 'G1' reaches over 60 millivolts/volt at about 420E and is associated with an *increase* in resistivity to about 3000 ohm-metres from an 800 ohm-metres background. The maximum depth to source is estimated to be of the order of 40 metres. On *line 8N* twin maxima of 66 millivolts/volt at 512E and 412E were recorded. The decay form of the former is normal while the latter shows a slow decay form with ΔMn = +7%. The accompanying resistivities range between 1200 and 2000 ohm-metres. The source is interpreted as being disseminated in nature, and is at a maximum depth of 30 to 35 metres.

Zone 'G2' was defined at about 200W on line 4N as a 75 millivolts/volt maximum associated with resistivities of the order of 900 ohm-metres (±). The decay form observed is slow, with ΔMn = +12.5%, which infers a coarser than normal grain size to the sulphide/graphite source. On *line 6N* 'G2' reaches about 60 millivolts/volt in close proximity to a change in resistivity, the absolute amplitude of which is of the order of 600 ohm-metres (±200 ohm-metres). The decay form at +12% is similar to line 4N. While higher chargeabilities are noted on line 8N along strike, they cannot be directly linked to 'G2'. The maximum depth to source is estimated to be about 60 metres.

A distinct chargeability anomaly, 'G3', was defined on line 4N at 480W having an amplitude above background of about 24 millivolts/volt. A slight increase in resistivity from the base level of 200 ohm-metres(±) to 700 ohm-metres was noted. The maximum depth to source is estimated at 50 metres. This sub-zone has no expression on line 6N and is open to the south.

'G4' ... A similar response of 24 millivolts/volt was defined at 312W which on this occasion is associated with a distinct, broad depression in apparent resistivity to about 350 ohm-metres from the 700 to 1000 ohm-metres background. Two distinct sources are inferred, and a second associated with a shoulder at about 350W. The maximum depth to source is estimated to be of the order of 50 metres. This response is open to the south but closed to the north.

LIMITED POLE-DIPOLE SURVEYS

Limited pole-dipole surveys were carried out over sections of lines 20N and 26N to investigate features on these lines and to study horizontal layering on these lines.

LINE 26N *West* $\rightarrow P_2 P_1 C_1 \rightarrow$ *E* $a = 25$ *metres*, $n = 1$ *to* 4

This line was surveyed between 200W and 25W and the data is presented in standard pseudo-section format.

The gradient array data showed a general resistivity level of about 1000 ohm-metres over the section covered by the detail, and a chargeability level of about 8 to 12 millivolts/volt.

A most significant feature of the pole-dipole data, ignoring the local inhomogeneities, is that there is generally higher resistivity near surface west of 150W. This *may?* indicate, taken together with the gradient array data in the area, that the granites are underlain by rocks of lower resistivity. This would, however, not agree well with the overall concept of the area, and would perhaps suggest a faulted rather than an intrusive contact in the north.

The chargeability data generally agrees well with the gradient data, with higher readings east of 200W of 10 to 12 millivolts/volt and lower readings of 7 millivolts/volt(±) west of 200W. The small single station 6 millivolts/volt anomaly located at 212W was not clearly identified on the pole-dipole data.

LINE 20N *West→C P_1P_2→East* *a = 25 metres, n = 1 to 4*

This line was surveyed between 350E and 750E over an anomaly defined between 440E and 650E on the gradient data. Three chargeability sources at about 470E, 530E and 590E were defined from rocks whose bulk resistivity was of the order of 500 to 600 ohm-metres.

The pole-dipole data showed a multiple double peak interference pattern, with sources shallower than 25 metres centred at 540E(±), 580E and 625E with a halo east and west of these maxima. The resistivities observed are of the same order as the gradient array data. This data merely confirmed the interest of the anomalies located on the gradient array data.

COMMENTS ON THE ELECTRICAL PROPERTIES ARE THEY RELATE TO THE GEOLOGY AS KNOWN AT 23RD OCTOBER, 1979.

As remarked earlier the chargeability and resistivity data has been contoured on to Renison standard sheets for the area at the scale of 1:5000. These are shown in Plates 1&2 and 3&4 respectively. Also a summary of electrical properties map has been constructed which displays the salient characteristics of both contour interpretations.

Resistivity Data (two plates)

The western margin of the area is defined by granites. The resistivity data records the granite Cambrian contact as a sharp change in resistivity of about tenfold. To the north of the grid, granites have been mapped between lines 22N and 24N, however, *no* significant contrast in resistivity has been noted to mark this granite/Cambrian boundary. The gradient array data shows only lower resistivities typical of the Cambrian sediments. This is an unexpected result and not easily explained. The north-eastern contact between the Cambrian/Ordovician sediments and the granite is again marked by a tenfold change in resistivity with the granite, as would be expected, being significantly more resistive.

The Cambrian Ordovician sediments enclosed by the granites appear to have a distinct trend about normal to the grid lines which appears valid notwithstanding the 400 metres interline spacing. This is particularly true of the alternations of resistive (3000 ohm-metres+) and conductive (700 ohm-metres-) units seen between the access road and the eastern granite contact. A number of distinct resistive 'marker' horizons can be identified which are considered 'real' features and not a function of the line spacing. These occur as narrow features in the west and as much wider features in the east. These features have been marked on the electrical property summary map (plates 5 & 6).

From the resistivity data only the granite unit on the east and west flanks of the area are distinctly seen. The northern margin is not seen distinctly, nor are the boundaries of the Cambrian Crimson Creek, Cambrian Ultrabasic or Ordovician or Silurian sediments of the eastern section clearly delineated in terms of resistivity alone.

Chargeability Data (two plates)

The bulk of the area has a chargeability background in the range 10 to 20 millivolts/volt. Against this low background a number of linear induced polarization anomalies such as zones 'A' and 'B' were located.

In stark contrast to the above, highly anomalous induced polarization was recorded in the south-western and central southern sections of the area.

High chargeability values in excess of 100 millivolts/volt have been recorded in high resistivity sections on the western end of lines 2N, 4N and 6N which on a basis of their high resistivities were taken to be of granite origin. Thus either the granite contains sulphides as such, or perhaps includes sections of the chargeable Crimson Creek formation.

To the east of the granite on lines 2N, 4N and 6N high chargeability of 50 to 100 millivolts/volt(+) and lower resistivities in the 500 ohm-metres range have been recorded from an area mapped as Crimson Creek formation. These properties are in accord with those defined elsewhere in the region.

An area of very high chargeability trending grid north-south and extending from line 16N south to line 2N where it is open to the south was recorded. This zone appears to mark the limits of the unit mapped as ultrabasics just east of the Crimson Creek formation, but unlike that unit it is not seen in the north or east of the area surveyed. The eastern margin appears to be a marked resistive ridge (see plates 5 & 6). There is no real difference between the geological units (as depicted in the October, 1979 geological map) mapped as Crimson Creek and ultrabasics. Undoubtedly the magnetic field data would be able to make clear differentiation.

In summary, the electrical properties of chargeability and resistivity while showing an overall similarlity with the known geology, also show a number of marked contrasts with it. Also a number of unexplained features emerge, such as the very high chargeability (and high resistivity) within the south-western granite unit, and the lack of a resistivity contrast in the granite/sediment contact in the north of the area.

CONCLUSIONS

1. The most significant induced polarization responses are summarised by zone below.

   Zone 'A' ....An increase of 14 to 16 millivolts/volt above background culminating in two distinct maxima at 1188W and 1240W on line 26N, and a more resistive maximum of 24 millivolts/volt at 1312W and 1350W on line 24N, have been designated zone 'A'. The maximum depth to source on line 26N is 100 metres (but is certainly excessive), while on line 24N the maximum depth to source is 40 metres. The resistivities are a high 3500 ohm-metres which clearly infers the source to be disseminated in nature. If anything, slight increases were observed which would indicate the host to the chargeable material is *more* resistive than the enclosing rocks. The decay form on line 24N shows a slightly slower than normal decay form (ΔMn = +6%), inferring a coarser than normal grain size to the chargeable material. On line 26N the decay form is similarly slow (ΔMn = +5%).

Zone 'B' .... A single 24 millivolts/volt above the average 6 millivolts/volt level was recorded on line 20N at 940W. A coincidental threefold increase in the apparent resistivity to 3000 ohm-metres clearly infers the host to the mineralisation to be resistive relative to the enclosing rocks. The maximum depth to source is less than 20 metres. This response cannot be identified on either line 18N or 22N.

Zone 'C' .... This zone occurs as a series of two small amplitude responses at about 1400W and 1600W on line 18N and progressively broadens out until on line 4N it extends from 3500W to 1200W. To the south, resistivities become progressively lower and have a very low central core (to 10 to 15 ohm-metres). It is not possible to correlate individual highs between lines due to the long interline spacing of 400 metres. A summary of the individual anomalies is included below.

Line	Station	Sub-zone	Anomaly/ Background	Resistivity Background	Maximum Depth	Decay (ΔMn)	Priority
18N	1640W±60m	C1	10/8	3000 Ωm±	60 m	-	Sy
18N	1400W±60m	C2	10/8	3000 Ωm±	100m	-	Sy
16N	(1860W (	C3	200/8	250/1000Ωm	40m	+5%	Py
16N	(1690W	C4	100/8	300/1000Ωm	40m	+8%	Py
16N	1890W	C5	36/8	4000/1000Ωm	40m	-	
14N	1885W	C6	50/12	100/5000Ωm	60-80m	+12%	Py
14N	1600W- 1850W	C7	40-60/10	1K/5K-1KΩm	40-60m	-	Sy
14N	1485W	C8	38/12	2000/1000Ωm	?	-	Sy/Ty
14N	1540W	C9	34/12	800/1000Ωm	30m	+3%(W)- +37%(E)	Sy/Ty
12N	1795W- 1260W	C10	60/12	20-800/1000Ωm	60m(W)	-	? Formational
10N	1700W- 1240W	C11	50-100/12	250-5K/1000Ωm	50-60m	-	? Formational
10N	1810W	C12	16/10	14K/11KΩm	50±10m	0	Sy
10N	1150W	C13	20/16	1000/800Ωm	35m	0	Sy
8N	2300W- 1140W	C14	50-130/8	20-/3000Ωm	to 50m	-	? Formational
6N	2560W- 1080W	C15	50-150/8	3-1000/1000Ωm	40-100m	-	? Formational
6N	1350W±50m	C15	150	3Ωm	40m	-	Py
4N	2920W- 1180W	C16	50-180	4-/1000 Ωm	-	+8% - +40%	? Formational
4N	2880W	C16	70	15 Ωm	35m	-	Py
4N	1190W	C16	62/30	20 Ωm	25m	-	Py

Zone 'D' .... This zone was defined to the west of the highly chargeable and conductive zone 'C' on lines 4N and 6N, and remains open to the west and south. Overall the source is generally much more resistive by one to two orders of magnitude than seen over zone 'C'.

Line	Station	Subzone	Anomaly/ Background	Resistivity/ Background	Maximum Depth	Decay (ΔMn)	Priority
6N	2788W	D1	10/20	8000 Ωm	20m	normal	Ty
6N	2860W	D2	13/27	10,000 Ωm	40m	-	Ty
6N	2950W	D3	12/28	8000 Ωm	35m	-	Ty
6N	3000W	D4	14/28	6000 Ωm	25m	normal	Ty
4N	3175W	D5	26/28	8000 Ωm	40m	normal	Ty
4N	3260W	D6	26/20	1200 Ωm	25m	-	Ty
4N	3335W	D7	170/40	400/3K± Ωm	50m	-	Sy
4N	3465W	D8	50/40	3500/9K Ωm	30m	+11%	Sy/Ty

Zone 'E' .... A series of 20 millivolts/volt(±) responses was defined on line 22N between 0 and 300W at 270W and 225W (E1), 125W and 160W (E2), 090W (E3) and 037W(E4). None show any distortion in the resistivity and have normal to near normal decay forms. The interpreted sources range from 15 metres (E3) to 35 metres (E1). The source is disseminated sulphide or graphite of average grain size.

Zone 'F' .... Two chargeability maxima of 24 millivolts/volt(F1), 71millivolts/volt (F2) and 76 millivolts/volt (F2) above background were noted at 450E, 630E and 590E on line 20N. The accompanying apparent resistivities are low, but only F2 shows any depression in this level. The decay form is near normal (ΔMn = +3%). The interpreted source is disseminated sulphides and/or graphite at a depth of 30 to 40 metres.

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Zone 'G' .... Two material anomalies were located on lines 4N, 6N and 8N which have an inferred strike normal to the grid. In detail these are summarised below:

Line	Station	Subzone	Anomaly/ Background	Resistivity Background	Maximum Depth	Decay (ΔMn)	Priority
8N	412E	G1	66/30	2000 Ωm±	80m	+7.4%	Sy/Ty
8N	512E	G1	66/30	2000 Ωm±	40m	normal	Sy/Ty
6N	412E	G1	30/30	3000/800 Ωm	40m±	-	Sy/Ty
6N	262E	G2	30/30	800/350 Ωm	50m±	+11%	Sy/Ty
4N	012E	G1	37/30	1200 Ωm	80m	+12%	Sy/Ty
4N	200W	G2	35/40	1000 Ωm	?	+13%	
4N	312W	G4	24/20	350/1000 Ωm	50m±	-	Sy/Ty
4N	460W	G3	24/20	700/300 Ωm	50m	-	Sy/Ty
4N	137E)	G5	8/26	6000/1200Ωm	50m±	-	Ty
4N	188E)		8/24	1800 Ωm	50m±	-	Ty

None of the anomalies are assessed to be of primary geophysical interest and all are essentially disseminated in nature.

2. The limited pole-dipole detail carried out on lines 26N and 20N added little to the data derived from the gradient array survey.

3. A study of the contoured chargeability (plates 1 and 2) and resistivity data (plates 3 and 4), while showing a broad similarity to the mapped geology (october, 1979), also shows marked differences. The most chargeable units are seen to be the south-western granite, the ultrabasics and the Crimson Creek formation. The former is relatively resistive and the latter

two units relatively conductive.

4. The geophysical data will require careful study in conjunction with the magnetic field data, revised geology, and geochemistry before the significance of this work can be assessed.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.

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

GEOPHYSICIST

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APPENDIX

BRIEF SIMPLE COMMENTS ON THE GRADIENT, DIPOLE-DIPOLE AND POLE-DIPOLE ARRAYS AND ON DECAY FORM

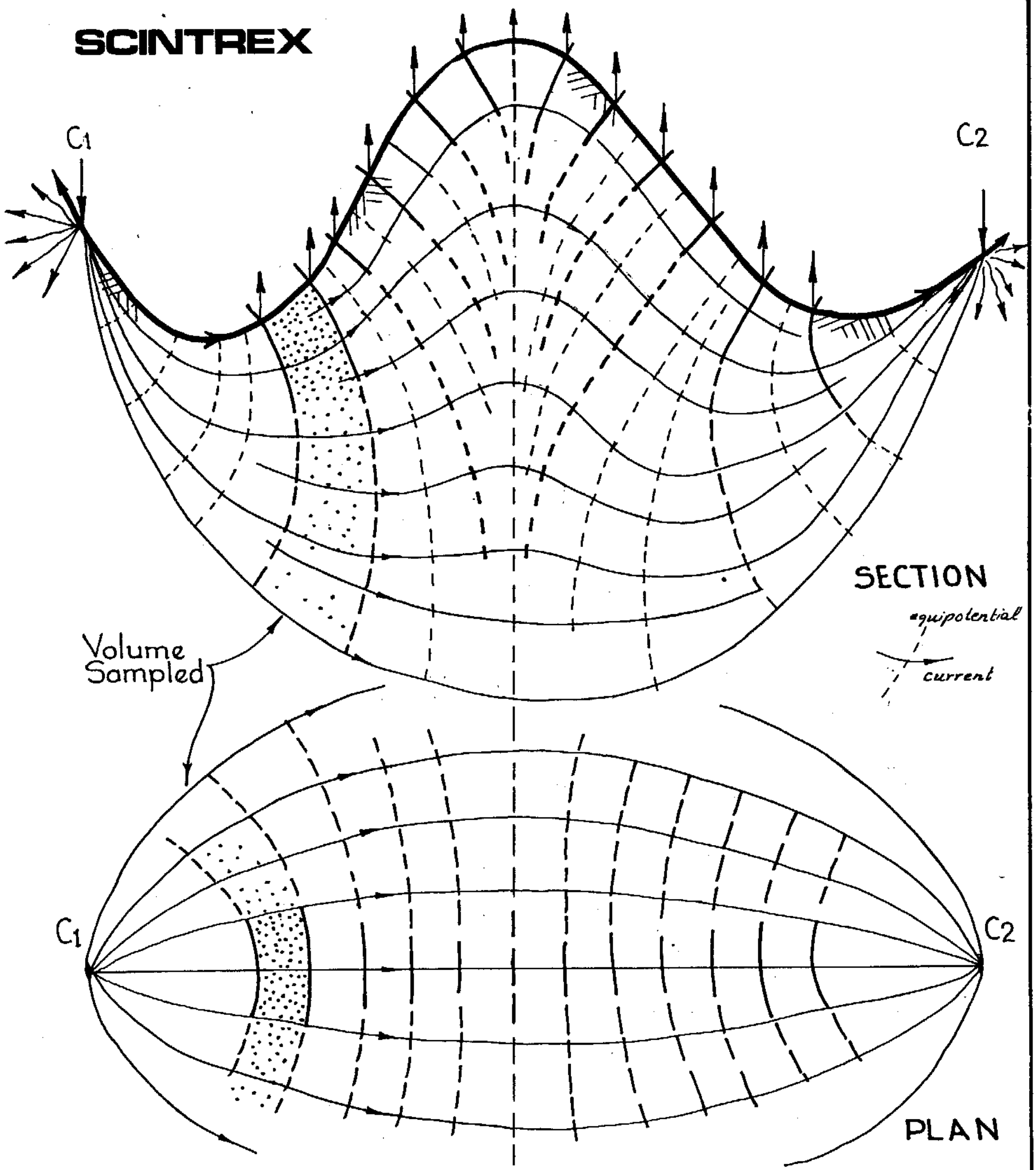
INTRODUCTION

In the case of the surveys discussed in this report, it is important that the geologist can relate the geophysical data to the underlying geology if he is to make the best use of this data. It is the author's opinion that *only* the geologist will be able to relate the data to geology. For this reason brief, simple comments follow on the salient features of the gradient, dipole-dipole and pole-dipole arrays. These comments show how the data relates to the volume of underlying rock which influences it. Comments are also made on the decay form.

DISCUSSION

Gradient Array:- In this array both current electrodes are distant from the potential dipole. Figure 1 displays the salient features of the *primary* current flow and primary equipotential field generated during energisation and shows the influence of terrain on the current paths. From this diagram it can be seen that the *apparent resistivity* measurement is a summation of a volume of material normal to the local slope, *beneath* the surface and at *right angles* to the line.

The apparent resistivity will be *biased by* the influence of each current electrode, but the *relative* values of *adjacent* readings can be considered to be *reliable*. As each electrode is approached, the readings become *increasingly biased by* that electrode.



Diagrammatic Representation of Primary Current and Potential Field in Steep Topography.

FIGURE 1.

Note particularly that the *source volume* is *normal to slope* and not vertically beneath the potential dipole. Therefore all maximum depths refer to depths below surface *normal to the slope*.

Note also that the volume of material *closest to* the potential electrodes will influence the data most. It is difficult to easily quantify the complex relationship between the volume of material sampled and its distance from the potential dipole.

Figure 2 displays the secondary current pattern generated from the decay of induced polarization effect *within* a chargeable sulphide source, together with the equipotential field generated by that decay. Note that due to the necessarily curved nature of the current flow outside the body, the on-surface manifestation is *wider than* the *source width*. Note also that the volume sampled in the primary potential field (apparent resistivity ρa) is not necessarily the same volume as is the secondary potential field (apparent chargeability *Ma*). This is, of course, true for *any* array.

Dipole-Dipole:- In this array the current dipole is generally small, generally 20 to 100 metres. Figure 3 displays the current pattern in section and in plan for a dipole-dipole array. The equipotential P_1 and P_2 tap a volume as shown in this diagram whose characteristics are read on the $n = 1$ station and plotted as a single point midway between the transmitting dipole C_1 to C_2 and the potential dipole P_1 to P_2. As progressively higher n values are read, a deeper and wider volume of material is sampled, this always being plotted midway between the transmitting and receiving dipole, and at a deeper level in the pseudo-section presentation used in this report. It is *vital* to realise that this data point

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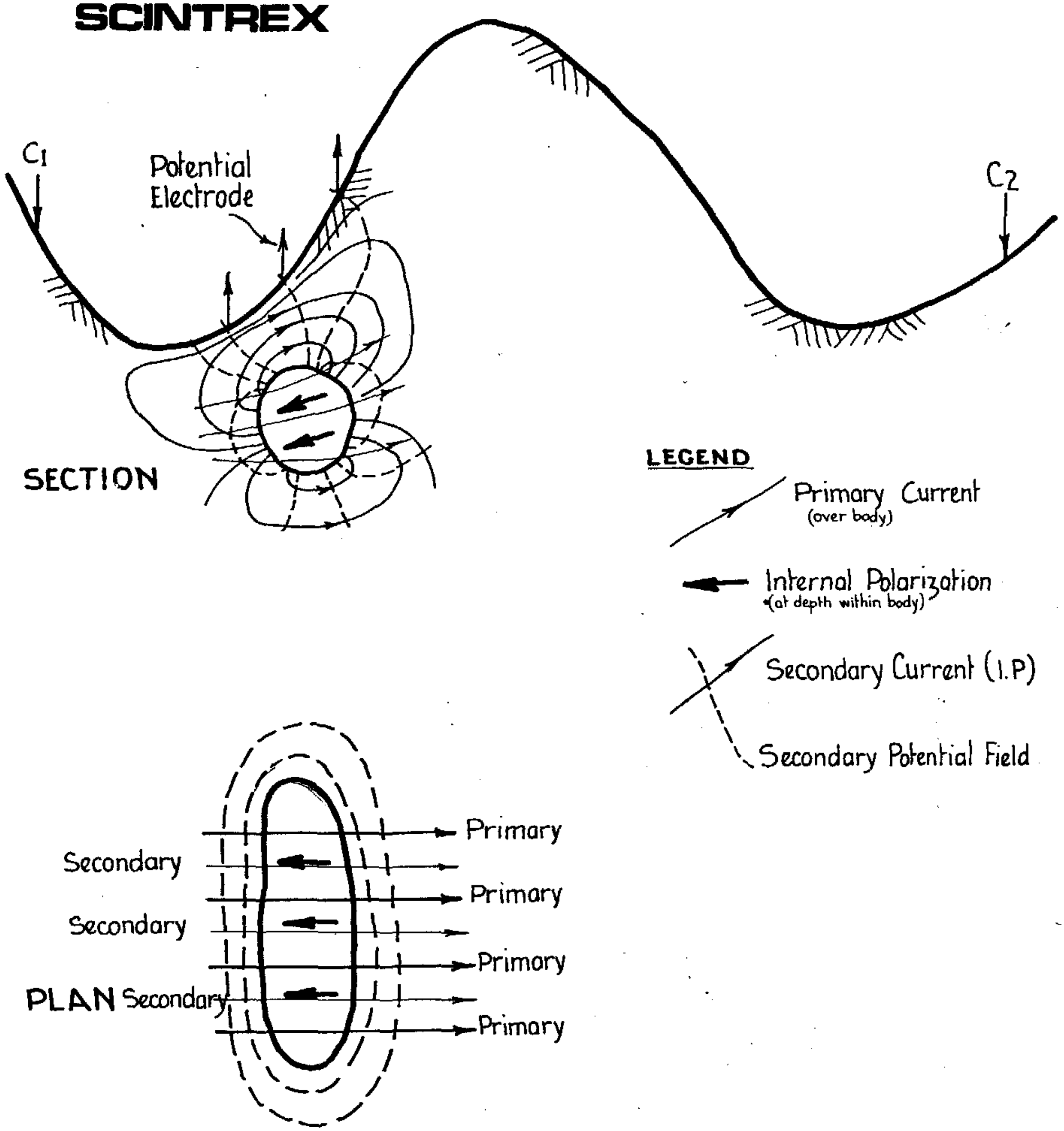

Diagrammatic representation of secondary current (I.P. effect) and secondary potential field in steep terrain.

FIGURE 2.

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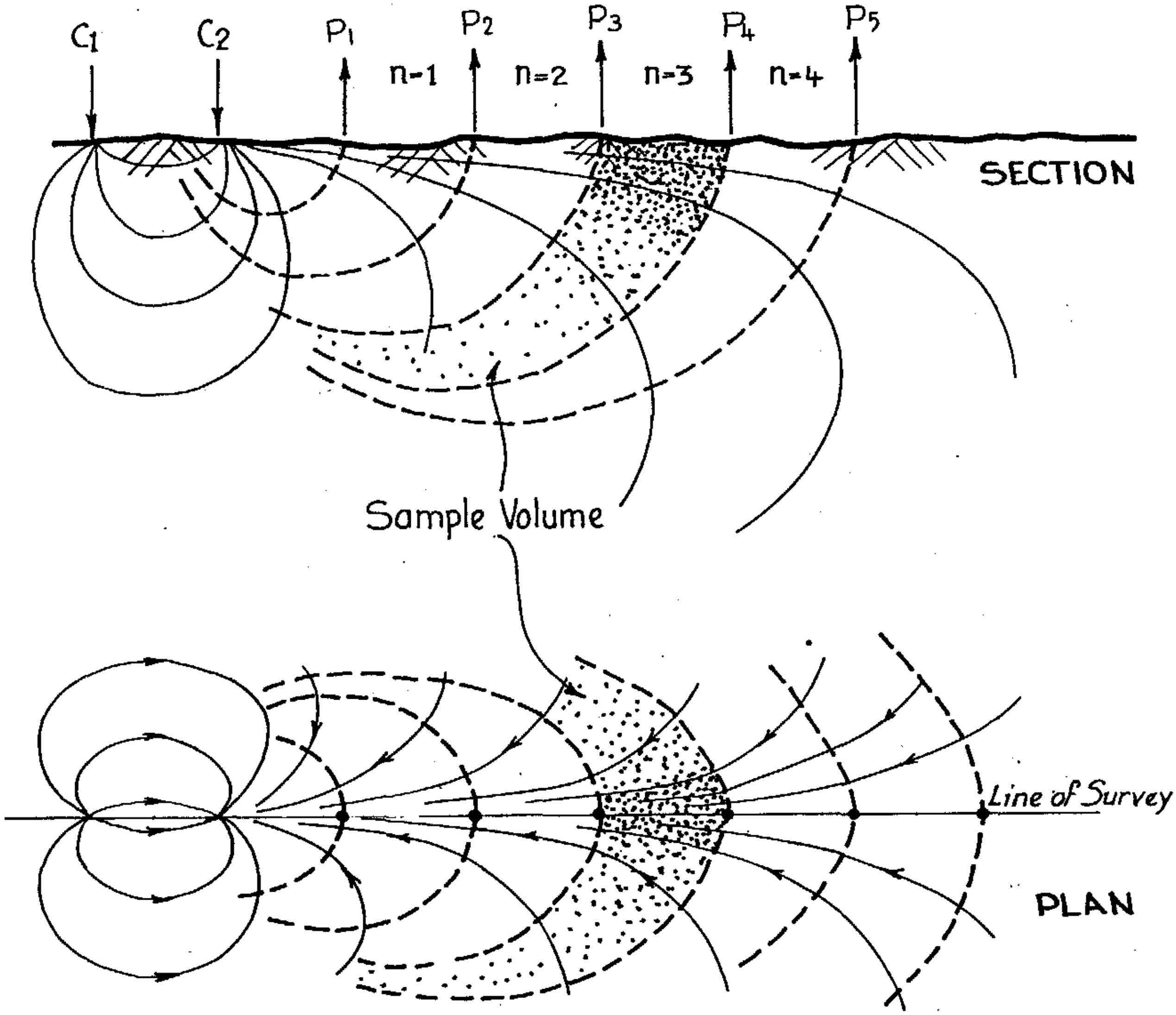


Dipole - Dipole Array
Primary current paths and equipotential field
Showing volumes sampled

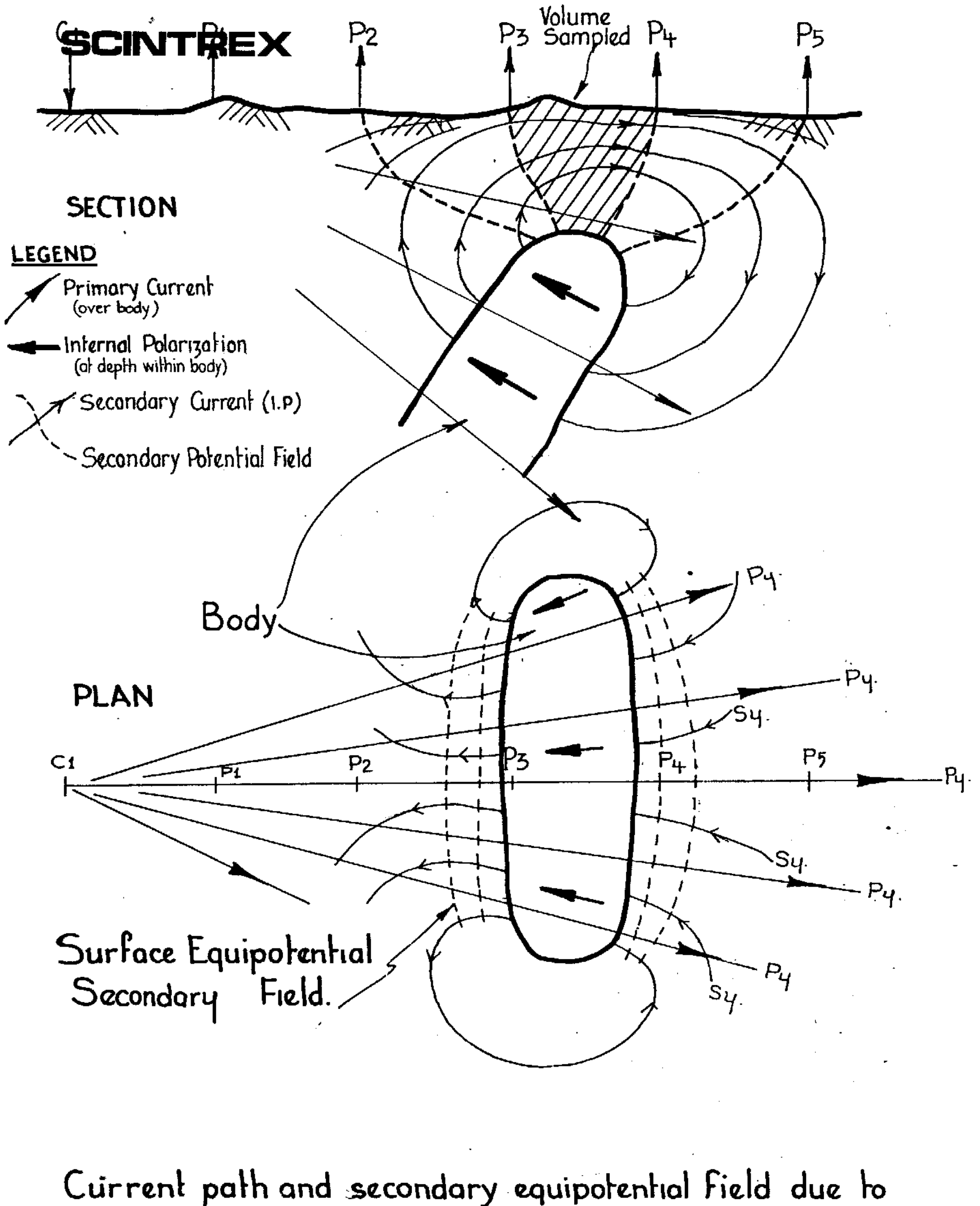
FIGURE 3.

does not represent the characteristics of the ground at the point plotted, but that of the *total volume* sampled.

A further characteristic of the array is that where the effective spacing ($n \times a$) is greater than the depth to the source, a 'high' (or 'low', depending on characteristics) will occur as each of the dipoles (i.e. transmitting C_1 and C_2 and potential P_1 and P_2) pass over the source of that anomaly. The resultant 45° patterns on the pseudo-section DO NOT represent dip, or even depth extent, but merely represent a complex interference pattern over the source due to the potential and current dipoles. For a single source, this *double peak effect* can be recognised as it tends to have two maxima displaced by ($n \times a + w$) where w is the width of the source. For multiple bodies this is difficult if not impossible to resolve by dipole-dipole arrays alone.

The enclosed Figure 4 shows the discharge of the energy stored in the body. As can be seen, the area sampled in section is tapped between the equipotentials generated by the discharge of the stored energy. These will not necesssarily be of the same form as those for the resistivity data, although they are, for convenience, plotted in the same format as for resistivity. Again, it is vital to note that theyrepresent the volume sampled as shown in Figure 4, *and not* the characteristics of the point at which they are plotted. Double peaks also occur as each of the two sets of electrodes pass over a source, where $n \times a$ is greater than the depth to source. Where $n \times a$ is less than the depth to source, a single maximum will be produced midway between the energising and measuring dipoles C_1/C_2 and P_1/P_2.

Pole-Dipole:- This array is similar in principle to the dipole-dipole array,



Current path and secondary equipotential field due to discharge of stored energy (I.P. effect) in the case of Pole-Dipole or Dipole-Dipole.

FIGURE 4.

except that a single electrode is placed 'close' to the potential dipole, with an 'infinite' electrode placed $10 \times n \times a$ away from the 'pole-dipole' set-up, and, where practical, at right angles to it. The enclosed Figure 5 shows the distribution of current flow in section and in plan, about the pole source C_1. The potential electrodes P_1 and P_2 tap off the volume between them, which is contained between spheres whose centres are the pole source. The primary current reading is normalised for the geometry and plotted in profile or pseudo-section format as per dipole-dipole, namely, midway between the closest potential and current dpoles, which in the pseudo-section format is 45° towards the pole source. The chargeability reading is generated in a similar fashion to that described for dipole-dipole (Figure 4).

As with the dipole-dipole array, a double peak will result when $n \times a$ is greater than the depth to source, however, with pole-dipole it will be asymmetric. This will be true for both major resistivity features as well as for chargeability features. An example of this asymmetry for different depth to spacing arrays is shown for the three-array. (The three-array is a pole-dipole array when $n = 1$ and the a spacing is varied.)

The Choice Between Arrays:- Even after some thirty years of active use of gradient, dipole-dipole and pole-dipole arrays, controversy still reigns as to the relative merit of the various arrays. Much depends on the object of the programme, the terrain, the type of source sought, the type and complexity of the overburden/oxidation. Table 1 shows a comparison between arrays which may be helpful, taken from a fairly recent Canadian Geological Survey publication. In resistive mountainous terrain the author prefers the gradient array as the prime reconnaissance method due to the high productivity (2 to 5 times that for

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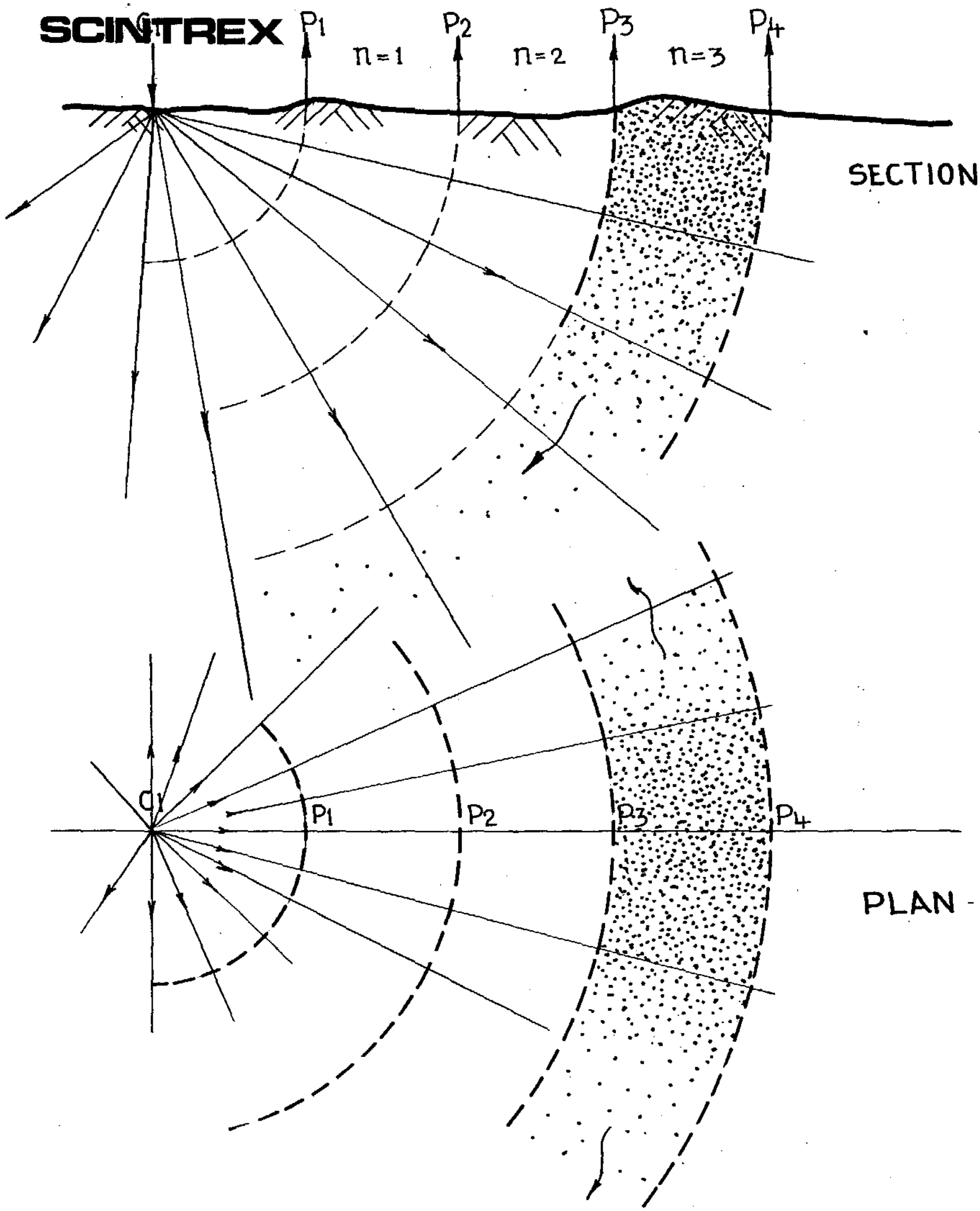

Current Path and Primary Equipotential Field from Pole-Dipole Array

FIGURE 5

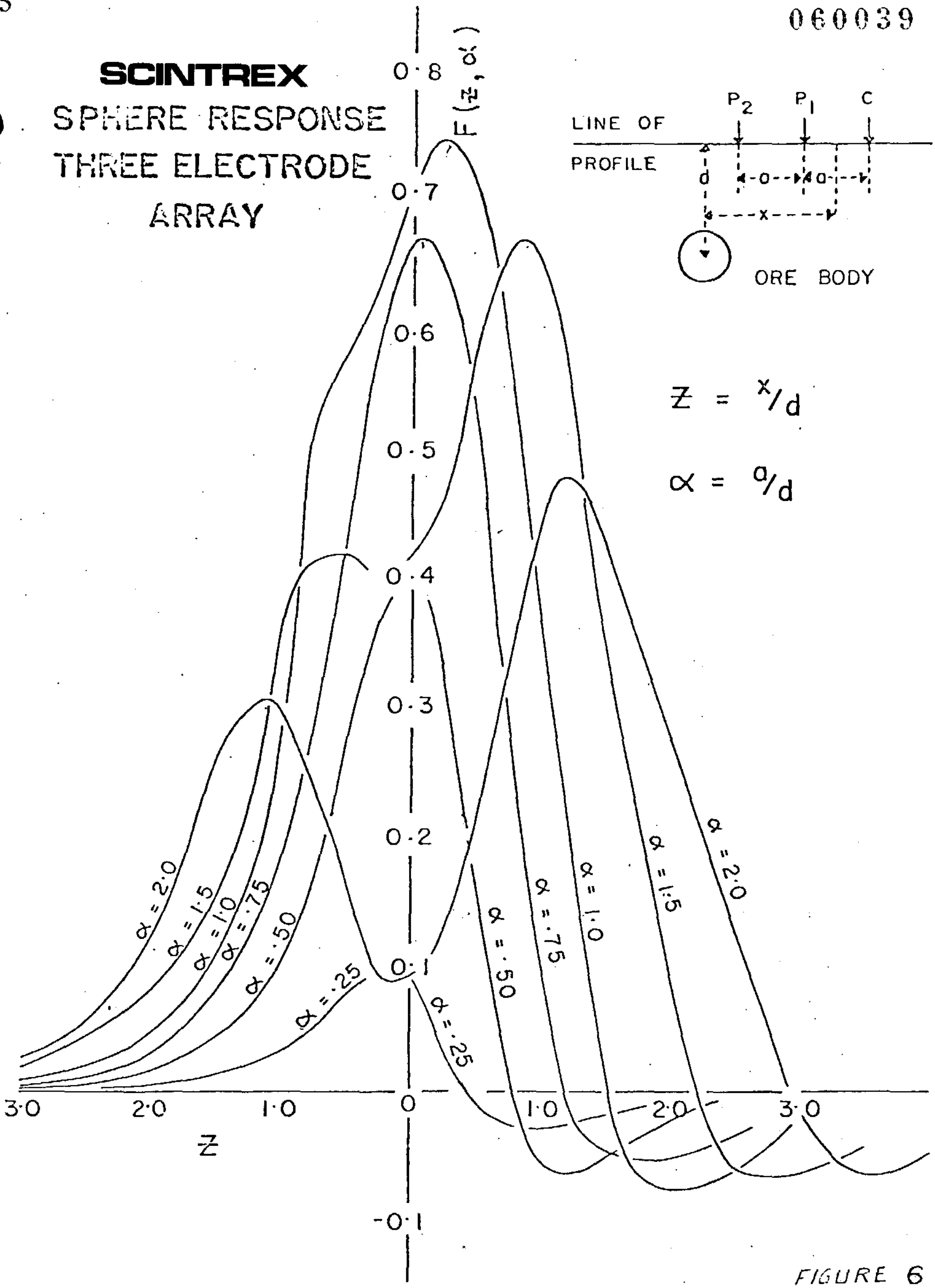
SCINTREX
SPHERE RESPONSE
THREE ELECTRODE
ARRAY
F(Z, α)
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
-0·1
LINE OF
PROFILE
P2
P1
C
d
a
a
x
ORE BODY
Z = x/d
α = a/d
α = 2·0
α = 1·5
α = 1·0
α = ·75
α = ·50
α = ·25
α = ·25
α = ·50
α = ·75
α = 1·0
α = 1·5
α = 2·0
3·0
2·0
1·0
0
1·0
2·0
3·0
Z

FIGURE 6

TABLE 1

(Table 3.1)

SCINTREX Comparison of IP Survey Electrode Arrays

(after Sumner, 1972)

	Advantages	Disadvantages	Survey Speed	Signal to-Noise	EM Coupling Rejection
Parallel Field Arrays Wenner	Anomalies symmetrical Synchronous detector possible Many case histories available	Requires more wire: larger field crew Poor resolution Unfavourable in capacitive coupling *situations*	Fair	Good	Fair
Schlumberger	Symmetrical array Synchronous detection possible *Fewer men required* Works well in layered earth Type curves available	Less horizontal resolution Unsuitable for horizontal profiling Capacitive coupling possible	Fair	Fair	Fair
Gradient	*Map interpretation easier* Less masking by conductive overburden Penetration good: safer Communications easier Can use two or more receivers Less topographic effect Data easily contoured in plan Useful where difficulty in making good current contacts	Poor resolution with depth Poor in low resistivity areas Geometric factor varies complexly	Good	Fair	Poor
Potential-About-a-Point Three-Array	Good reconnaissance array Fairly good resolution	Asymmetrical More wire needed	*Fair*	*Good*	*Good*
Pole-Dipole, Collinear	Good resolution Good subsurface coverage	Asymmetrical Asymmetrical	Fair	Fair	Fair
Perpendicular Three-Array, Pole-Dipole, Pole-Pole	Virtually eliminates EM coupling	More wire needed	*Fair to* Poor	*Fair*	Very Good
Pole-Pole (Two-Array)	Smaller crew needed Less wire needed than for some arrays Good penetration in nonconductive overburden	Susceptible to masking by *conductive over-burden*	Good	Fair	Poor
PDR (Potential Drop Ratio)	Sensitive to lateral variations "Common mode" noise rejection	Complex interpretation	Fair	Good	Fair
Dipole Field Array Dipole-Dipole Collinear	Symmetrical, good resolution *Good penetration* Less survey wire needed	Slow unless equipment is portable Resistivity topographic effects Interpretation somewhat involved	Fair	Poor	Fair
Dipole-Dipole, Parallel	Special use for EM coupling *interpretation*	Not used for routine surveying	Poor	Poor	Fair
Down-the-Hole Arrays *Azimuthal Array* (One Potential Electrode Down the Hole)	Fair for exploration purposes Useful in finding the best search direction	Interpretation complex Negative anomalies Strong geometric effects Mainly measures changes in resistivity	Fair	Good	Good
Radial Array (One Current Electrode Down the Hole, mise-à-la-masse)	Good for exploration purposes Useful in finding the best search direction Hole need not stay open	Interpretation complex Negative anomalies Not good for obtaining rock properties	Fair	Good	Good
In-Hole Arrays (More than One Electrode in the Hole)	Good for obtaining rock properties Good for assaying Interpretation simple	Current densities may be too large Possible capacitive coupling problems *Not designed for exploration purposes* Special equipment, expensive	Good	Fair	Good

Extract from: Geological Survey of Canada - Paper 75-31 "Borehole Geophysics Applied to Metallic Mineral Prospecting: A Review" dipole-dipole), but this should be followed-up by detailed dipole-dipole or pole-dipole surveys as the gradient array, while giving 'maximum depths', cannot give 'minimum depths' as moving source arrays can. Similarly pole- or dipole-dipole surveys which have complex or muliptle sources can very often be resolved by use of limited gradient array detail. While pole-dipole is more efficient to apply in mountainous terrain, it tends to yield asymmetric double peak anomalies, however, to the trained observer, this is no disadvantage.

Brief Comments on Decay Form:- In most surveys three 'slices' of the decay form for the induced polarization reponse are acquired for each station as shown in Figure 7. While six slices are capable of being measured (M_1 to M_6), they are normally combined into pairs $M_1 + M_2 = M_1$ etc. as shown in Figure 7(C). Each of the slices M_1 to M_6 is normalised for a 'normal' decay form such that should the decay form be 'normal' $M_1 = M_3 = M_5$. Thus the operator can immediately recognise any anomalous decay forms which may arise from one of two major sources. Firstly the type of the source can influence the decay form. Coarse grained efficient sources such as sulphides show *slow* decay forms, magnetic and fine grained sulphides often show *fast* decay forms. This can be shown as $\Delta M = M_5 - M_1$, where positive ΔM infers *slow* decay form and negative ΔM *fast* decay form. A superior parameter is ΔMn where

$$\Delta Mn = \frac{M_5 - M_1}{M_3} \times 100 \text{ (in percent)}$$

which is essentially ΔM normalised for the amplitude of the decay. ΔM and ΔMn are merely short hand ways to profile changes in decay form and are essentially qualitative and relative.

Decay forms can also demonstrate the presence of electromagnetic coupling as Figure 7 shows. This is a regional effect as shown on Figure 7(b). This will

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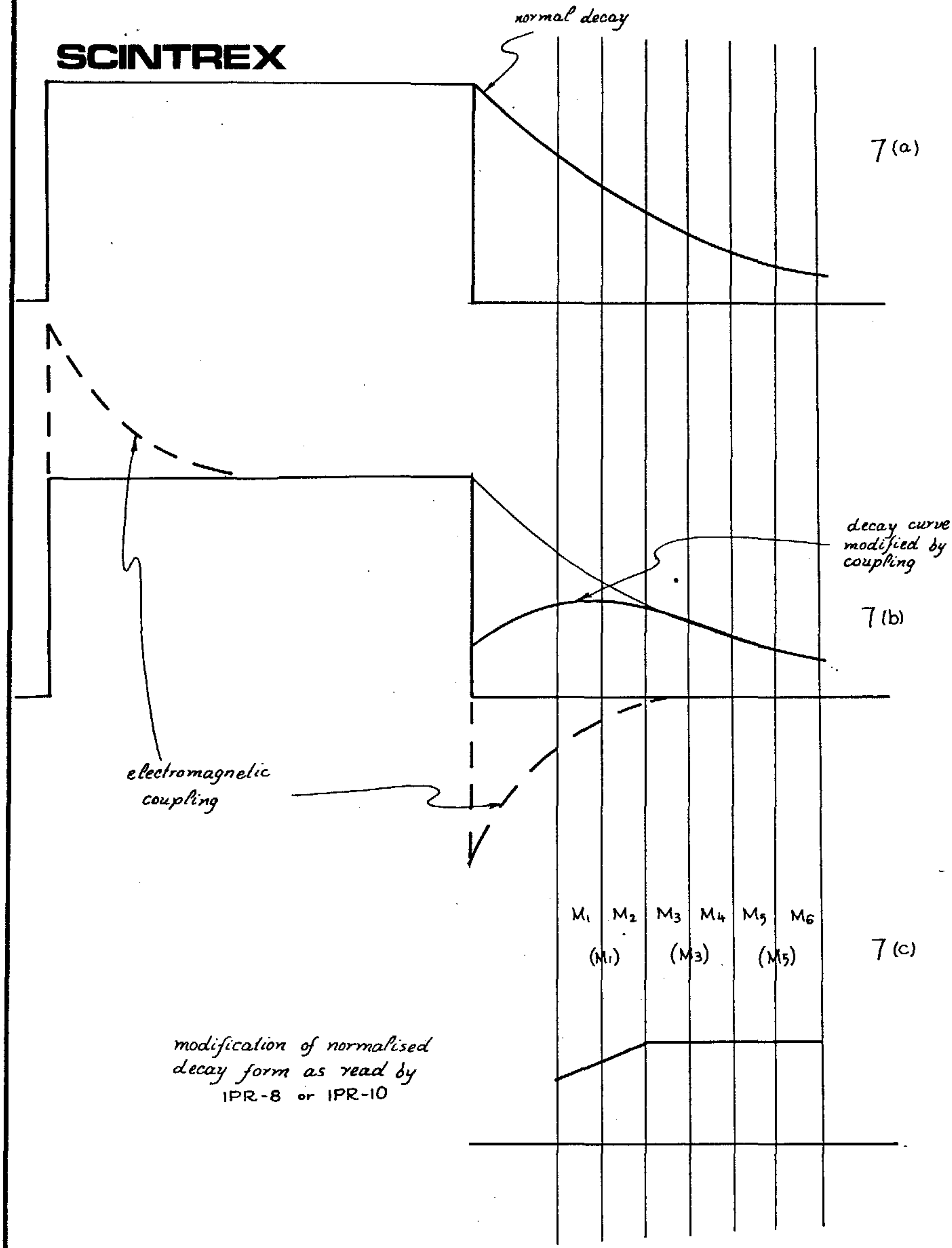

EFFECTS OF ELECTROMAGNETIC COUPLING ON IPR-8 / 10

Fig. 7

produce a normalised M_1 smaller than either M_3 or M_5.

Conclusion:- The above comments are indeed simplistic, and should be considered as a guide only. The author would be pleased to supply references on additional reading on any of the points commented upon.

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26N
Harmon River
GRADIENT ARRAY
TAS-074-E
ARRAY 1
Chargeability in milli-volts per volt
Resistivity in ohm-metres
A
2000W
1900W
1800W
1700W
1600W
1500W
1400W
1300W
1200W
1100W
1000W
900W
800W
700W
600W
500W
400W
300W
200W
100W
00

060045


044-1
044-2
044-3
044-4
044-5
24N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAY 1
A
CREEK

045-1
045-2
045-3
045-4
045-5
045-6
060046
22 N
Horman River
GRADIENT ARRAY
TAS-074-E
ARRAY I
E1
E2
E3
E4

046

060047

20 N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAY 10
Chargeability in millivolts per volt
Resistivity in ohm-metres
10,000
5000
2000
1000
500
200
100
48
40
36
32
28
24
20
16
12
8
4
0
100E
200E
300E
400E
500E
600E
700E
800E
68


047-2
043-3
047-4
047-5
047-6
047-6
047-7
060048
20N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 4 & 3
B
F1
F2
M
mv/V

060049
18 N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 4 & 3
048-1
048-2
048-3
048-4
048-5
048-6
048-7
048-8
C_1
C_2


049-2
049-3
049-4
049-5
049-6
049-7
049-8
NOTE REDUCED SCALE
M mV/V
200
150
100
50
0
50
100
ZONE 'C'
C3
C4
C5
060050
16 N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 4 & 3


060051
14 N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 5 & 6
050-2
050-3
050-4
050-5
050-6
050-7
050-8
NOTE REDUCED SCALE
M mV/V
100
50
0
C6
C7
C8
C9
ZONE 'C'


051-2
051-3
051-4
051-5
051-6
051-7
051-8
060052
12N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 5 & 6
ZONE C10

060053


051-2
052-3
052-4
052-5
052-6
052-7
10 N
Harman River
GRADIENT ARRAY
TAS-074
ARRAYS 5 & 6
NOTE: REDUCED SCALE
C12
C11
C13

053

060054

8N

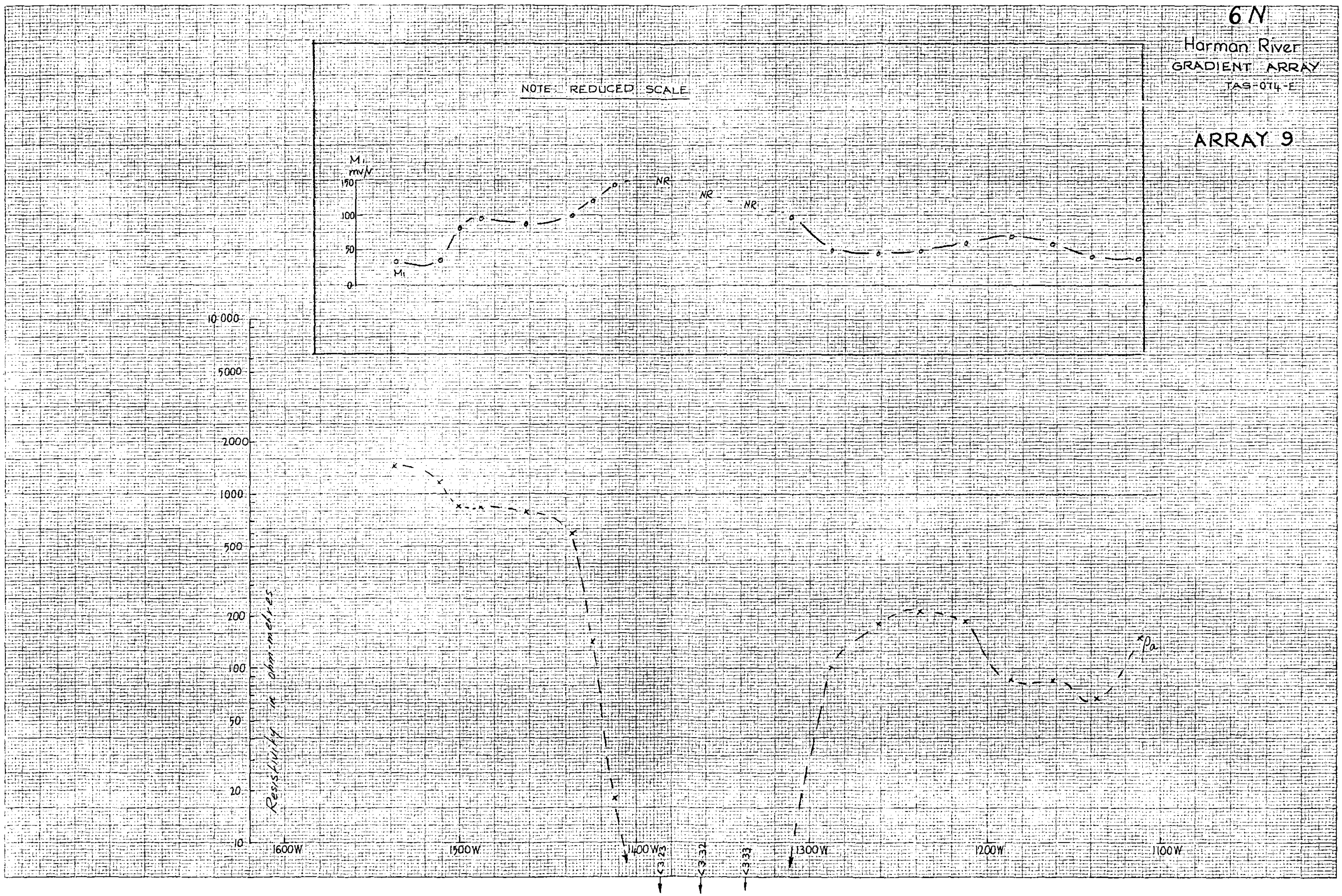
Harman River

GRADIENT ARRAY

TAS-074

ARRAY 9


054-1
054-2
054-3
054-4
054-5
054-6
054-7
054-8
060055
8N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 7+8
NOTE REDUCED SCALE
M
mv/V
150
100
50
0
GI
GI



6N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAY 9
NOTE: REDUCED SCALE
M1 mV/V
150
100
50
0
M1
NR
NR
NR
10 000
5000
2000
1000
500
200
100
50
20
10
Resistivity in ohm-metres
ρa
1600W
1500W
1400W
1300W
1200W
1100W
3.23
3.32
3.33

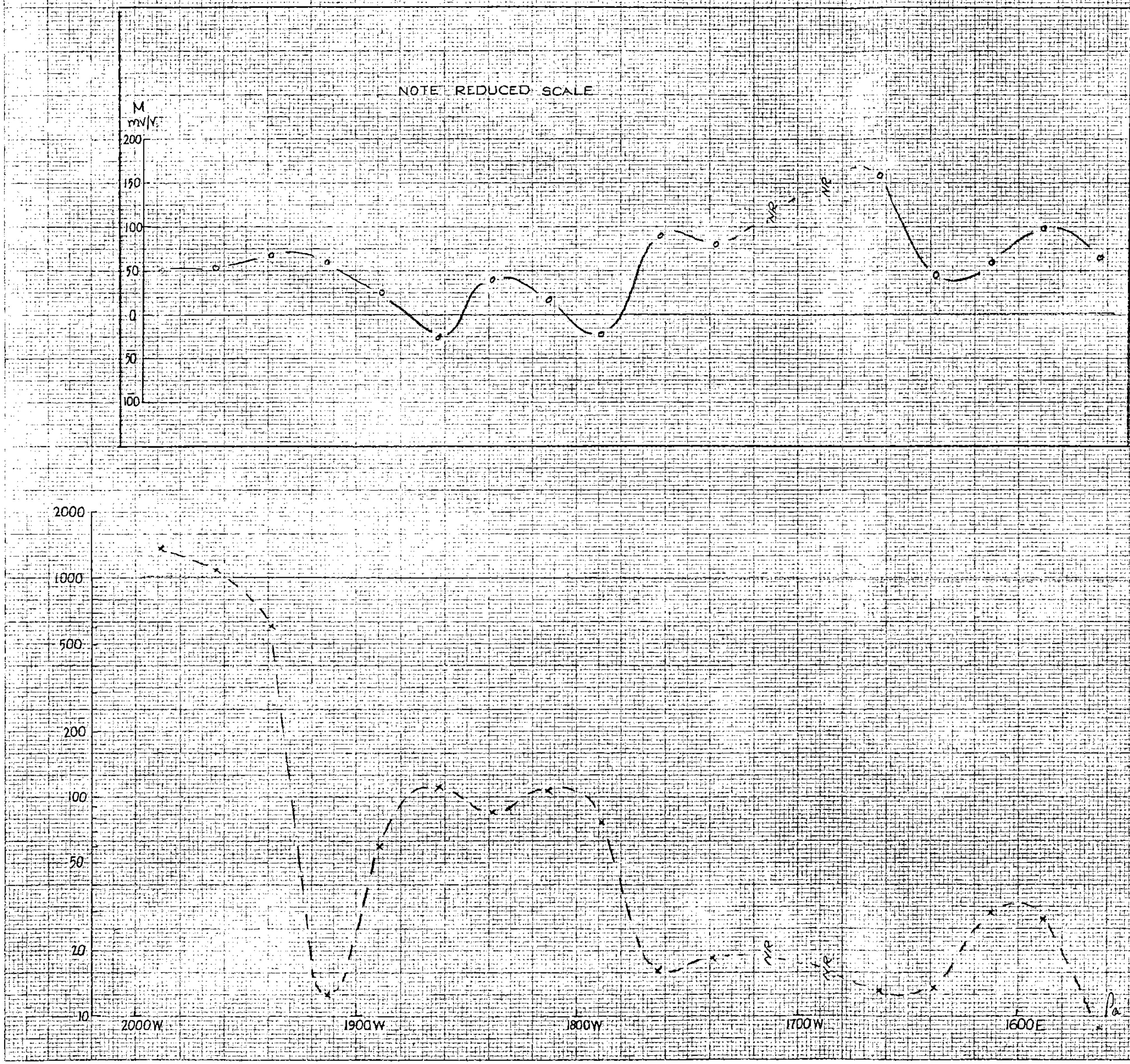

056-1
056-2
056-3
056-4
056-5
056-6
056-7
056-8
056-9
NOTE REDUCED SCALE
D4
D3
D2
D1
ZONE C15
ZONE C15
G2
G1
6N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 7&8
060057

060058

4 N

Harman River
GRADIENT ARRAY
TAS-074

ARRAY 9




4N
Harman River
GRADIENT ARRAY
TAS-074-E
ARRAYS 7+8
NEW REDUCED SCALE
D8
D7
D6
D5
G4
G3
G2
G1
G5

059-1

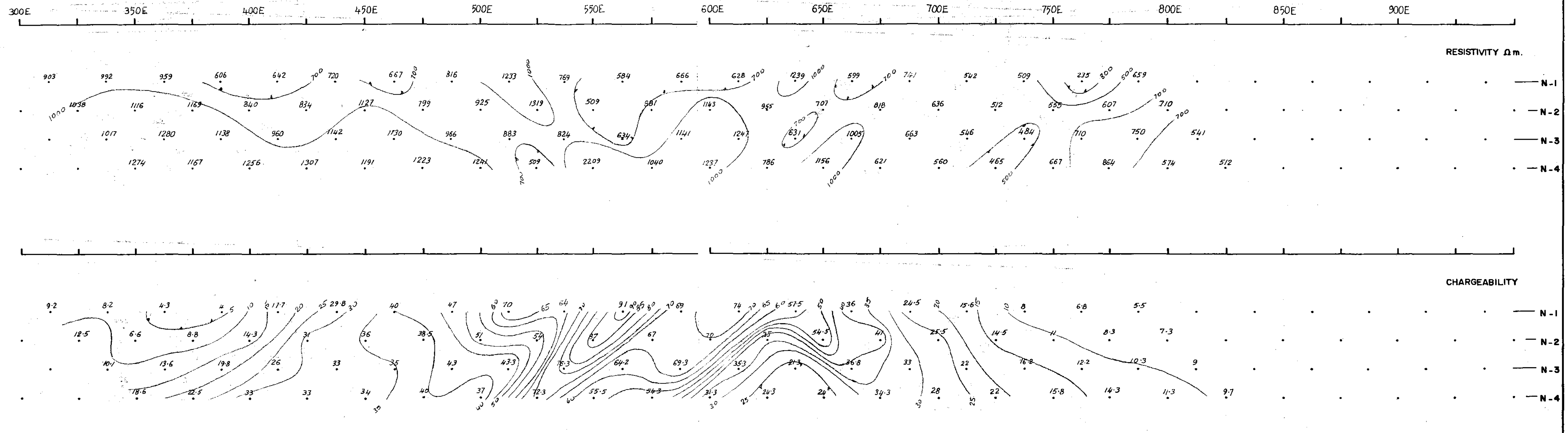
059-2

060060

SCINTREX PTY. LTD. INDUCED POLARIZATION AND RESISTIVITY SURVEY DIPOLE - DIPOLE ARRAY	DATE 20-2-80	
	PLOTTED BY BE	
	PULSE 2 sec	Rx.
	DIPOLE SPACING 25 m	

SCINTREX PTY. LTD. INDUCED POLARIZATION AND RESISTIVITY SURVEY DIPOLE - DIPOLE ARRAY	DATE 22-2-80	
	PLOTTED BY BE	
	PULSE 2 Sec	Rx.
	DIPOLE SPACING 25 m	

LINE No.	20N
PROSPECT	HARMAN RIVER
JOB No.	TAS-074-E



5 cm

060

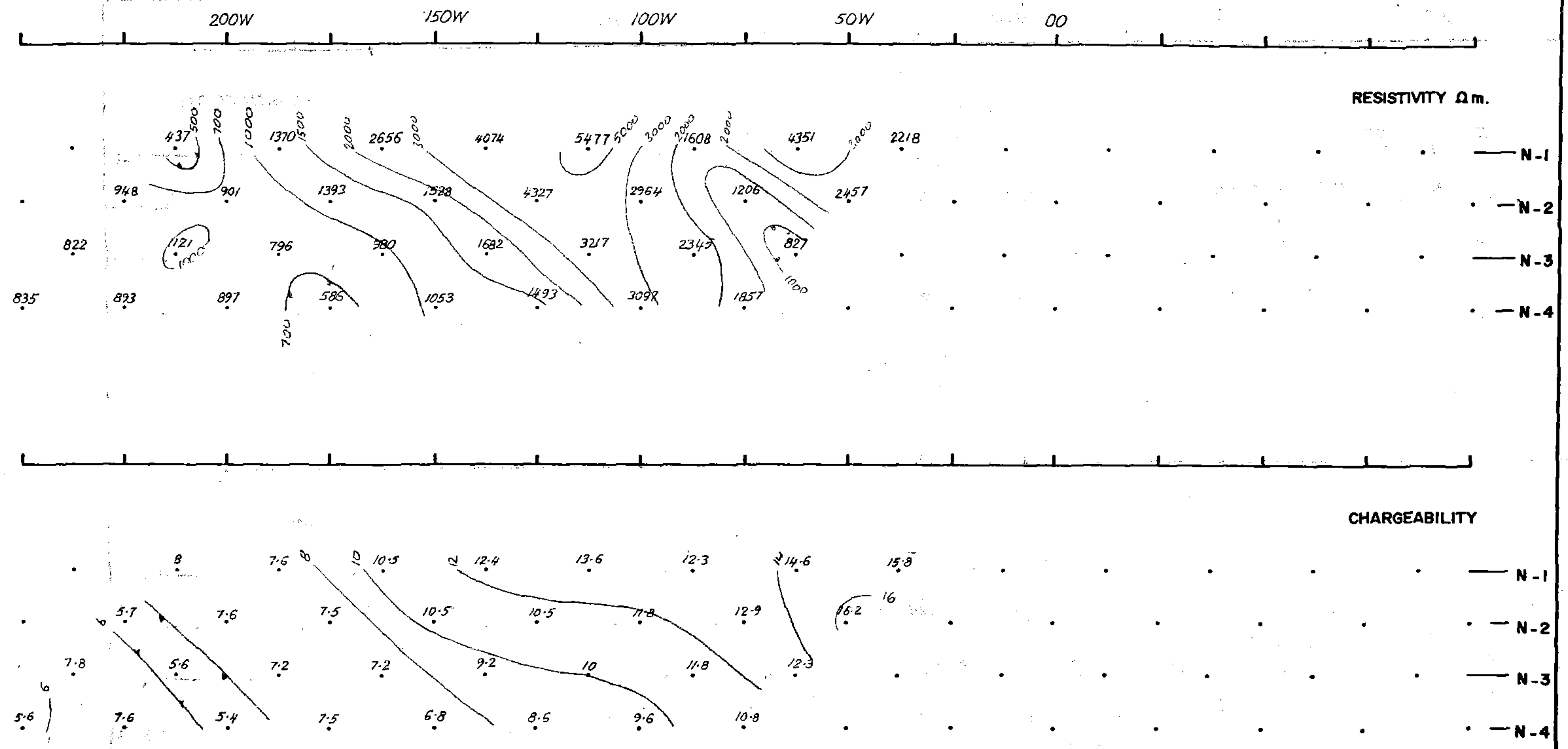
060061

SCINTREX PTY. LTD.

INDUCED POLARIZATION AND RESISTIVITY SURVEY

POLE - DIPOLE ARRAY

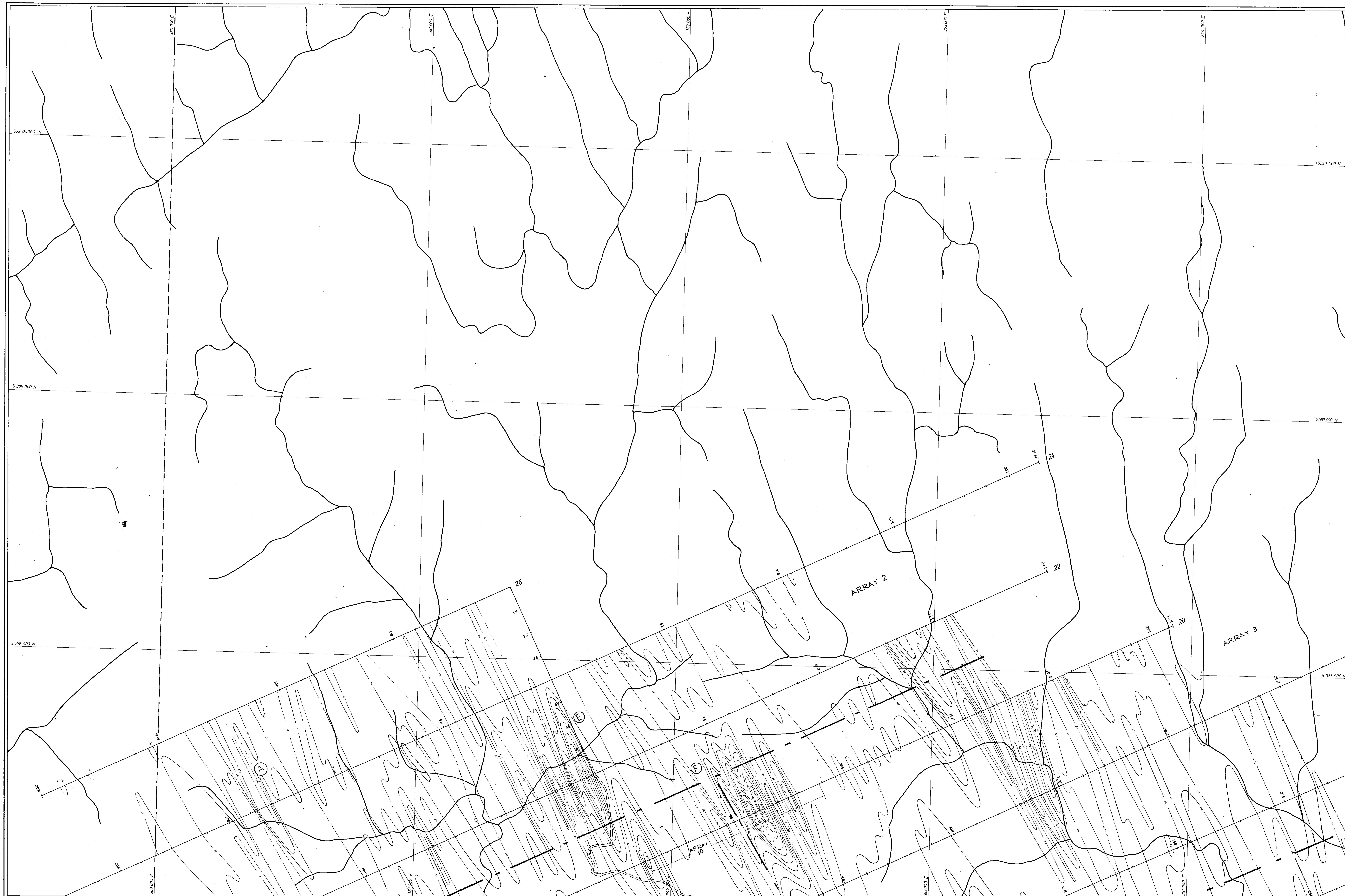
DATE	22-2-80
PLOTTED BY	BE
PULSE	2 sec
Rx.	
DIPOLE SPACING	25m
LINE No.	26 N
PROSPECT	HARMAN RIVER
JOB No.	TAS-074-E



5 cm

2916

2916



Legend

ARRAY 1. - Electrodes at 2400W + 2100E on 24N
3. - 200W + 3000E on 18N
4 - 2400W + 3000E on 18N
5 - 2500W + 700E on 12N
6. - 300W + 2900E on 12N
7. - 3400W + 200W on 6N
8 - 1000W + 2200E on 6N
9 - 2100W + 500W on 6N
10. - 100E + 1000E on 20N

SURVEYED & COMPILED BY SCINTREX
JAN - FEB - 1980
Job N° TAS - 074 - E

060062

RENISON LIMITED

CORINNA D1/2

GRADIENT ARRAY EIP SURVEY
CHARGEABILITY CONTOUR MAP

GEOLOGIST	SCALE 1 5000 METRES
DRAUGHTSMAN	100 0 100 200
DATE	
REVISIONS 2916 80-1465	DRAWING No PLATE 1 Sht 1 of 2

5 cm

2917

E.L. 17/77
E.L. 18/73
E.L. 2/63
ARRAY 4
ARRAY 5
ARRAY 6
ARRAY 7
ARRAY 8
ARRAY 9
Harman Camp
Wilson River
5 386 000 N
5 385 000 N
5 384 000 N
Legend
ARRAY 1. - Electrodes at 2400W + 2100E on 24N
3 - 200W + 3000E on 18N
4 - 2400W + 3000E on 18N
5 - 2500W + 700E on 12N
6 - 300W + 2900E on 12N
7. - 3400W + 200W on 6N
8. - 1000W + 2200E on 6N
9. - 2100W + 500W on 6N
10. - 100E + 1000E on 20N
5 cm
D1/1
D1/2
CORINNA D1
D1/3
D1/4
D2/3
D3/2
SURVEYED & COMPILED BY
SCINTREX
JAN-FEB-1980
Job N° TAS-074-E
060063
RENISON LIMITED
CORINNA D1/4
GRADIENT ARRAY EIP SURVEY
CHARGEABILITY CONTOUR MAP
GEOLOGIST
DRAUGHTSMAN
DATE
REVISIONS
SCALE 1 5000 METRES
100
0
100
200
2917
80-1465
DRAWING No
PLATE 1.
SHT. 2 of 2.

2918

2918

060064

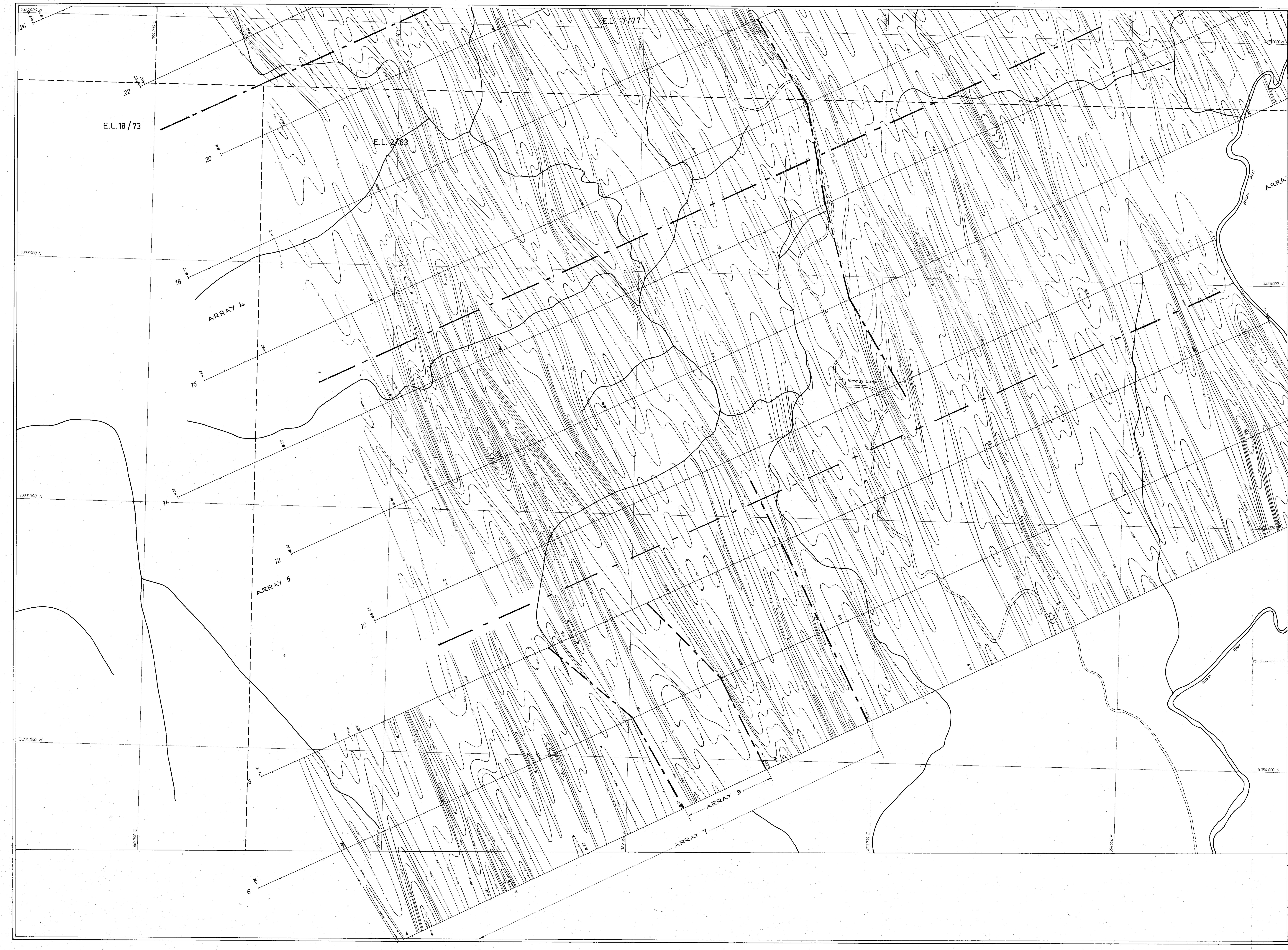
RENISON LIMITED

CORINNA D1/2

GRADIENT ARRAY EIP SURVEY
RESISTIVITY CONTOUR MAP

GEOLOGIST	SCALE 1 5000 METRES
DRAUGHTSMAN	100 0 100 200
DATE	
REVISIONS 2918	DRAWING No. PLATE 2. SHT. 1 of 2.

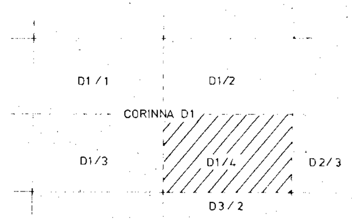
80-1465



Legend

ARRAY 1. - Electrodes at 2400W + 2100E on 24N
3 - 200W + 3000E on 18N
4 - 2400W + 3000E on 18N
5 - 2500W + 700E on 12N
6 - 300W + 2900E on 12N
7 - 3400W + 200W on 6N
8 - 1000W + 2200E on 6N
9. - 2100W + 500W on 6N
10 - 100E + 1000E on 20N

5 cm



SURVEYED & COMPILED BY SCINTREX

JAN-FEB-1980
Job No TAS-074-E

060065

RENISON LIMITED

CORINNA D1/4

GRADIENT ARRAY EIP SURVEY
RESISTIVITY CONTOUR MAP

GEOLOGIST	SCALE 1 5000 METRES	
DRAUGHTSMAN	100 0 100 200	
DATE		
REVISIONS	2919	DRAWING No PLATE 2. SHT. 2 of 2

80-1465

RENISON LIMITED

CORINNA D1/2

GRADIENT ARRAY EIP SURVEY
INTERPRETATION PLAN

060066

2920

80-465

PLATE 3.
SHT. 1 of 2.


2921
2921
B
ZONE C
ZONE C
ZONE D
ZONE G
5 385 000 N
5 384 000 N
Legend
Chargeability high
Major areas of high induced polarization
less resistive
R resistive
resistive axes
conductive axes
conductive areas
5 cm
D1/4
SURVEYED & COMPILED BY
SCINTREX
JAN-FEB 1980
Job. No TAS-074-E
RENISON LIMITED
CORINNA D1/4
GRADIENT ARRAY EIP SURVEY
INTERPRETATION PLAN
060067
2921
PLATE 3.
SHT. 2 of 2.
80-1465