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Received - 6 JAN 1982 E & I
Answered

DEPT. OF MINES
REF. No. 130/82.

A REPORT ON

DETAILED GRADIENT AND DIPOLE-DIPOLE ELECTRICAL INDUCED POLARIZATION SURVEYS

AGNEW GRID, TRIAL HARBOUR ROAD ZEEHAN, TASMANIA

ON BEHALF OF

RENISON LIMITED

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A REPORT ON DETAILED GRADIENT AND DIPOLE-DIPOLE ELECTRICAL INDUCED POLARIZATION SURVEYS AGNEW GRID, TRIAL HARBOUR ROAD ZEEHAN, TASMANIA

ON BEHALF OF

RENISON LIMITED

BY

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DECEMBER,1981

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SUMMARY

A series of 500 and 600 metre gradient arrays, together with 30 metre dipole-dipole detailed arrays, were surveyed over some nine zones of interest defined in the January, 1981 reconnaissance survey.

The detailed gradient data has, in most cases, shown the anomalies to be of quite complex form, and to be composed of a series of events whose strike length is invariably less than the line spacing. On the whole, the form of the anomalies on the northern belt (i.e.1, 3, 4, 5 and 9) are reminiscent of Sweeney's and Federation grid type responses, only more extensive.

A wide variaty of decay forms within some of the areas (e.g. 1, 3 and 4), and between areas (e.g. 2 and 7) to the south and 1, 3 and 4 to the north were noted. It seems entirely possible that the material changes in decay form may differentiate economic and non-economic mineralisation in this (limited) case.

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INTRODUCTION

At the request of Mr. L.A. Newnham, Chief Geologist for Renison Limited, Scintrex Pty. Ltd. carried out a series of detailed electrical induced polarization surveys utilising the gradient and dipole-dipole geometries. The targets were generated as a result of a 44 line kilometre reconnaissance gradient array survey carried out in January, 1981 and described in Scintrex report dated May, 1981 by the author.

The work was carried out by senior Scintrex crew leader Mr. P. Brown, B.Sc., over the period 4th November to 7th December, 1981 in conjunction with surveys on other sites in the area. On-site geological supervision was carried out by Mr. P. Roberts, Senior Exploration Geologist, assisted in the latter part of the survey by Mr. D. Kilpatrick, Project Geologist for the area. The author visited the site on 23rd and 24th November, 1981.

METHOD

The method employed consisted of small current dipole gradient arrays of 500 to 600 metres using a 10 metre potential dipole and a = 30 metres dipole-dipole detail on selected lines for n = 1 to n = 5. Both geometries used a standard two second square wave for energisation, with the resultant secondary fields being recorded employing a three slice programme on two second timing. Appendices to this report briefly describe the salient features of these methods.

DATA PRESENTATION

The data is to be final drafted by Renison. It is strongly recommended that the scale be 1:2000 as this scale best displays the data.

Scintrex has presented the data for each of the detail sites at the scale of 1:2000 for apparent resistivity and chargeability for both profile and contour maps. The scales used were:-

Chargeability: 1 centimetre = 4 millivolts/volt

Decay Form, ΔMn: 1 centimetre = 5%

Resistivity: 5 centimetre log cycle

The dipole-dipole data is presented in standard format on Scintrex data sheets.

For each gradient detail, the original chargeability data has been contoured and is designated "OM", the detailed chargeability data contoured and designated "DM", and the detailed resistivity contoured and designated "DR". In addition, where significant, the decay form has also been contoured and is designated "DS". The area number follows the designation and identifies each area.

DISCUSSION OF RESULTS

Each of the nine areas are separately discussed below. Reference to the comments in the author's report on the original reconnaissance work are given at the top of each section. (Reconnaissance Survey Report, pages: RSR pp). The original anomaly designation is also given

AREA 1 *RSR: pp 4-5*

Original survey zone A

The detailed survey used a current dipole of 500 metres with electrodes at 620N and 1120N on 700E. Some six lines, 550E, 600E, 650E, 700E, 725E, 750E and 800E were surveyed using a 10 metre potential dipole.

The original induced polarization response was essentially seen on two lines 600E and 700E and showed little if any material response on lines 500E and 800E. As originally contoured (Plate OM-1), a simple source was implied. Plate DM-1 however, clearly demonstrates that the source is complex, and has three main loci situated as follows:

Zone 1A 700E/845N, 650E/875N, 600E/865N

Zone 1B 650E/830N

Zone 1C 600E/895N

It is assumed that the relative line positions are in fact as supplied, however, the data suggests that the better fit to the data would be to move the anomaly on line 650E at 825N some 50 metres north to give two en-echelon zones. It is suggested that this be checked in the field at the earliest opportunity.

There is a most significant contact in chargeability, with subzones A and B reaching 60 millivolts/volt(+) as compared to a background of 5 to 10 millivolts/volt. A further contact with background is seen in the decay form. For the most part the background decay form is quite fast with ΔMn being as low as -58%. The polarization responses, however, are invariably slower, and for the larger responses (50 millivolts/volt+), reach near normal decays. This implies the source material to be coarser, and a more efficient holder of the induced charge than the mafic mineral background of the host rocks. However, the essentially normal decay implies only average grain size for the source.

The original survey gave a somewhat exaggerated impression of the strike length of the anomaly. At most the mineralisation has a strike length of about 140 metres, being contained between coordinates 725E and 575E. The source is obviously multiple in nature, and even from the density of information on the detail, the orientation of the causative mineralisation cannot be positively identified, as the anomaly form gives a biassed impression.

From the gradient array data a maximum depth to the top of the source can be estimated. By line and station these are as follows:-

Line 600E	at 895N	30 metres
	at 865N	27 metres
Line 650E	at 875N	35 metres
	at 825N	30 metres
Line 700E	at 905N	10 metres
	at 870N	25 metres
	at 845N	35 metres
Line 725E	at 835N	35 metres

The associated apparent resistivities are a relatively low 400 ohm-metres in sub-zones A and B and below 1000 ohm-metres in sub-zone C as compared with a background of 1500 ohm-metres to 2000 ohm-metres in the host rocks. Thus either the mineralisation is such as to influence the bulk resistivity of the enclosing rocks or alternatively seritisation alteration could be responsible. A further observation is that the resistivity may form a roughly circular pattern around the mineralisation, namely, a low resistivity centre (e.g. 400 to 1000 ohm-metres), a resistive 'halo' to 2000 ohm-metres ($\pm$) and more normal backgrounds away from this resistive halo. When the direction of the energising current is allowed for this remains a possibility.

The decay form, ΔMn, suggests a circular structure over the more intensely mineralised zone also, with a coarser grain size over the deposit, with progressively faster decay away from it, suggesting progressively finer grain size (or less efficient sources). The near normal decay form suggests a bulk sulphide content in the range 3.5% to 5% by volume within the zone.

The low resistivities indicated in the dipole-dipole data (to 50 ohm-metres on line 650E at 840N), again strongly suggest that either alteration is present if the mineralisation is of the Waxman-Weston type, or that if pyrite is present in the Sweeney style, then other minerals such as chalcopyrite or pyrite could be present also to provide the interconnection required for the observed low resistivities.

Review of Lines in Detail

Line 550E ..... The first line on which the anomaly is seen is 550E. The chargeability background at 6 to 8 millivolts/volt is accompanied by low, -25%, decay form, which implies abnormally fast decay forms. The anomalous response reaches 15 to 20 millivolts/volt between 820N and 935N, with individual maxima at 825N (maximum depth 10 metres), 865N (maximum depth 20 metres), 905N and 935N (maximum depth 20 metres).

Line 600E ..... There is a dramatic increase in amplitude between 550E and 600E with the response being situated between 805N and 905N. The major maximum (sub-zone C) of just under 50 millivolts/volt is situated at 895N and has a maximum depth to source of the order of about 30 metres. A second significant source of 42 millivolts/volt was defined at 865N (sub-zone A) and has an estimated maximum depth of 27 metres. This response coincides with the lowest recorded apparent resistivities of 650 ohm-metres. A third minor source is inferred at *about* 825N($\pm$) where a 'shoulder' of about 10 millivolts/volt above background was recorded. There is a marked decay form response over the polarization section. North of about 920N and south of 810N the ΔMn values are a fast -30%, while over the two major maxima at 895N and 865N, decays are almost normal.

A comparison with the original 20 metre reconnaissance data shows a displacement south of the anomaly for the larger current dipole. This would tend to indicate a steep south dip with respect to the enclosing host rocks.

The 30 metre dipole-dipole run at a = 30 metres for n = 1 to 5, shows significant anomalism of 33 to 39 millivolts/volt between 900N and 840N. While the chargeable material comes to within the dipole length (30 metres) of surface, a higher chargeability of 47 millivolts/volt at 870N may imply greater interest at depth at this point. Of significance is the low apparent resistivities of 120 ohm-metres at 870N (n=2) which show a four fold contact with apparent resistivities to the north and a 15 fold contact to the south.

Line 650E ..... This line, run only on the detailed survey, showed strong anomalism of over 44 millivolts/volt between about 795N and 895N. The form of the response suggests three individual sources at 825N where the maximum depth is 30 to 35 metres at 855N and at 875N where the maximum depth is of the order of 35 metres. The associated resistivity shows a marked depression to 300 ohm-metres at 835N as compared to 2000 ohm-metres at 930N±20 metres and 1500 ohm-metres at 775N.

As for other lines, decay forms over the maxima are near normal, but decrease to moderate negative values to the north and south.

The a = 30 metres, n = 1 to 5 dipole-dipole data shows very strong chargeabilities of 83 millivolts/volt centred at 855N, with lower values to 68 millivolts/volt extending south to 825N. Certainly the depth to source is less than the 30 metres dipole used.

The apparent resistivities recorded from 870N to 810N from n = 1 and n = 2 lie between 47 and 89 ohm-metres and represent the lowest values recorded in this zone, and make excellent contacts with the 500 ohm-metres background to the north and 900 ohm-metres background to the south.

A detailed dipole-dipole survey was carried out between 810N and 900N employing an 'a' spacing of 15 metres on n = 1 to 5 (and 6). A great deal of detailed information is contained in the pseudo-section. Firstly, the apparent resistivities at 818N show a low 44 ohm-metres within 7 metres of surface. This is accompanied by 75 millivolts/volt chargeability. This response is the most convincing for semi-massive sulphide seen on any of the data.

A distinct resistivity low between 862N and 840N for n = 3 clearly demonstrates that a shallow near surface zone of higher (but still low in absolute terms) resistivities is present to about 15 metres±. Also clearly demonstrated is the extremely high coincident chargeabilities of 96 millivolts/volt which show slightly slower than normal decays of +2.5%. The maximum depth to source is seen as about 30 to 35 metres.

Line 700E ..... The anomaly was defined between 800N and 910N. A sharp maximum of 24 millivolts/volt was defined at 905N which has a narrow source at a maximum depth of 10 metres. A second more material response at 870N of 36 millivolts/volt defines a second source whose maximum depth to source is 20 to 25 metres. The major response of 65 millivolts/volt on this line (sub-zone B) is centred at 845N. The maximum depth to source is estimated at 35 metres. A relatively minor 'shoulder' response of 22 millivolts/volt (±) is interpreted as being a source at a depth of about 15 metres below 810N.

As with other lines, the decay forms are near normal over the two major maxima, and become rapidly faster as the edges of the sulphide source are reached.

A significant resistivity low of about 450 ohm-metres was defined centred at 845N as opposed to maxima of 2000 ohm-metres at 915N and 1700 ohm-metres at 790N. What is interesting is that while the highest chargeability values are associated with the lowest apparent resistivities, the high apparent resistivity forms a 'halo' around the low, inferring perhaps silicification on the periphery of the mineralisation?

A comparison between the reconnaissance data and detailed data, as expected, shows similar results, but with the chargeability maximum displaced south. After allowing for the change from 20 metres to 10 metres potential dipole, this would still imply a south dip (with respect to the surface) to the source.

The dipole-dipole data was acquired between 960N and 780N for a = 30 metres between n = 1 and n = 5. The data shows a broad source between 870N and 840N (made up of the two individual maxima at 845N and 870N resolved from the gradient data) having a maximum depth to source of less than 30 metres. The amplitude of the background at 6 millivolts/volt(±) to the north and 7 to 9 millivolts/volt to the south conform well with the gradient data as does the amplitude of the maximum response of 61 millivolts/volt recorded for n = 1 at 855N. Of greater significance are the lower apparent resistivities of 100 to 200 ohm-metres recorded over the zone of maximum polarization. These values are indicative of significant alteration and/or interconnection as they represent 10% of the value observed within the granite hosts.

Line 725E ..... The gradient array data shows the presence of the anomaly between 845N and 755N (or to the south thereof) but with much reduced amplitude averaging about 20 millivolts/volt(±). The maximum of 24 millivolts/volt at 835N has a depth to source of about 30 metres, and is associated with a narrow, but definite resistivity low. Other maxima of 21 millivolts/volt at 795N and 18 millivolts/volt at 765N have maximum depths of the order of 15 metres(±). The average resistivities observed over the higher chargeability at 1000 ohm-metres(±) are about half that seen to the north.

Line 750E ..... This is the final line over which the anomaly extends, albeit at the relatively minor amplitude of 16 millivolts/volt as against 10 millivolts/volt. The anomaly has a sharp boundary at 825N and is still open to the south of 755N where the survey line ends. The maximum depth to source at 815N is 20 metres.

As observed on other lines, the decay form is slower over the higher chargeability than to the north over background, however, at -20% it is itself quite fast.

Line 800E ..... The final line surveyed revealed two 22 millivolts/volt responses centred at 890N and at 805N, both against a background of about 8 to 10 millivolts/volt. The maximum dpeth to source in both cases is 20 metres(±) and both show relatively fast decay form of ΔMn = -10% as against -20% to -30% background. These responses do not appear related to those recorded in the main zone to the west.

CONCLUSIONS

1 *The mineralisation detected has low bulk resistivities of 50 to 200 ohm-metres coincident with the highest chargeabilities and has an inferred halo of higher than average resistivity. The mineralisation is characterised by near normal decay forms, indicating 'average' grain size, but is surrounded by material having much faster decay forms indicative of fine grain or inefficient (mafic minerals?) source.*

2 *The chargeability indicates the bulk of the source material to lie within a strike length of about 140 metres(±) between lines 550E and 725E, with the most significant responses being seen on lines 600E, 650E and 700E. The form of the anomalies is multiple. (However, it is possible that line 650E should be moved 50 metres (±) to the north, and if so, the result would be two en-echelon zones).*

3 *The maximum depths to the top of the sources range to 35 metres and are often half this. The dip indicated is to the grid south.*

4 *The best line for drilling is line 650E, with three maxima at 830N, 855N and 875N, indicating three separate sources within the anomalous zone between 805N and 890N(±). Two shorter holes may be preferable to a single longer hole to test the width of this zone. While line 650E is the preferred line for investigation by drilling, line 600E and 700E rank almost equally. In both cases multiple sources over 60 metres(±) in width would also imply a two hole test of the source. Minimum target depths are 30 to 35 metres.*

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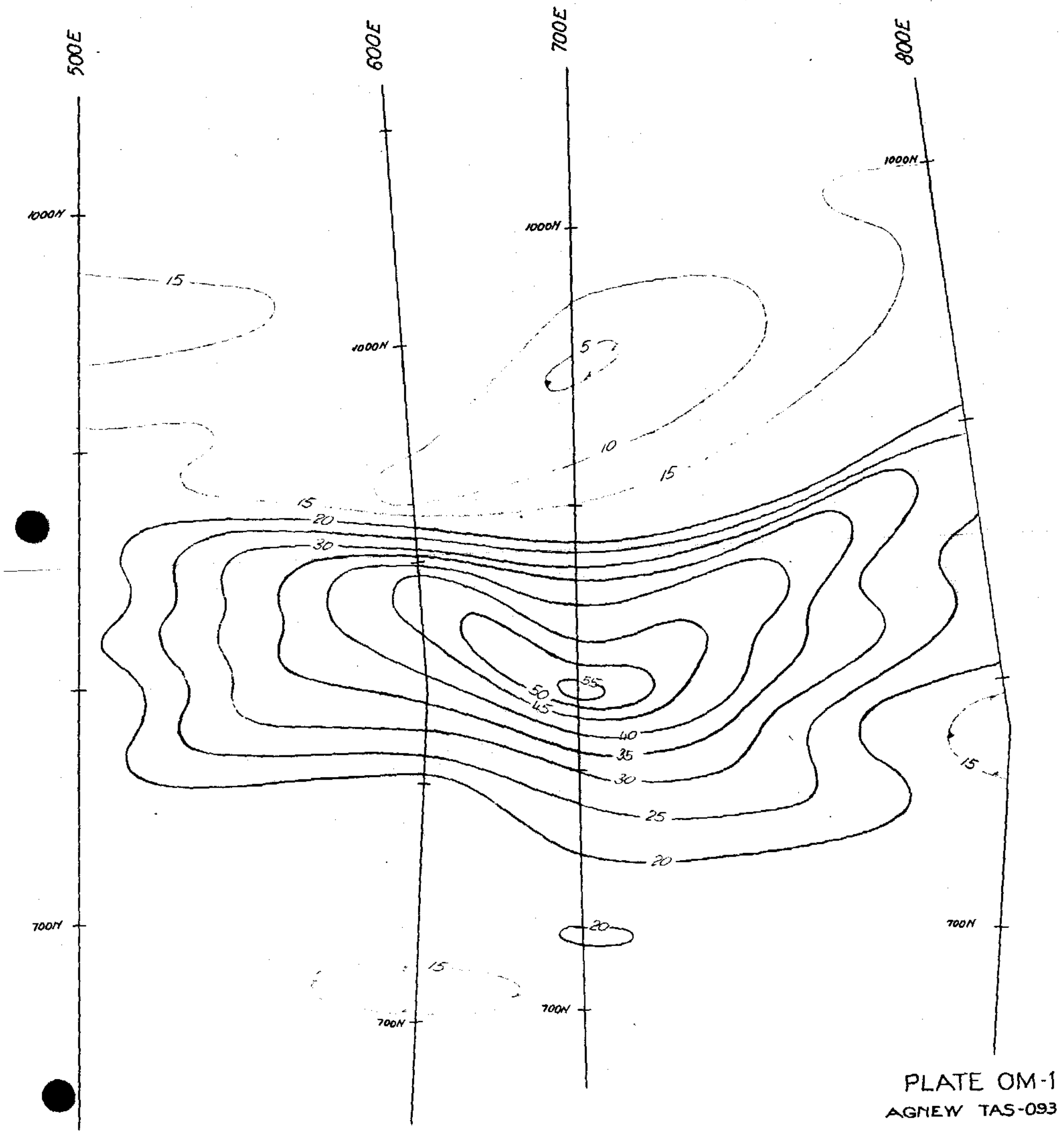

PLATE OM-1
AGNEW TAS-093

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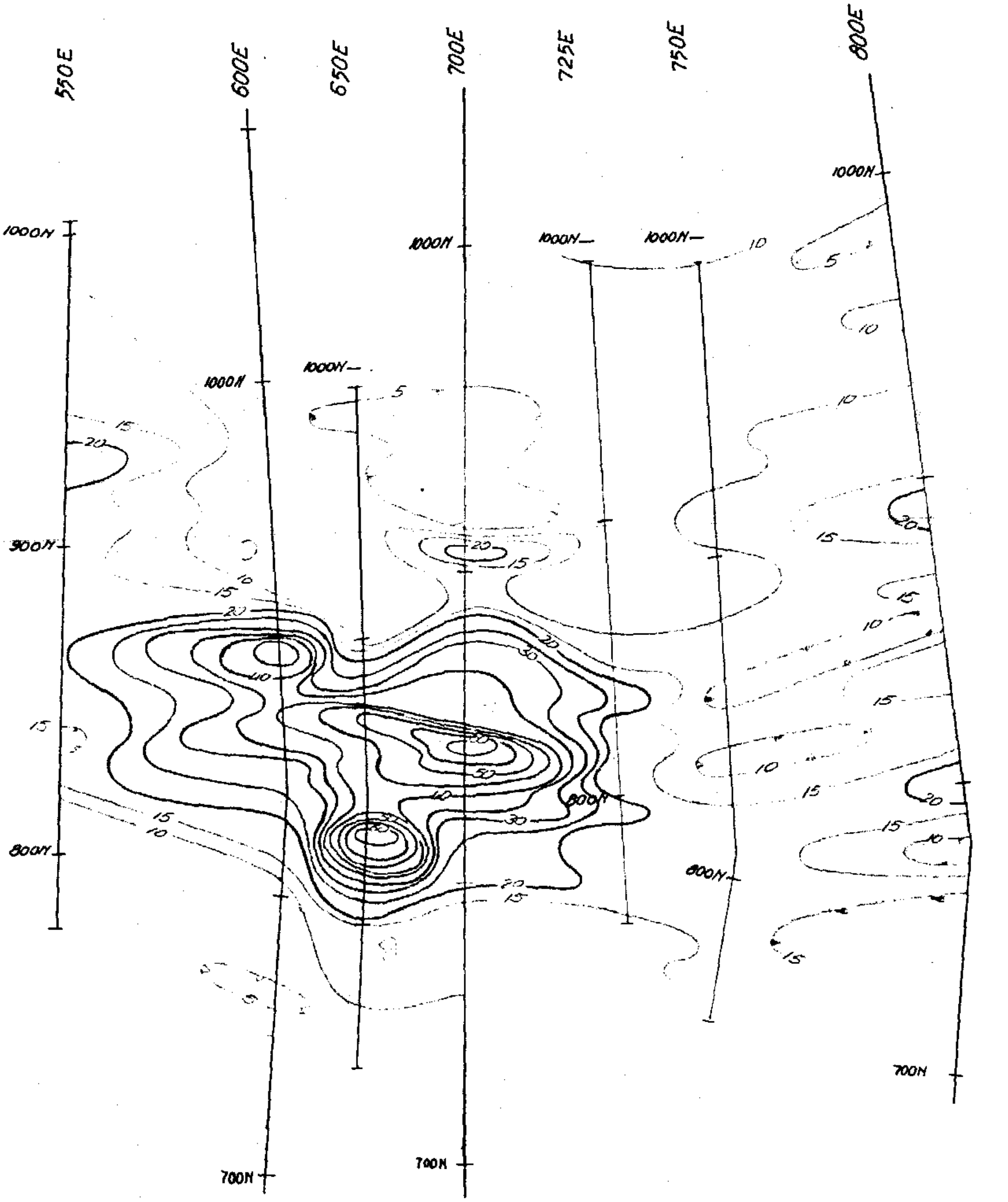

PLATE DM-1
AGNEW TAS-093

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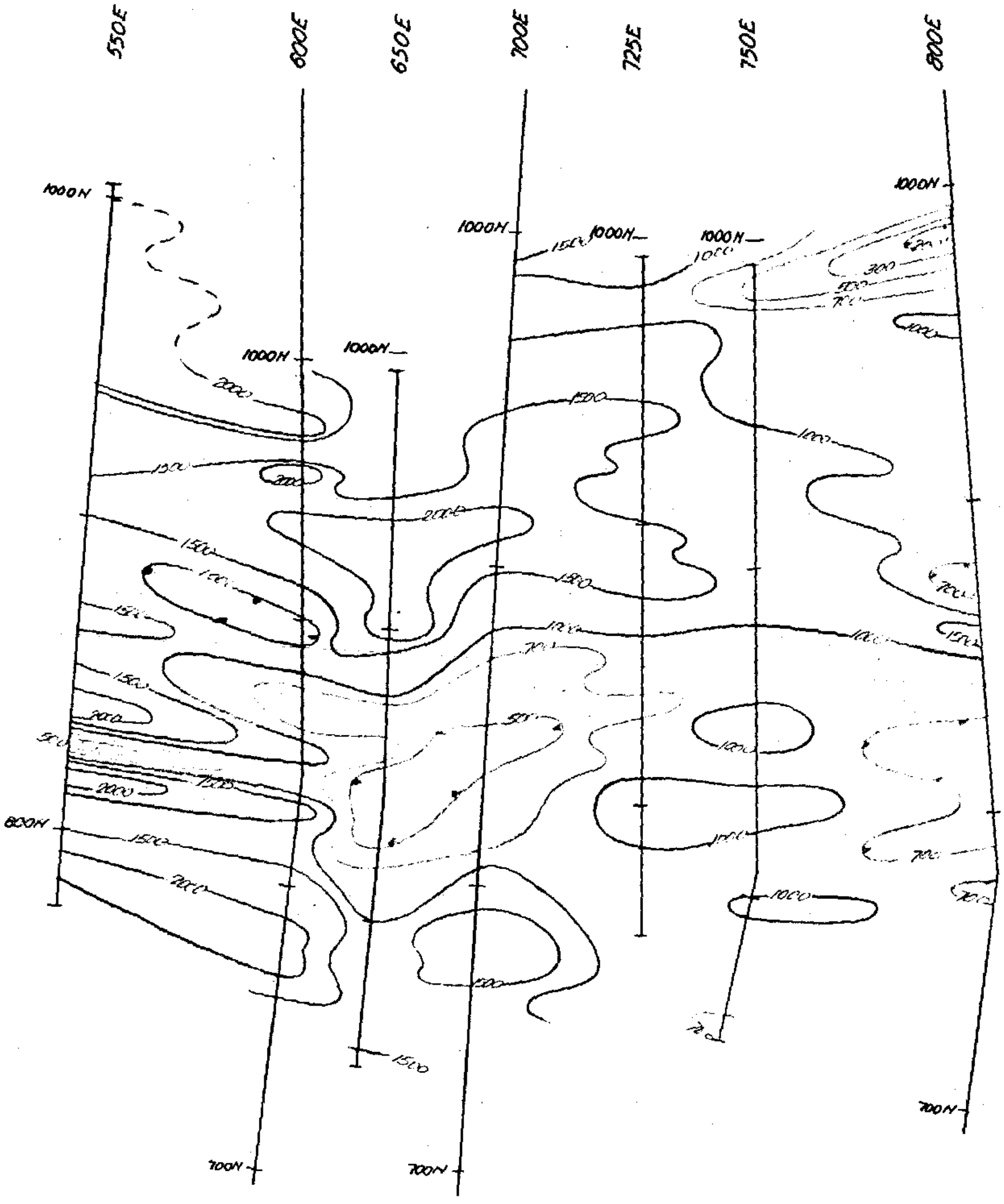

PLATE DR-1
AGNEW TAS-093

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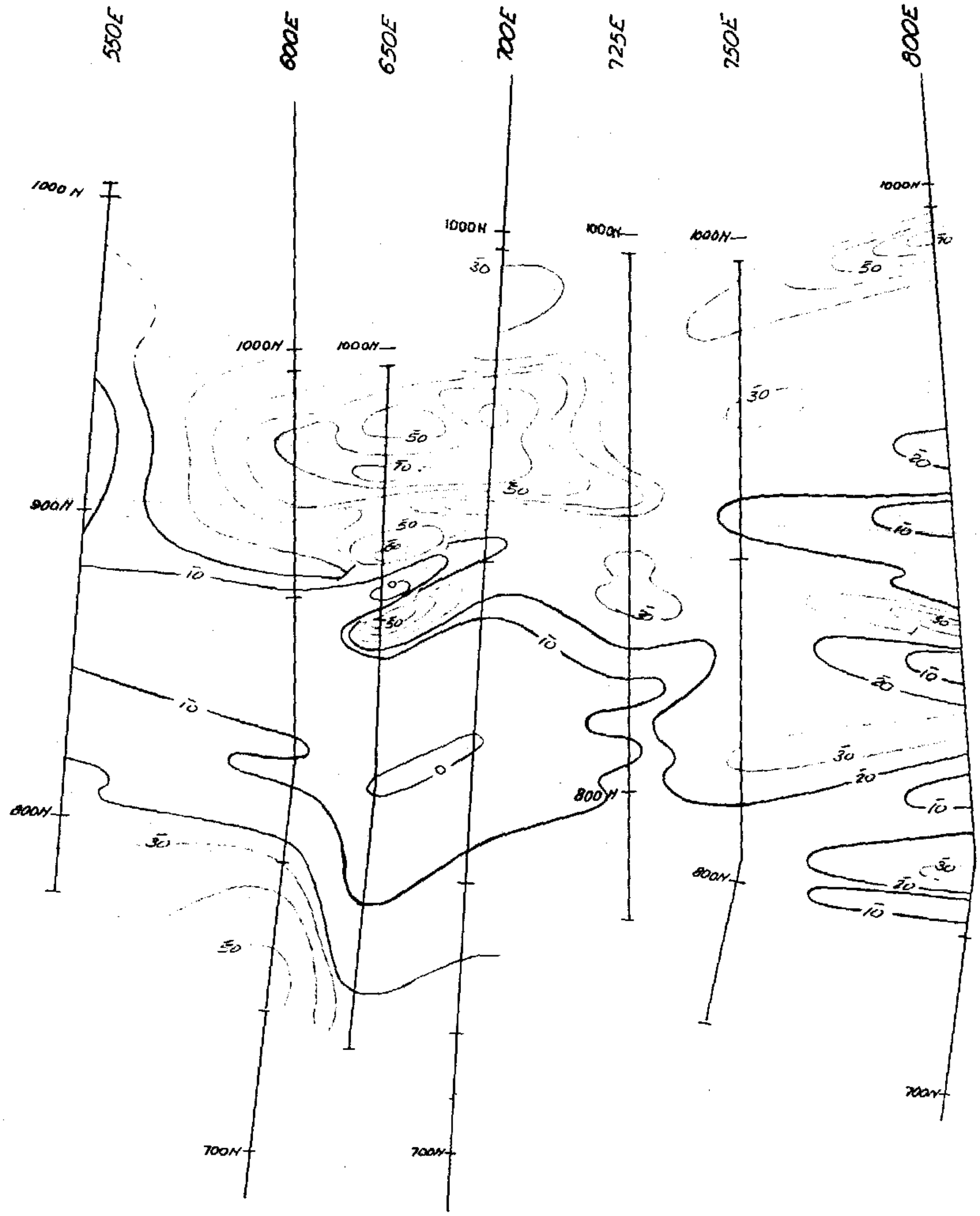

PLATE DS-1
AGNEW TAS093

AREA 2

RSR: pp 8-9

Original survey zone E

The detail array employed electrodes positioned at 360S and 960S on 350E. Lines were read from 250E to 450E at 50 metre intervals with a 10 metre potential dipole.

The reconnaissance survey detected the main zone centred at 590S on line 300E and at 610S on line 400E, where the maximum depth to source was estimated at 50 metres and 60 metres respectively. The original data has been contoured in plate OM-2 and shows a simple response.

The detailed survey confirms the presence of the major anomalies on lines 300E and 400E designated zone A, and on the grid map as supplied, shows a marked curvature to the north on line 350E as plate DM-2 shows. *However, it is considered likely that the location of the anomaly centre at 545S is 60 metres too far north with respect to the adjacent lines 300E and 400E. It is suggested that this be checked in the field at an early opportunity.*

The original reconnaissance survey implied a 'shoulder' at 670S on lines 400E and 300E. The detail data confirms this 'shoulder' on these lines, and in addition reveals a distinct and significant anomaly at 655S on line 350E some 18 millivolts/volt above the local (high) background). On the contour data this shoulder correlates well with the responses east and west. This zone is designated 2B.

The main anomaly and the shoulder response both reach their maximum development on line 350E and 400E also, however, the levels of 25 millivolts/volt(+) recorded over the outside lines, 250E and 450E, at 600S± and 665S, clearly imply the mineralised zone continues, albeit in reduced form.

In stark contrast to zone I, the majority of decay forms observed are just under normal. This is an important observation as it may imply that as the bulk of the readings are well above average, the whole of the detailed area may be weakly mineralised. However, the most likely explanation is that the enclosing rocks have a higher mafic mineral content, and a variation in mineral species from those which exist in the vicinity of anomaly I.

The apparent resistivity data shows both subzones A and B to be associated with bulk resistivities of less than 500 ohm-metres as against 2000 ohm-metres(±) outside the highest chargeability zone. However, the high resistivities observed around the chargeability maxima (say above 30 millivolts/volt) are generally higher than seen in zone I where the cut-off between the anomaly as such and the enclosing rocks was rapid.

Line 250E ..... A broad zone of increased chargeability was recorded from about 725S to north of 545S (the most northerly point surveyed). This section may either represent anomalous conditions or alternatively a variation in the essentially high background observed to the south of the Agnew grid. The resistivity over the highest section (above 20 millivolts/volt) averages about 800 ohm-metres(±), and over the anomalous section decay forms have fairly uniform ΔMn values of -5%(±).

Line 300E ..... On this line, anomalism extends from 565S to about 745S.

The maximum of 48 millivolts/volt was defined at 595S, and at this point has an estimated maximum depth to the top of the source of 40 metres. From 625S to 765S there is a gradual, irregular decrease in chargeability from about 34 millivolts/volt to less than local background of 10 millivolts/volt(+). Between 625S and 705S minor maxima represent multiple sources within a broad zone. The original reconnaissance data gave a response of a similar *form*, and as the location of the maximum at 595S is the same on both surveys (or at least within the resolution of the respective dipoles used), the dip of the source appears to be near vertical. The higher magnitude recorded in the initial reconnaissance survey would indicate increasing importance with depth.

On both surveys, while average resistivity remains at about 1000 to 1200 ohm-metres(+), 40%(+) reductions were observed at 605S and at 655S. The former is associated with the chargeability maximum, and the latter with one of the inferred multiple sources.

The decay forms (ΔMn) are again -5%(+) and imply a near normal grain size.

Line 350E ..... This line is the most significant in the detail area. The maximum of 72 millivolts/volt was defined at 545S and has an estimated maximum depth of the order of 35 metres. The most northerly extension of the zone was not able to be defined (due to line termination), however, this section of the anomaly runs from an inferred 510S(+) to above 595S. The decay forms over the zone vary *about* the normal.

A relatively minor maximum of 32 millivolts/volt at 620S implies a further individual source at this point and is accompanied by near normal decay form.

A second most significant response of 43 millivolts/volt was defined centred at 645S and 665S. The maximum depth to source is estimated at 10 metres and 20 metres respectively while the inferred dip is vertical to steep south. Again near normal decay forms were observed.

The resistivity data shows a relative fall to 500 ohm-metres from 1000 ohm-metres over the major response at 535S±20 metres, indicating either an interconnection between sulphide (graphite?) grains, or perhaps due to alteration. At 645S a local sharp decline to 500 ohm-metres from 1100 ohm-metres accompanies the high chargeability reading, however, the 'twin' response at 665S must be wholly disseminated in nature as no such depression in resistivity was noted.

A dipole-dipole traverse was run from 510S to 690S at a = 30 metres and n = 1 to 5. This shows a most significant source situated at 540S (545S as defined by the gradient array) which causes a chargeability response of 89 millivolts/volt. The accompanying resistivities at 470 ohm-metres are significantly lower than the 2900 ohm-metres seen 30 metres to the north. The depth to source is significantly less than the 30 metres dipole used. The importance of the anomaly is confirmed by the typical interference pattern formation. However, to the south thereof, readings remain high to 660S where a second source is inferred by a weak interference pattern. Again the depth to source is inferred to be less than 30 metres. The second source, however, is accompanied by 200 ohm-metres apparent resistivity near surface (at n = 1) which highlights the conductive properties of this zone, at least close to surface.

Line 400E ..... The responses recorded on this line are very simple in form. The major anomaly of 59 millivolts/volt was centred at 595S and is allied with a local reduction of 70% in the resistivity. The maximum depth to source is of the order of 35 metres. The original data has the maximum displaced to the south which would infer a steep south dip. The accompanying ΔMn values at $\pm$2% are slightly higher than the local ~5% background and thus infer a slightly coarser grain size within the source than immediately outside it.

A second less significant source of 32 millivolts/volt against a high local background of 26 millivolts/volt was observed centred at 670S coincident with a far more significant response observed on the reconnaissance survey. The maximum depth to source inferred is about 20 metres, and the dip near vertical. The difference in amplitudes seen infers greater importance of the anomaly with depth. Again, a slightly higher than background decay form was noted over the peak. The detailed 10 metre dipole survey clearly demonstrates a narrow relative conductive zone within the chargeable source by virtue of a coincident 55% depression in the local resistivity to 500 ohm-metres.

Line 450E ..... This line, surveyed furthest to the east on the detail, shows a significant 38 millivolts/volt response centred at 660S, showing a gradual fall-off for 50 metres$\pm$ to the north and south, together with a subsidiary maximum at 695S. This is interpreted as a broad zone of sulphides (or graphite?) having maximum concentrations at the above sites. No clear depth to source estimate is possible, however, consideration of the slope suggests about 25 metres at most at 660S. The resistivity shows a broad low of 600 to 700 ohm-metres as compared to 1500 ohm-metres resistivities seen on the flanks of the material response at 605S($\pm$) and 705S($\pm$).

Minor maxima at 565S and 765S are considered relatively insignificant.

Of interest is that the decay form remains a uniform -2.5%(±) over the anomalous section detailed.

An a = 30 metres, n = 1 to 5 dipole-dipole survey was executed from 540S to 720S. This confirmed the interest of the broad gradient response centred at 660S, and demonstrated that the source becomes more significant at depths of about 45 metres(+) The n = 2 and n = 3 values are 60 to 70 millivolts/volt, which certainly enhance the interest of this zone. Also of interest on the dipole-dipole data is the fact that the near surface resistivities of 2000 ohm-metres seen on n = 1 are significantly higher than those at depth. This suggests that alteration increases in intensity with depth.

Beneath the resistive capping, two zones of low resistivity which could indicate alteration were defined at 690S at 50 metres±10 metres to the top of the source, and at 570S at depths of the order of 60 to 70 metres. As these values coincide with twice background chargeability, these two must represent a zone of interest. The gradient data implies that this zone comes closest to surface at 565S.

Line 500E ..... No detailed gradient was surveyed on this line, however, the reconnaissance data showed a broad response (32 millivolts/volt) of up to 10 millivolts/volt above background centred at about 300S ±20 metres.

A dipole-dipole traverse between 210S and 390S at a = 30 metres for n = 1 to 5, has confirmed a broad response centred at 315S with a depth to source to 30 metres, although the inference is that disseminated chargeable material comes closer to surface than this. This data does imply the continuation of anomalous polarization conditions to twice background across this line.

Line 570S Dipole-dipole along strike

Presumably for experimental purposes a dipole-dipole array was surveyed semi-parallel to the strike of the anomalism from about 290E to 410E. The 'a' spacing of 30 metres was read from n = 1 to 5. The difficulty in the interpretation of dipole-dipole placed parallel to strike, especially where the sources may be intermittent or sinuous as inferred here, is that depth to source and lateral distance from source cannot readily be distinguished. The comments which follow should bear these factors in mind.

The first major response was defined at about 300E and no doubt relates to the major response recorded on line 300E at about 590S. The depth to source is inferred at 30 metres and the zone is inferred to extend to depth.

The second response centred at 395E is related to the major anomaly defined on line 400E at 590S. While the source comes within 30 metres of surface, the impression of increasing importance with depth may in fact be some function of distance of the traverse from the source.

What is perhaps of interest is that the anomalism *is not continuous* from 290E to 410E. This may imply the crescent shape shown on the contour map of the chargeability to be a true representation of the shape of the source.

CONCLUSIONS

1 *The main zone (sub-zone A) is considered to cross lines 300E, 350E and 400E at 595S, 595S and 605S respectively. The chargeability is a high 50 to 70 millivolts/volt, while the resistivity is depressed to 500 ohm-metres(±) from*

a background of twice this level. The maximum depth to source is 35 metres. The anomaly forms suggest a vertical (line 300E) to steep south dip (line 400E). The decay form is normal over the chargeability highs, but while having faster decays outside the anomalous areas, is only slightly more so. (This is quite unlike zone 1.)

2 *The chargeability data as shown in plate DM-2 assumes the line locations are as given, and if so, would either imply a crescent form to the source, or perhaps a series of grid north-east and north-west en-echelon anomalies. The former is favoured, but conclusions as to form should await a confirmation of the location of line 350E with respect to the adjacent lines.*

3 *Sub-zone B was defined as a distinct maximum on line 400E at 670S, line 350E at 645S and 665S, and on line 300E as a 'shoulder' at 640S±20 metres. While of lesser magnitude than sub-zone A, this response is also considered most significant. The accompanying resistivity is generally some 50% to 60% lower than local background, implying either some interconnection between the chargeable source material, or perhaps alteration akin to the Waxman-Weston model.*

4 *There are a number of differences in form of this response to that seen at detailed site 1:- (a) The background chargeabilities over I are much lower at 10 millivolts/volt± than seen over 2, namely 20 millivolts/volt(±), (b) while the decay form within the anomalous region is normal to fast-normal in both cases, the decay form of the surrounding host rocks in the case of I were abnormally fast at -30% to -50% ΔMn. Thus the host rocks would appear different, but the mineralisation may be the same (at least geophysically!)*

5 *Should drilling be considered, line 350E is recommended. Two distinct targets are recommended.*

A *Source centred at 545S, maximum depth to top of source, 35 metres. Dip steep south to vertical (with respect to local slope).*

B *Secondary source between 645S and 665S. Maximum depth to source, 20 metres, dip, vertical to steep south.*

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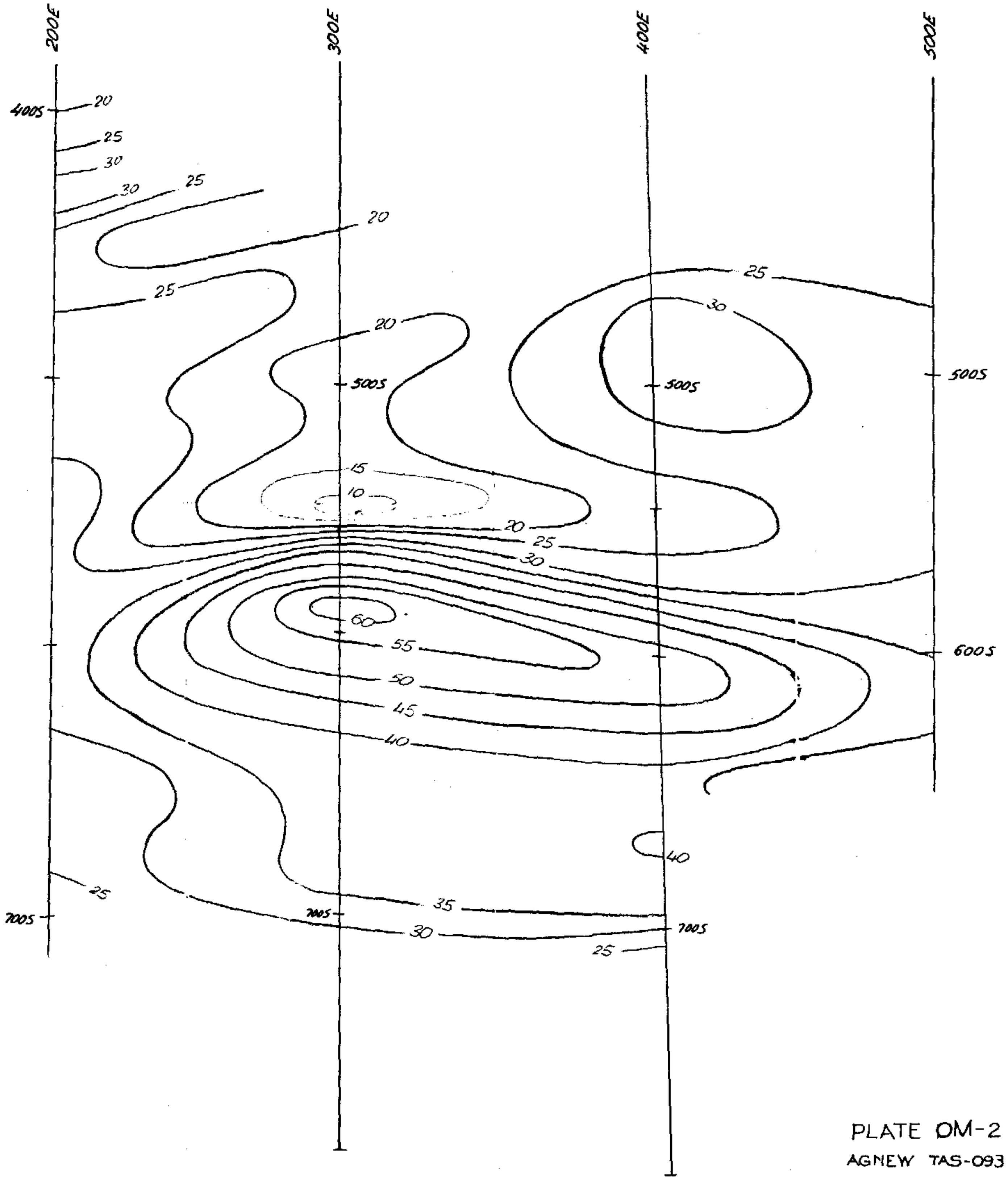

PLATE OM-2
AGNEW TAS-093

SCINTREX

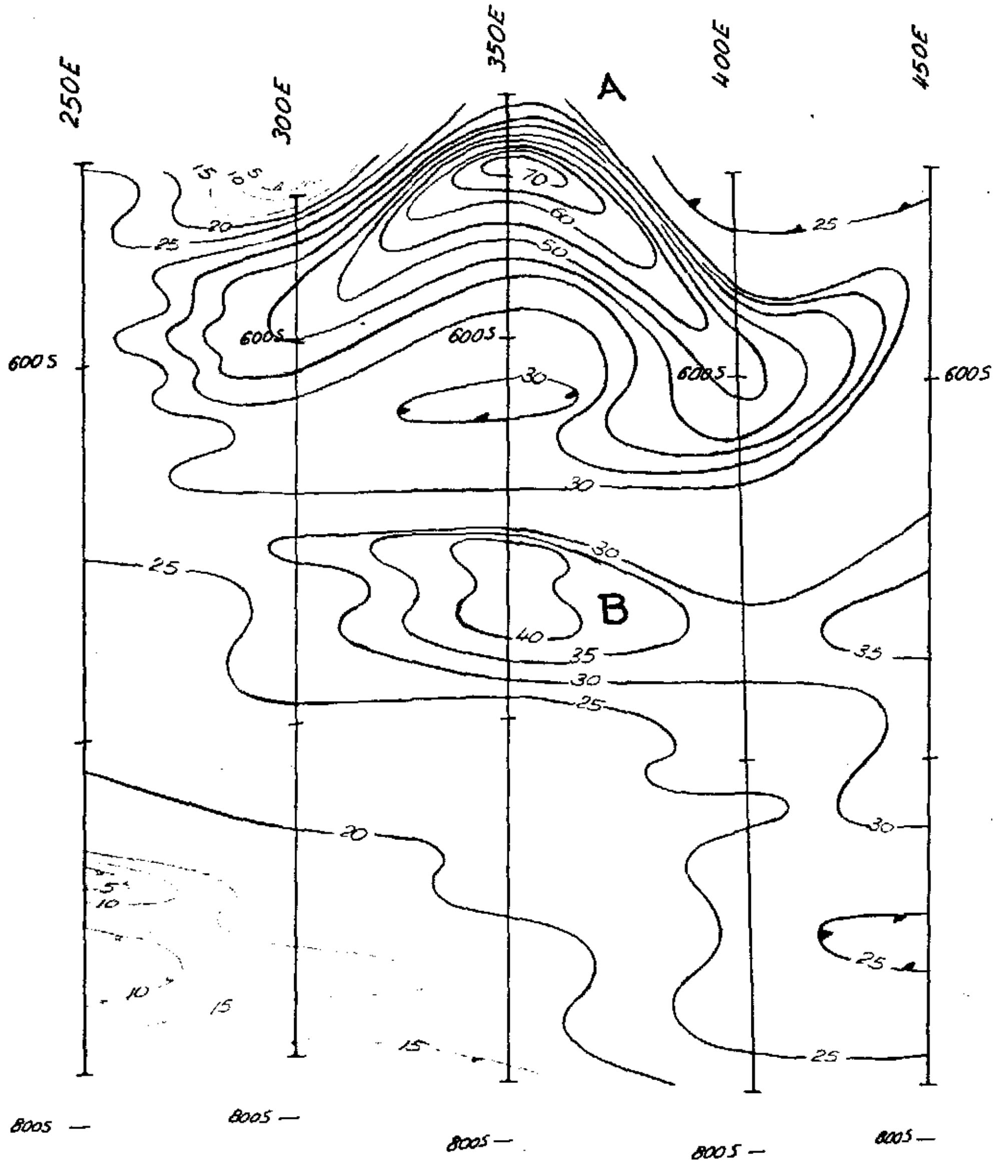

PLATE DM-2
AGNEW TAS-093

SCINTREX

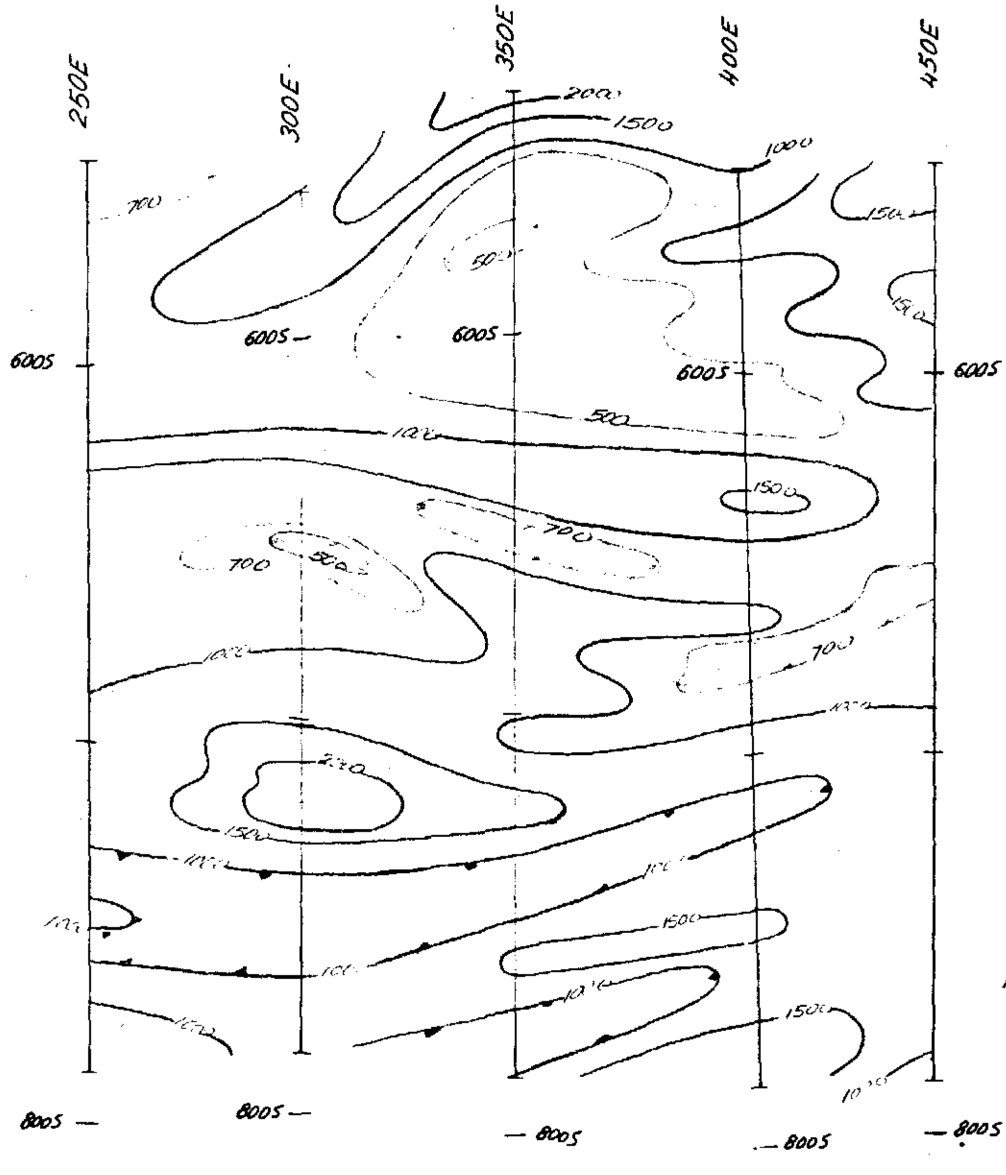

PLATE DR-2
AGNEW TAS-093

AREA 3

(RSR: pp 5-6

Original Survey Zone B

A 500 metres current dipole was established with electrodes centred at 530N and 1030N on line 1100E. From this set-up lines 1050E to 1250E were surveyed using a 10 metre potential dipole.

As seen on the reconnaissance data (Plate OM-3), the original inference was of a simple source. As the contour presentation of the detailed chargeability data shows, the anomaly is in fact quite complex. In fact, the 50 metre line spacing will not allow a unique contouring of the data due to the number of events, and their identifiable strike length being less than the interline spacing. As would be expected then, the contour maps seen on the original reconnaissance and detailed arrays are hardly recognisable as the same area!

The high polarization values are associated with, but not necessarily coincident with resistivity lows, and also show slightly slower decay forms than the enclosing rocks (albeit still faster than normal).

Line 1250E ..... Between 755N and 875N resistivities of 1300 ohm-metres(±) were defined which are lower than the local background of 3000 ohm-metres(±). Coincident with this lower resistivity, higher than background chargeabilities of 14 to 18 millivolts/volt were recorded in three local peaks at 755N, 825N and 860N. While this anomalous zone whose relatively minor anomalism has maximum depths to source of 20 to 25 metres, is obviously an extension of the more significant anomalism to the west, it is of much lesser magnitude. The decay forms, while being fast (ΔMn = -15%), slightly slower decays were noted over the three chargeability maxima above.

Line 1200E ..... The anomalous zone extends from 835N to 710E. The data from the reconnaissance and detailed surveys show excellent correlation. The main zone is seen as chargeability maxima of 31 millivolts/volt and 33 millivolts/volt centred at 745N and 765N. The maximum depth to source in both cases is about 20 metres, and the guesstimated dip is near vertical. Of significance is a drop to 400 ohm-metres from a background of 2500 ohm-metres observed centred at 755N. The decay forms at ΔMn = -5%, while being faster than normal, are still slower than the local background of -10%.

The distinct shoulder seen at 815N on the reconnaissance survey is seen as two low amplitude anomalies centred at 820N and at 805N on the detailed survey. The indicated maximum source depths are of the order of 20 metres(±).

A slight shoulder observed at 715N on line 1200E on the reconnaissance survey is seen in the detail as a very sharp maximum of 27.5 millivolts/volt which is due to a narrow (5 metres?), shallow, near surface source (5 metres?).

The overall response of the zone is seen as moderate to high chargeability, relatively low resistivity and decay forms of -5%(±5%) as against a background of -20% for ΔMn.

Line 1150E ..... This line is dominated by a 42 millivolts/volt response centred at 795N which coincides with a massive 85% decrease in background resistivity to 450 ohm-metres. The maximum depth to source is not greater than 20 metres. The anomaly suggests a gradual fall-off in response to the north, however, separate sources are suggested at 810N(±) and at 830N(±). Close to the latter at 825N a distinct resistivity low of 350 ohm-metres was defined which is some 65% lower than the background to the north.

Two related peaks of 20 and 22 millivolts/volt at 865N and 895N from 1000 ohm-metres backgrounds, imply a wholly disseminated source whose maximum depth to source is of the order of 10 to 20 metres.

Again, both the above responses are characterised by faster than normal decay forms of -5% and -7% respectively which are nevertheless slower than local background.

Line 1100E ..... As seen on line 1200E, the reconnaissance and detail data show godd correlation after allowances for the greater resolution afforded by the 10 metre dipole. Some three distinct maxima were recorded which in detail are difficult to correlate either east or west.

The central response is characterised by a 31 millivolts/volt response centred at 785N of which the maximum depth to source is about 20 metres. A second narrow shoulder at 765N represents a narrow source whose maximum depth beneath this point is about 15 metres.

To the north, two distinct narrow sources were resolved with the 10 metre spacing. A 33 millivolts/volt response at 845N, and a 'shoulder' of 21 millivolts/volt at 830N were recorded, both having depths to source of about 20 metres.

The most southerly response was centred at 725N where a narrow disseminated source has a maximum depth of the order of 20 metres.

While the anomalies centred at 785N($\pm$) and at 845N($\pm$) are associated with lower resistivities, the anomaly centre of the 'low' is centred *between* them at 815N where resistivity reaches 350 ohm-metres as compared with local background of 2000 ohm-metres(±). This situation may again be indicative of alteration in the Waxman/Weston style where sulphide and alteration maxima are not coincident. The resistivity low cannot be due to 'massive' sulphides in the present situation.

On all three maxima, the decay forms as measured by ΔMn are -5% to -10%, which although faster than normal are slower than the background as recorded at -15%.

The dips appear near vertical in all cases.

Line 1050E ..... The data on this line indicates two groups of responses separated by a distinct chargeability low of +4 millivolts/volt centred at 795N.

The 32 millivolts/volt maximum at 775N implies a narrow (5 to 10 metres) source at a maximum depth of about 20 metres. The decay form as seen via ΔMn is -10%(±), and is slower than local background of -20%. A slight reduction to 1600 ohm-metres in the otherwise high 2000 ohm-metres(±) background resistivities, indicates a disseminated or electrically discontinuous source.

To the north of the central chargeability low referred to above, twin peaks of 24 millivolts/volt and 25 millivolts/volt were defined at 905N and 845N respectively, with a high 20 millivolts/volt 'background' between. The ΔMn values at -5% to -10% over the zone fall away to the north and south of 935N and 825N respectively. The maximum depth to source is inferred at about 20 to 30 metres. While each of the maxima depresses the resistivity backround slightly, the source is still considered to be essentially disseminated in nature.

CONCLUSIONS

1 *In stark contrast to the continuity inferred from the reconnaissance survey, the detailed survey demonstrates that this zone consists of a series of significant chargeability sources of limited strike length, set within a disseminated halo. No direct correlation is seen between high chargeability and locally low resistivity, although the two are quite obviously related. This is reminiscent of the Waxmans/Weston deposit in which the alteration was marked by low resistivity and the presence of sulphides by higher chargeability.*

2 *Investigation by diamond drilling is recommended on line 1150E to intersect the source at 795N whose maximum depth to source is estimated at 20 metres. Additional zones of interest are inferred at about 815N(±) and 835N(±).*

037

908039

SCINTREX

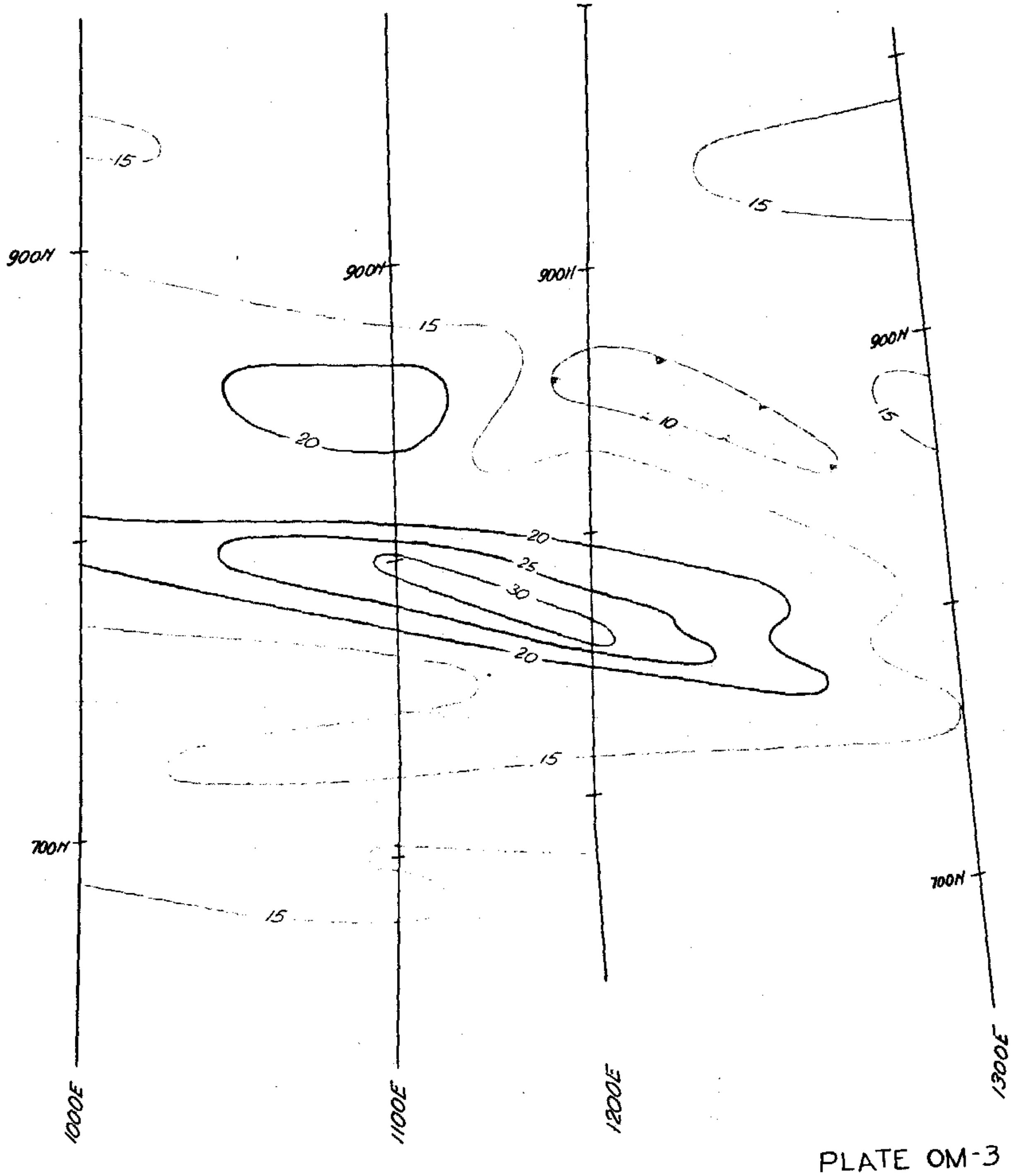

PLATE OM-3
AGNEW TAS-093

038

SCINTREX

908040

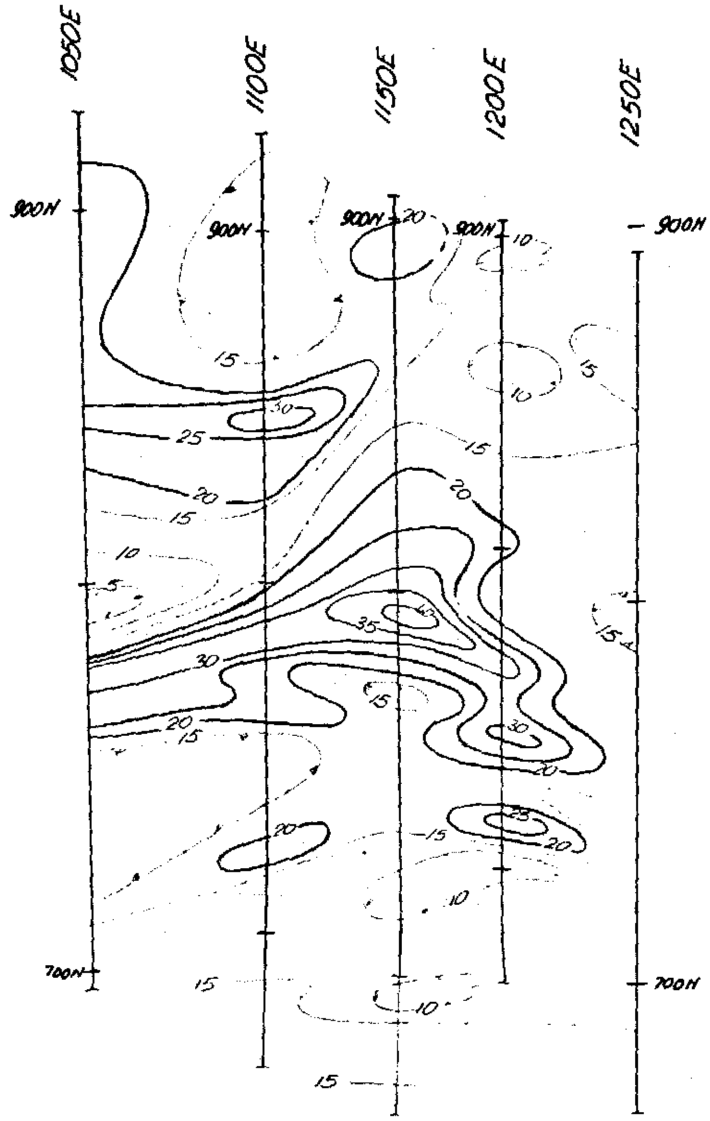

PLATE DM-3

AGNEW TAS-093

039

SCINTREX

908041

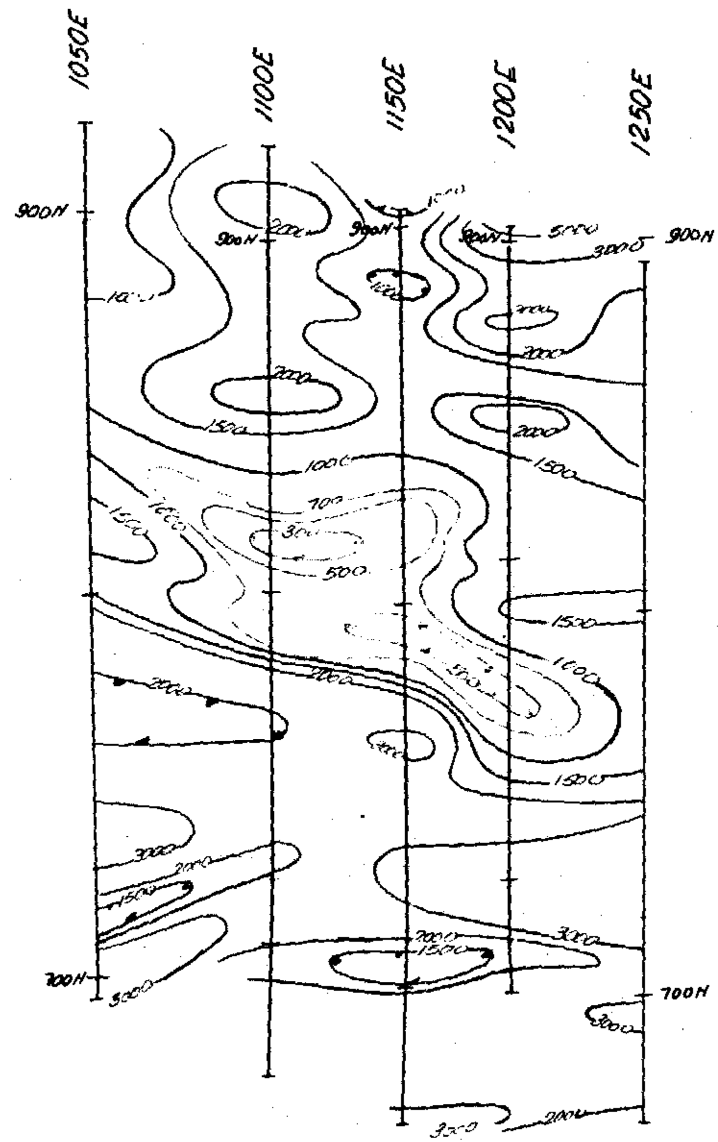

PLATE DR-3

AGNEW TAS-093

AREA 4

RSR: pp 6-7

Original survey zone C

The detailed array employed a 500 metres current dipole whose electrodes were placed at 590N and 1090N on line 1500E. From this location lines 1350E to 1500E were surveyed using a 10 metre potential dipole.

In this case the detailed array has given a confirmation of an essentially simple anomaly form, with little complexity. (This is in complete contrast to areas 1 to 3 described above). The contour presentation of the reconnaissance survey (Plate OM-4) compares well with the detailed data (DM-4). The anomaly reaches its maximum development between lines 1350E and 1500E, although higher values on these lines do confirm the extension of the sulphide(?) halo along strike. The resistivity contour presentation (plate DR-4) shows a simple correlation between low chargeability and high resistivity. Also, while all decay forms are significantly faster than normal, the anomalous zone is invariably characterised by slower than average decays.

Line 1500E ..... Within a broad relative low of about 1000 ohm-metres as compared to a background of 1500 to 2000 ohm-metres, a broad chargeability maximum reaching 20 millivolts/volt against the 10 millivolts/volt background, was recorded centred at 840N$\pm$20 metres. The background decay form values to the north are a low -35%, and to the south, an even lower -50%. The anomalous region shows slower decay rates of -20% to -25% over the central portion. The source looks to be broad and multiple. The data does not permit a definitive depth to source estimate.

Line 1450E ..... In broad terms, the anomaly form on this line is similar to that seen on line 1500E, except that the chargeability is higher, and the apparent resistivity lower. The main zone extends from about 805N to 870N within which a maximum of 55.4 millivolts/volt was recorded centred at 835N (15 to 20 metres maximum depth). A 26 millivolts/volt shoulder at 815N (maximum depth 25 to 30 metres), and a second shoulder of 24 millivolts/volt at 855N were recorded. While the background resistivity is about 1000 ohm-metres, a material and broad low to 450 ohm-metres was centred at 845N. The decay form, while faster than normal over the major peak ($\Delta Mn = -10\%$), and still faster over the anomaly as a whole ($\Delta Mn = -25\%$), the decay remains slower than the host rocks.

A dipole-dipole traverse was run from 960N to 780N for a = 30 metres, n = 1 to 5. The data shows a most excellent double peak anomaly centred at 855N which implies a broad, 50 metres$\pm$, wide source within 30 metres of surface. A more or less coincident resistivity low of 200 ohm-metres($\pm$) as compared with enclosing rock of 4 to 5 times this figure, was defined. Decay forms generally compared with those observed on the gradient array.

Line 1400E .....The gradient array data from the reconnaissance and detailed surveys correpsond well with a *slight* northerly displacement of the anomaly in the detailed array, *perhaps* suggesting a south dip to the source. The main response was recorded between 810N and 875N with three distinct maxima implying three distinct loci for sulphides. At 865N a 29 millivolts/volt maximum was defined coincident with a most significant resistivity low of 250 ohm-metres as against 1000 ohm-metres($\pm$). The maximum depth to source is 20 to 25 metres. The decay form at -19% is slower than the background values of -31%. A peak of 28 millivolts/volt recorded at 845N also has a maximum depth to source of the order of 25 to 30 metres, while a 'shoulder' of 22 millivolts/volt at 815N has a 20 metres estimated source depth. In the last case the source must be disseminated as the underlying resistivities are of the order of 1000 ohm-metres. The decay over the latter two peaks of -15% is slower than over the maximum at 865N.

Line 1350E ..... While the zone is inferred to continue across this line between 800N and 880N, the amplitude of 13 to 20 millivolts/volt is low compared to lines 1400E and 1450E. Three individual sources are inferred at 825N, 855N and 875N. The maximum depths to source are estimated between 10 and 20 metres. The decay form remains faster than normal, but slower than average.

CONCLUSIONS

1 *In common with the other zones, higher chargeability and lower resistivity are associated, but do not form a 1:1 correlation. As suggested elsewhere, this is reminiscent of the Waxman/Weston situation. The highest chargeabilities generally have the slowest decay forms, and thus would imply a coarser than average (for the zone) grain size. Like area 1, the decay forms (expressed as ΔMn) within the background are an extremely low -30% to -50%.*

Depths to source are shallow and rarely exceed 35 metres.

2 *Investigation by diamond drilling could be carried out on either line 1400E or 1450E. On the former the source should be tested between 805N and 875N (three sources at 815N, 845N and 865N), and on the latter between 805N and 865N (815N, 835N and 855N). The dip on line 1400E is steep, perhaps south*

043

908045

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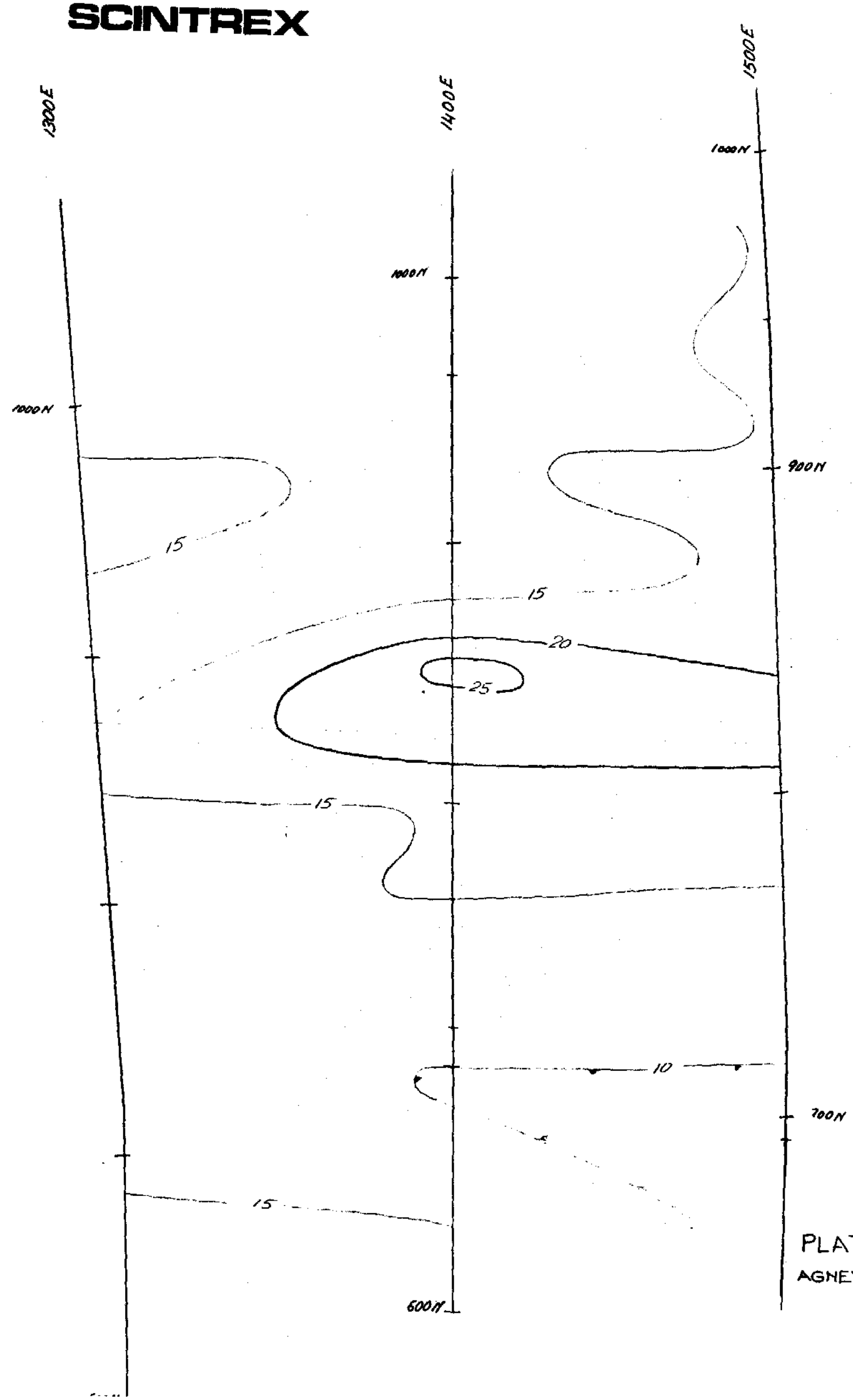

PLATE OM - 4
AGNEW TAS-093

044

SCINTREX

908046

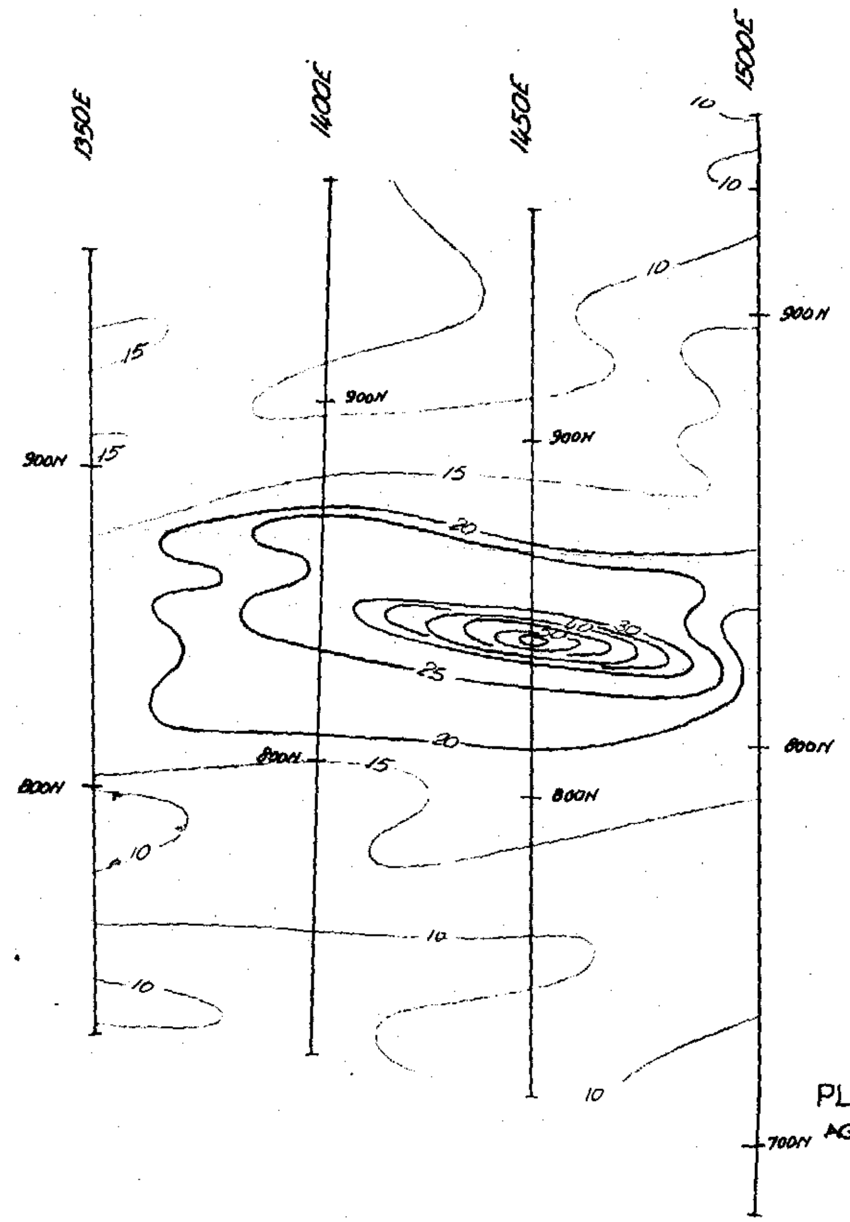

PLATE DM-4
AGNEW TAS-093

045

SCINTREX

908047

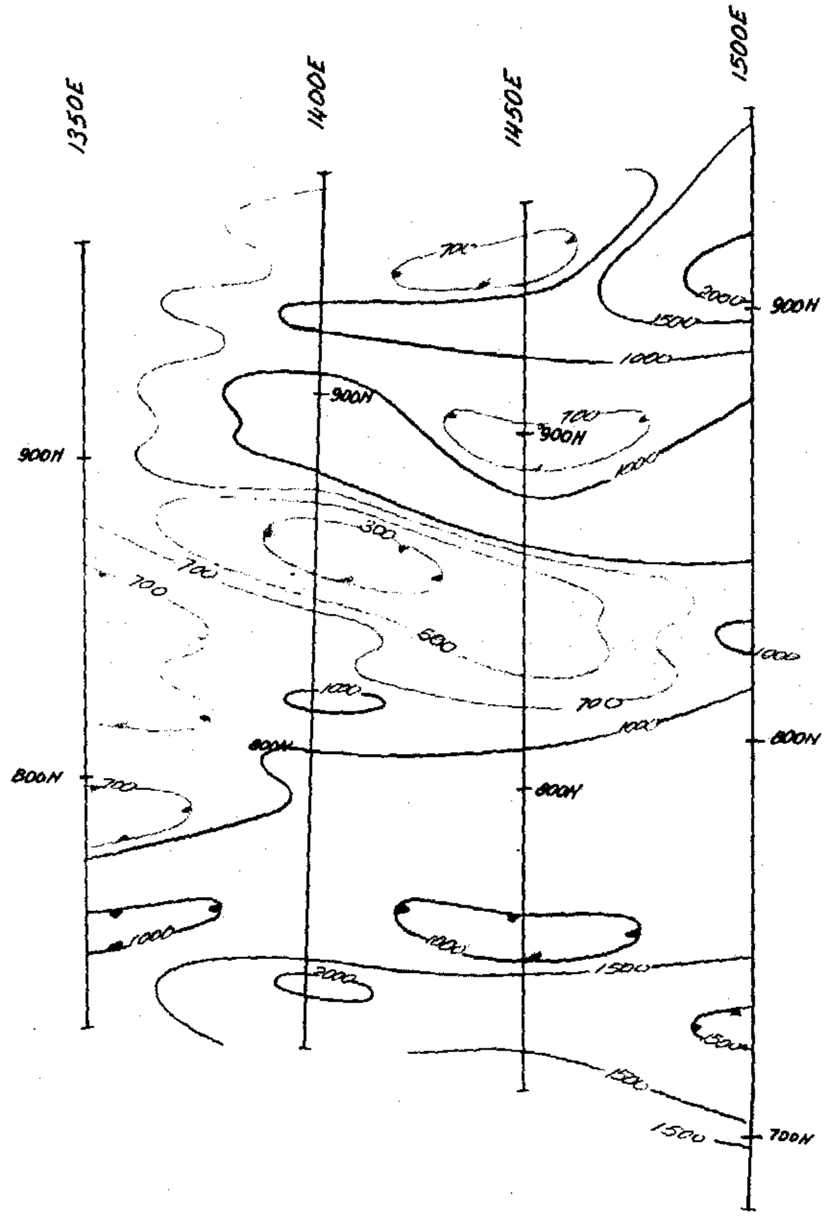

PLATE DR-4
AGNEW TAS-093

AREA 5

RSR: pp 7-8

original survey zone D

A 500 metres gradient array whose electrodes were emplaced at 740N and 1240N on 1700E was employed to investigate lines 1650E to 1750E at 50 metres line intervals.

The background chargeability is about 15 millivolts/volt(+) with anomalous responses to twice this level being recorded. Resistivities range about 1000 ohm-metres. While moderate to small anomalous responses were defined on all three lines, their interline correlation is not at all clear.

Line 1650E ..... The background on this line can be considered to be about 16 millivolts/volt. Two responses of just under 26 millivolts/volt and of 22.5 millivolts/volt were recorded at 1005N and 975N respectively. The depth to source is no greater than 20 to 25 metres in each case. The resistivities are of the order of 900 to 1500 ohm-metres over this zone, and as such imply a disseminated source. Decay forms are fast, implying a fine grain size to the causative mineralisation. (However, the decay form remains slower than background.)

Line 1700E ..... The background is again about 16 millivolts/volt and again two discrete anomalies were recorded. The first of just under 26 millivolts/volt was recorded at 1015N and has a maximum depth to source of about 40 metres. The 'flat top' to the anomaly suggests a source width of 20 to 25 metres, or multiple sources within this width. While the apparent resistivity is slightly depressed over this response, the absolute values are a high 1000 ohm-metres, therefore a disseminated source is again inferred.

The second maximum is a narrow response from a narrow source situated at 925N.

The form of the 25 millivolts/volt anomaly implies a source depth of the order of 20 metres. The decay form remains fast over this section.

An a = 30 metres, n = 1 to 5 dipole-dipole set-up over this section implies a resistive surface capping between about 1000N and 920N, with higher polarization to 30 millivolts/volt(+) at a source depth of 40 metres(±) below 980N-990N. These depths correlate reasonably well with the maximum depth obtained from the gradient data. The second gradient source at 915N is not seen on the dipole-dipole.

Line 1750E ..... Against the background of 16 to 18 millivolts/volt, a broad moderate amplitude response of about 24 millivolts/volt(+) was recorded between 990N and 1085N. The only section of significance however, was between 1035N and 1085N where the chargeability reaches 28 to 29 millivolts/volt. Maxima at 1035N, 1055N and 1075N imply a multiple source. The maximum depth in each case is about 20 metres. The apparent resistivity shows a depression to 800 to 1200 ohm-metres, which implies a disseminated origin.

CONCLUSIONS

1 *Compared with anomalies 1 to 4 discussed above, this response is, from a geophysical standpoint, of second order importance. The events have a strike length of less than the interline spacing, and as such the detailed structure of the source cannot be adequately defined. While the apparent resistivity is often depressed over chargeability maxima, the absolute value remains a high 1000 ohm-metres±, and therefore a disseminated origin is interpreted for the anomaly.*

2 *Should this target be considered for drilling, two targets could be considered:-*

SCINTREX

A *1015N on line 1700E. Depth to source, 40 metres. Width, 30 metres±*

B *1035N-1065N on line 1750E. Depth to source not in excess of 30 metres*

049

SCINTREX

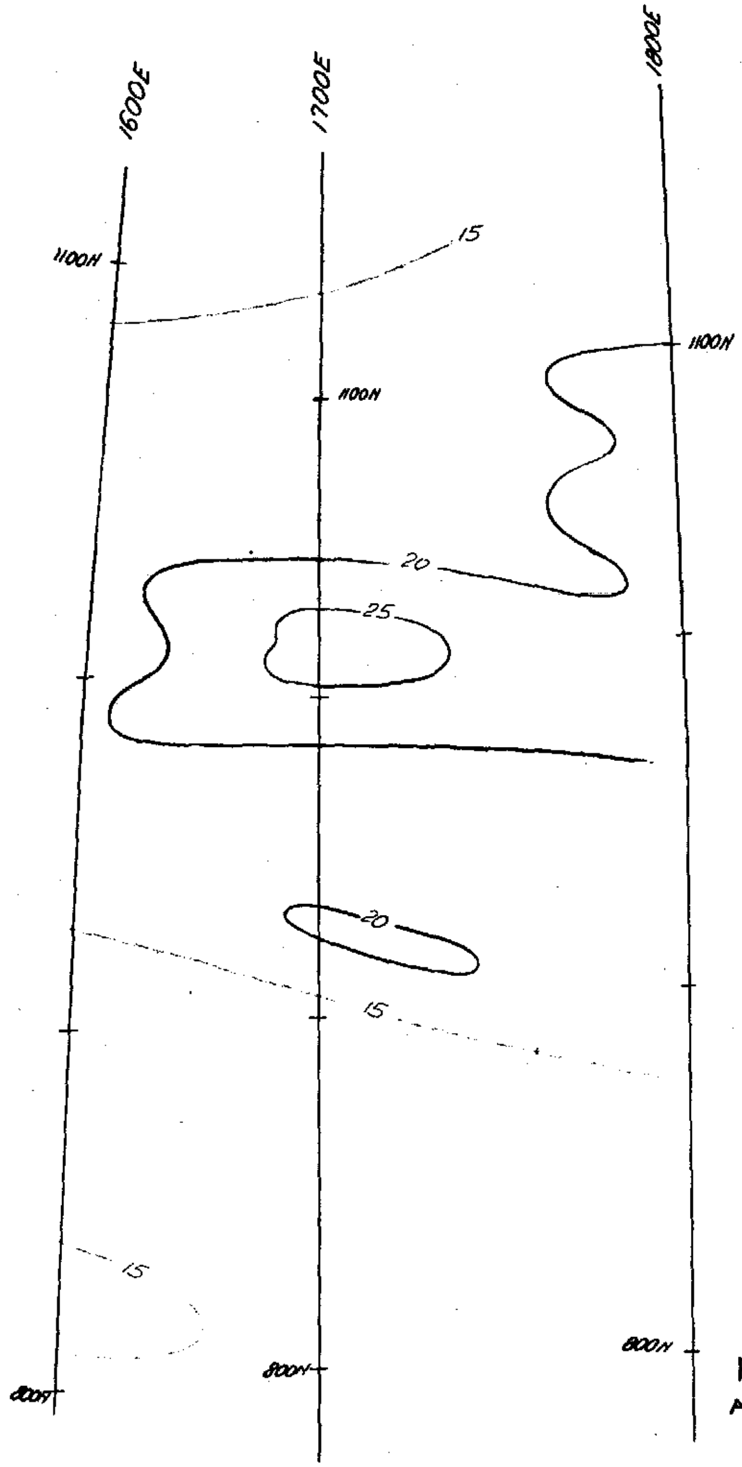

PLATE OM-5
AGNEW TAS-093

908052

051

SCINTREX

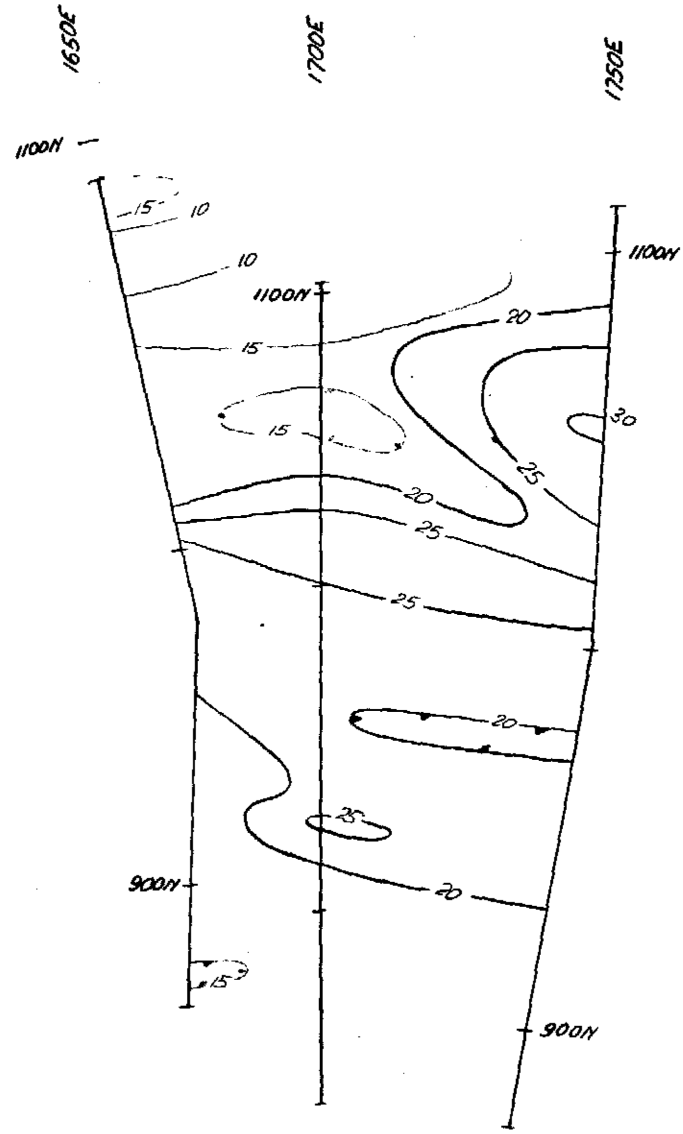

PLATE DM-5
AGNEW TAS-093

SCINTREX

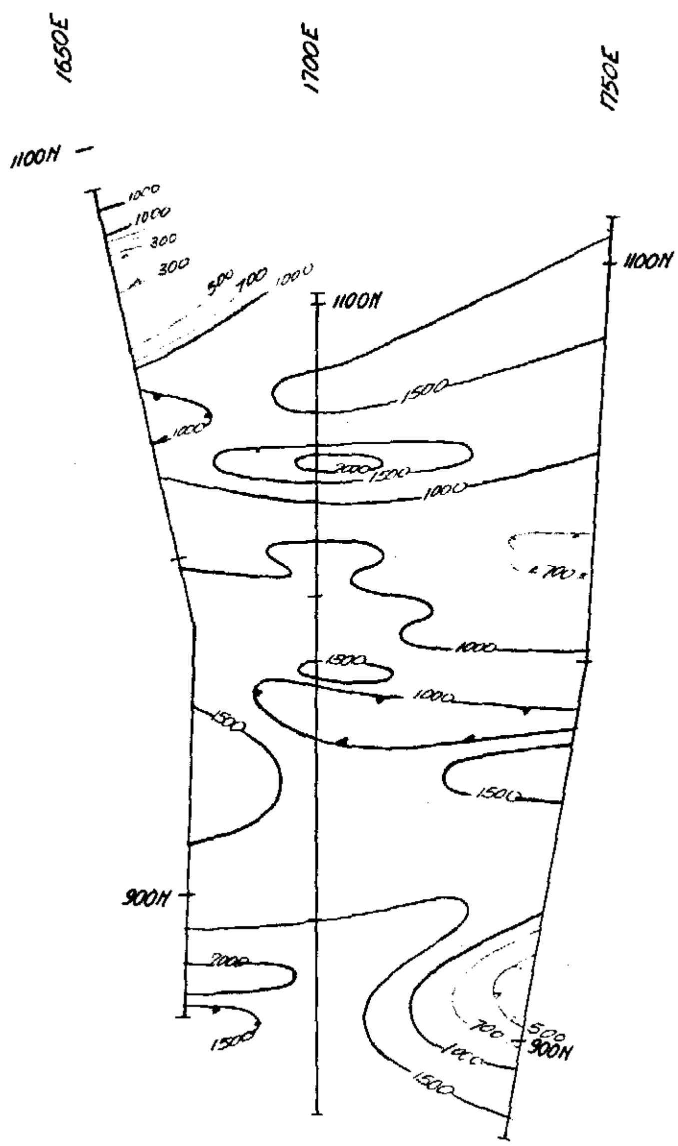

PLATE DR-5
AGNEW TAS-093

AREA 6

RSR: pp 9-10

Original survey zone F

Two lines, 1700E and 1800E, were investigated further with dipole-dipole. The spacing was a = 30 metres for n = 1 to 5.

Line 1700E ..... The dipole-dipole detail extended from 330S to 510S. The original gradient data delineated a 15 millivolts/volt response against a background of about 26 millivolts/volt± centred at 420S. The maximum depth to source inferred was 40 to 50 metres and a sharp local resistivity low was defined at 410S.

The dipole-dipole data confirms the source is broad and centred at 420S. The 57 millivolts/volt(±) readings defined are significantly above the 20 to 30 millivolts/volt background logged on the edge of the array. The anomaly implies a gradual decrease in chargeable material north and south of the centre at 420S, and as the accompanying resistivities are a high 2000 ohm-metres(± 500 ohm-metres), a disseminated source is interpreted. While a great variation in the chargeability of granites has been recorded, the majority lie in the range 4 to 20 millivolts/volt. Thus the 50 millivolts/volt(+) readings here, lie outside the normal range observed for granites, and the anomaly must therefore be of potential interest as a sulphide source. The decay forms are reminiscent of those observed in the north (areas 1, 3 4 etc.), namely the higher chargeability shows near normal decay, while the 'background' tends to be faster. Of further interest is that the nearer surface rocks (within 20 metres±) show distinctly higher apparent resistivities than at depth. This brings up the possibility that the surface geochemical expression may be a 'barren' capping. While additional more detailed dipole-dipole or sounding EIP/resistivity would be required to confirm this situation, it should be borne in mind when considering priorities.

Line 1800E ..... The original gradient array data yielded an excellent 25 millivolts/volt above background response centred at 510S, with an estimated maximum depth to source of 45 metres(±). The accompanying resistivity variation implies a resistive host. A second relative high was recorded between 280S and 420S, and allowing for the gradient in background, the anomaly itself is about 15 millivolts/volt above this background. The maximum depth to source is difficult to define from the gradient array data itself due to the transitional nature of the source to the south and north, however, the *maximum* depth is about 80 metres.

The dipole-dipole must be approached with some caution in this case. The gradient source is confirmed at 510S on n = 1 and is seen to be broad (20 to 30 metres) and to have a maximum depth of 30 metres as against 45 metres estimated from the gradient data. Similarly, the dipole-dipole data confirms a broad source extending from 285S(±) to 410S(±) which reaches a maximum development at 330S (±20 metres). The source lies within 30 metres of surface at 360S and has greater importance with depth.

The dipole-dipole data, however, shows a material response at 435S for n = 3 to 5, and it is here that caution is required. The source of this response does not lie at depth, but is a complex of the sources centred at 345S ±60 metres and at 510S ±20 metres.

The response at 510S is accompanied by higher apparent resistivities of 4800 ohm-metres flanked by resistivities of 30% to 50% of this figure. Thus the source is disseminated in nature. Decay forms were faster than normal. In the case of the response at 345S (±60 metres), the response was accompanied by a distinct low of 500 to 1000 ohm-metres centred at 300S(±) which clearly follows the gradient low recorded on the original survey.

Line 420S ..... A dipole-dipole line was also surveyed semi-parallel to the inferred strike at 420S between 1710E and 1890E. An a = 30 metres spacing was used for n = 1 to 5. Such surveys carried out semi-parallel to strike suffer a number of severe qualifications mentioned under the comments on zone 2 (Page20).

The data shows a broad anomalous zone between 1680E and 1830E which gradually tapers off to 1910E. This 'tapering off' could be due to the dipole-dipole line diverging from the strike of the source. A chargeable zone of 55 millivolts/volt was recorded from a source within 30 metres of surface at 1710E, while a second such source was defined at 1770E at an *apparent* depth of 30 to 45 metres. This data confirms the area to be anomalous, however, no quantitative information can be reliably interpreted from it.

CONCLUSIONS

1 *On line 1700E the response detected on the original gradient array at 410S is confirmed to be of interest, and in fact its interest is enhanced by chargeability readings up to 57 millivolts/volt being recorded from a source within 30 metres of surface at 420S. These conditions are quite anomalous within a granite. This response would represent a target of secondary importance in the absence of confirmatory geochemical data, however, an apparent resistive near surface layer may indicate a barren capping to the above source.*

2 *On line 1800E the significant 25 millivolts/volt gradient response defined at 510S is confirmed and shown to lie within 30 metres of surface. The source is confirmed as being disseminated in nature. The geophysical priority could be assumed as being of secondary to primary interest.*

3 *A broad zone detected from 300S to 420S(±) is considered to be of interest, particularly centred at 330S±20 metres. On the northern section of the anomaly, lower apparent resistivities of 690 ohm-metres as against 1000 ohm-metres were recorded. The maximum depth to source is less than 30 metres at 330S. The geophysical interest at this stage is secondary.*

4 *The most spectacular 'anomaly' defined at 435S for n = 3 to 5 is considered to be a complex of the two anomalies centred at 330S ±60 metres and 510S ±20 metres and not due to an individual source at depth. Dipole-dipole anomalies from multiple sources are difficult to resolve on their own, however, the gradient array in this case suggests two shallow (within 30 metres) sources to be the cause of the anomaly as plotted in the pseudo-section format.*

5 *In the cases of 1 to 3 above, the level of chargeability recorded is quite anomalous for granites, and introduced sulphides or introduced mafics are considered the source of the anomalies observed.*

AREA 7

RSR: pp 11-12

Original survey Zone H

The current dipole used to investigate this reconnaissance anomaly in detail was placed at 00 and 600S on line 2150E. The potential dipole was 10 metres.

The overall picture is best assessed with reference to the chargeability contour plan (plate DM-7), which sets out the very piecemeal nature of the anomalous sources detected. There is in fact very little continuity 'along strike' for these sources, with the inferred event strike length being less than the line interval of 50 metres(±). As can be seen by comparison with the original reconnaissance survey chargeability data (Plate OM-7), the original survey gave an overly simplistic picture, and implies a continuity which is not present. The relationship with the apparent resistivity can be studied with reference to plate DR-7, and as seen on most of the detailed work, while low resistivity zones are associated with the chargeability maxima, there is not a 1:1 correlation. Unlike most of the detailed zones to the north, the background decay forms are near normal at -2%±, while the polarization sources show either little variation from normal or a slower than normal decay, implying a source grain size that is average to greater than average. The data is best assessed on an individual line basis.

Line 2100E ..... The reconnaissance and detailed data give almost identical results for chargeability over this line. The resistivity data is similar, but as would be expected, of different level. The main anomaly is centred at 305S and consists of a 47 millivolts/volt response against a background to the north of 22 millivolts/volt, and either anomalous conditions or anomalously high backgrounds of 35 millivolts/volt(±) to the south. The maximum depth to source is about 30 metres, and the similar profile form for both reconnaissance and

and detail surveys, suggests a near vertical dip. The apparent resistivity shows about a 50% fall, indicating that the source, or at least the host to the source, is less resistive than the enclosing material. In this case the decay form does not distinguish the anomaly from background.

Twin maxima of 39 millivolts/volt at 350S and 385S appear against a 'background' of 34 millivolts/volt. In each case the 'local' resistivity is slightly depressed. Now, these conditions are quite unlike those recorded to the north of the grid where the background is a mean 15% to 20% of that recorded here, therefore it can be inferred that the environment is quite different. Certainly the high chargeability backgrounds are not typical of granites. It is suggested that perhaps the underlying rocks in this section contain absorbed mafic minerals from the marginal rocks, or are disseminated with a sulphide halo. Certainly conditions are different to those seen to the north.

The most southerly response defined was a significant 50 millivolts/volt at 445S, with a related maximum of 41 millivolts/volt centred at 465S. The maximum depth to source in each case is about 30 metres. Low resistivities of less than 750 ohm-metres (as compared to over 2000 ohm-metres to the immeidate south), clearly show the host to the source is less resistive than the enclosing rocks. The decay form shows little variation from just under normal.

Line 2150E ..... This line does show some correlation with line 2100E. The major response of 50 millivolts/volt at 295S which is associated with a 75% depression in resistivity is clearly associated with that recorded at 305S on 2100E. A distinct but minor response of 33 millivolts/volt at 275S is clearly associated with a change in slope seen at about 265S on line 2100E. The maximum depth to source at 295S is 10 metres and the source itself has a slower than average decay form with ΔMn being +5%. Twin maxima, also of 50 millivolts/volt at 355S and 375S both are associated with very minor decreases in apparent resistivity, and have source depths to 30 metres, and slow decay forms of +7% to +5% respectively.

The dipole-dipole on this line was surveyed from 210S to 420S at a = 30 metres for n = 1 to 5. Between 270S and 420S the apparent resistivity data appears to indicate a relatively low (500 ohm-metres±) near surface layer (less than 30 metres thick) over more resistive rocks having resistivities three times this level. The chargeability data shows the 'background' chargeabilities north of about 240S to be a low 8 to 15 millivolts/volt while values to the south remain a high 35 millivolts/volt (±). Superimposed on the latter, a source at 315S within 30 metres of surface can be defined, with a second at 375S. Yet a third is inferred at, or south of, 450S. As with the gradient array data, the decay forms are normal to slow over anomalous conditions, and slightly faster than normal within the 'background', that is, even within the 35 millivolts/volt background.

Line 2200E ..... The form of the reconnaissance and detail data, in general, are similar, but in detail, show some variation. Firstly, a slight southerly displacement in maxima may indicate a steep south dip to the source. Secondly, the superior resolution of the 10 metre dipole shows the source to be of a multiple rather than single nature.

Two groups of anomalies were defined - between 205S and 255S and between 280S and 355S. The former shows individual maxima at 210S (shoulder), 225S and 245S. All have maximum source depths of less than 20 metres, are associated with slight depressions in apparent resistivity and have slightly slower than background decay forms. The latter shows individual sources at 285S, 305S and 325S. Again maximum depths to source are less than 20 metres, while the sources at 285S and 325S are both associated with a 70% fall in local apparent resistivity to less than 500 ohm-metres. Decay forms are only slightly slower than normal.

Twin maxima of 40 millivolts/volt at 405S and 45 millivolts/volt at 425S were defined from apparent resistivities of about 1200 ohm-metres(±). These disseminated sources are multiple and show maximum depths to source of about 45 metres.

The final event, a rapid rise in apparent chargeability from 27 millivolts/volt at 465S to over 42 millivolts/volt at 485S (the end of the line), cannot be traced along strike due to the lack of data.

CONCLUSIONS

1 *The background chargeability values in this area of 20 to 35 millivolts/volt are themselves highly anomalous for granites, and as such require some explanation. Certainly they are quite different to the majority of sites investigated to the north of the grid, not only in background levels, but also in decay form. The northern grids show an anomalously fast decay form with ΔMn values of -25% to -40% being common, while the decay form here is -2%(±). While not as pronounced as for detailed area 2, these observations hold there as well. Therefore there must be a materially different host to the anomalies defined between the northern and southern anomaly groups.*

2 *As always, much depends on the goelogical and geochemical signature of the geophysical anomalies. Should these be facourable at any of the sites listed below, short exploratory holes could be considered. The maximum depths to*

source are invariably shallow - 20 to 30 metres.

2100E at 305S (30 metres)

2100E at 445S (30 metres)

2150E at 295S (10 metres)

2150E at 355S and 375S (30 metres)

2200E at 245S (20 metres)

2200E at 325S (20 metres)

The FORM and AMPLITUDE of the anomalies is strongly suggestive of graphitic or pyritic sediments. As sediments are recorded on the southern margin of the granite, it is always possible that some of this material is enclosed within the granites. This possibility should be borne in mind when assessing area 7.

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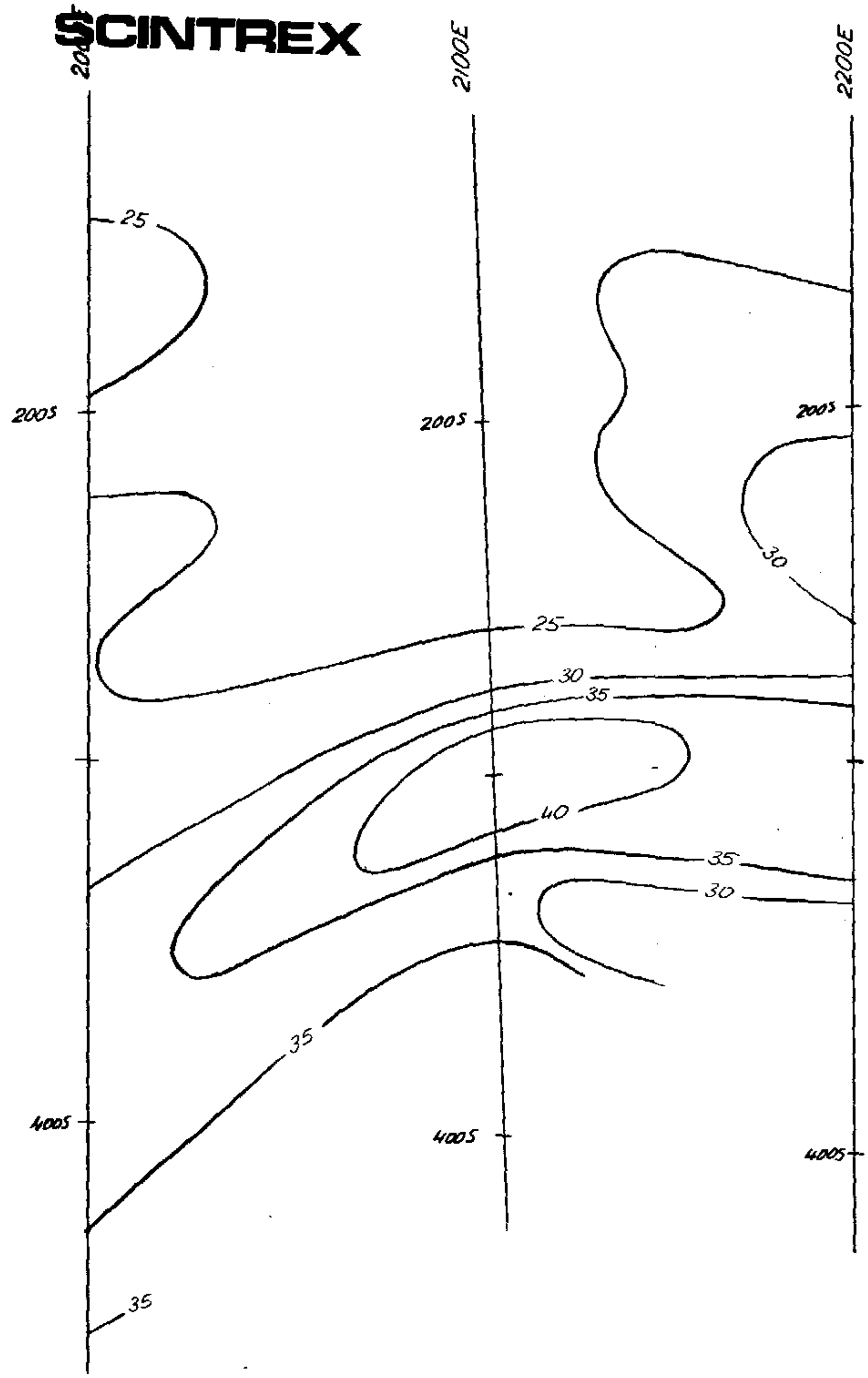

PLATE OM-7

AGNEW TAS-093

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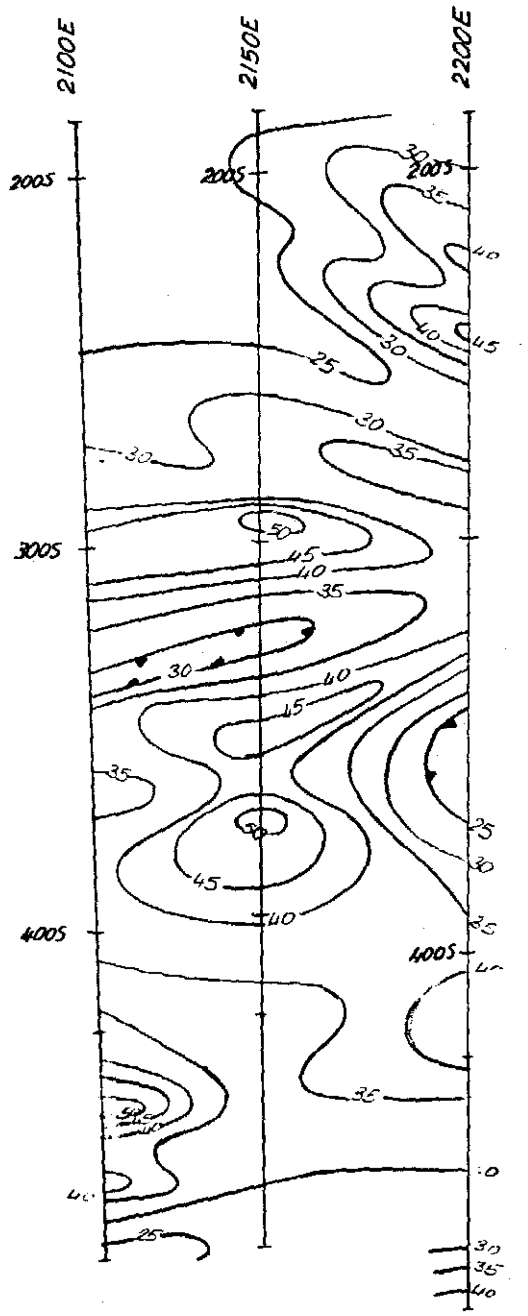

PLATE DM-7
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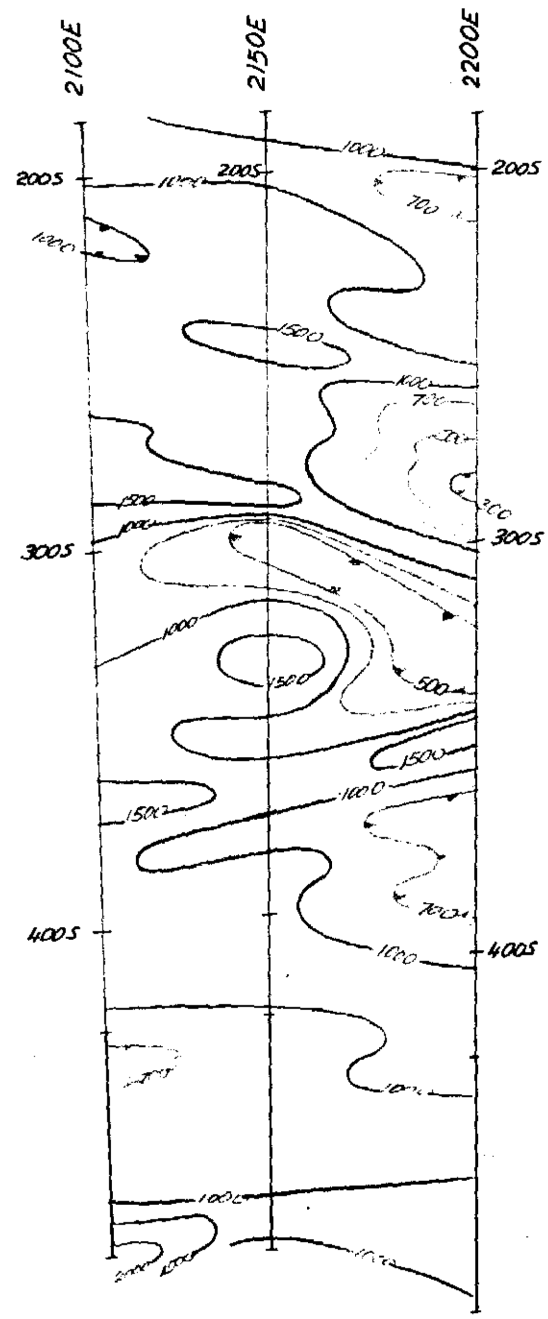

PLATE DR-7
AGNEW TAS-093

AREA 9

RSR: pp 7-8

Original survey zone D

A section of this response was detailed using a 500 metres current dipole whose electrodes were emplaced at 860N and 1360N on line 1950E.

The original chargeability data is presented in contour form on plate OM-9, and the detailed chargeability data on DM-9. The resistivity is presented on plate DR-9. In this case the scope of the detail survey was small and the events fairly continuous, so the contour format is not particularly helpful in setting the general picture for the area. A line by line description is more meaningful.

Line 2000E ..... The detailed gradient array certainly enhanced the interest of the anomaly located in the reconnaissance survey on this line. The maximum of 38 millivolts/volt centred at 1100N has a maximum source depth at this point of about 20 metres, and a second 'shoulder' type response at 1120N implies a second source at a depth of 15 to 20 metres below this point. The decay form shows no change from background, and in this it is in marked contrast to zone 1. While both the major and minor anomaly above are associated with very minor depressions in apparent resistivity, the source essentially must be disseminated in nature.

Line 1950E ..... On this line a 38 milllivolts/volt response at 1185N contrasts with a local background of about 26 millivolts/volt. The maximum depth to source is 25 to 30 metres, and as there is no change in apparent resistivity, a wholly disseminated source is interpreted. The decay form on this occasion is slightly slower than background, implying a coarser grain size to the host.

Line 1900E ..... On this line the response is materially different to that seen to the east. The anomaly is contained between 1100N and 1200N, and variations in form suggest multiple sources. Very slightly higher than background decay forms, and a broad resistivity low were also recorded. The lack of a *material* change in apparent resistivity implies a disseminated source. The maximum depth to source is difficult to gauge due to the multiple nature of the source, however, at 1185N the depth to source could be as great as 45 to 50 metres, while at 1125N as shallow as 25 metres.

A dipole-dipole survey carried out between 1200N and 1020N at a = 30 metres and n = 1 to 5, shows a broad anomalous response between about 1230N and 1110N, with the shallowest manifestation being seen between 1170N and 1110N. The dipole-dipole data indicates a greater importance with depth, and while n = 1 values of 25 millivolts/volt were recorded at 1140N, values for n = 1 - 3 increase to 30 millivolts/volt, indicating increasing importance of the source with depth. Also, between 1230N and 1170N a less chargeable surface layer is indicated.

CONCLUSIONS

1 *The anomalies located, while of moderate amplitude, are nevertheless quite distinct against background. The lack of material depression in resistivity indicates a disseminated to electrically discontinuous source. The lack of conduction may also indicate a lack of alteration, or at least intensity in any alteration present.*

2 *The chargeability backgrounds are higher than seen to the north (say on area 1) and the lack of appreciable change in decay form on the anomaly is also a noticeable difference from area 1, and in this it is akin to area 7.*

3 *The anonalies favoured for investigation by drilling, depending upon supportive geological and geochemical data, are:-*

A 2000E at 1100N - source depth 30 metres

or

B 1900E from 1110N-1200N, but two holes would be required to traverse the multiple sources indicated here. At 1185N a depth to source of 45 metres± is inferred, while at 1125N the source depth does not exceed 25 to 30 metres.

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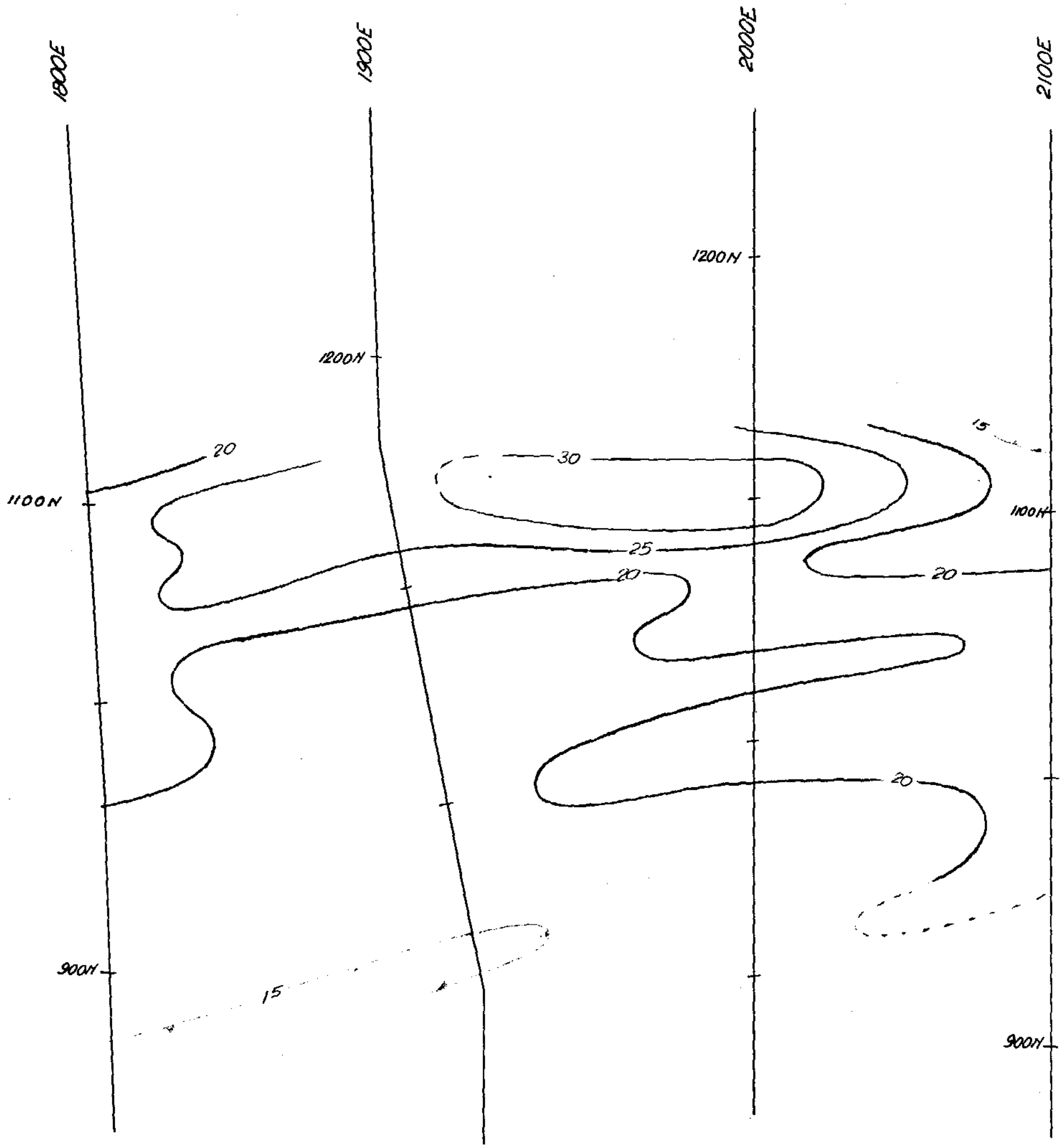

PLATE OM-9
AGNEW TAS-093

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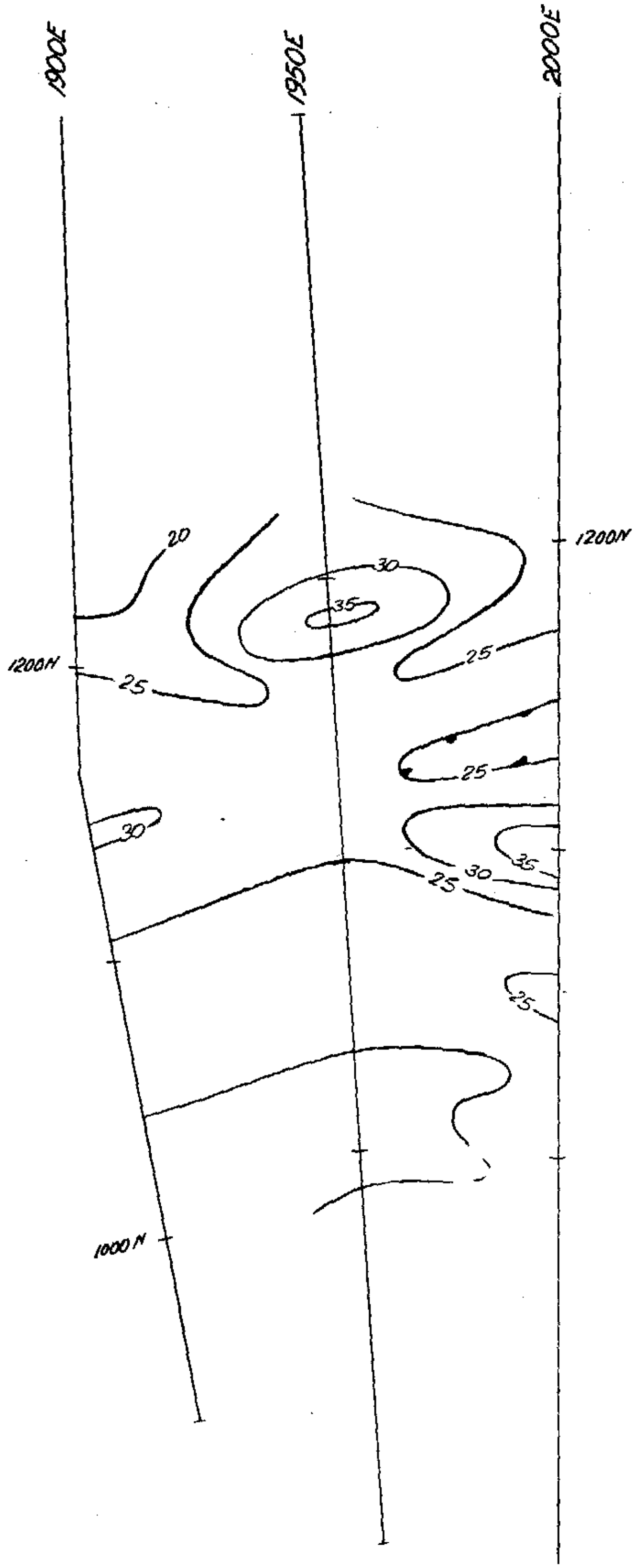

PLATE DM-9
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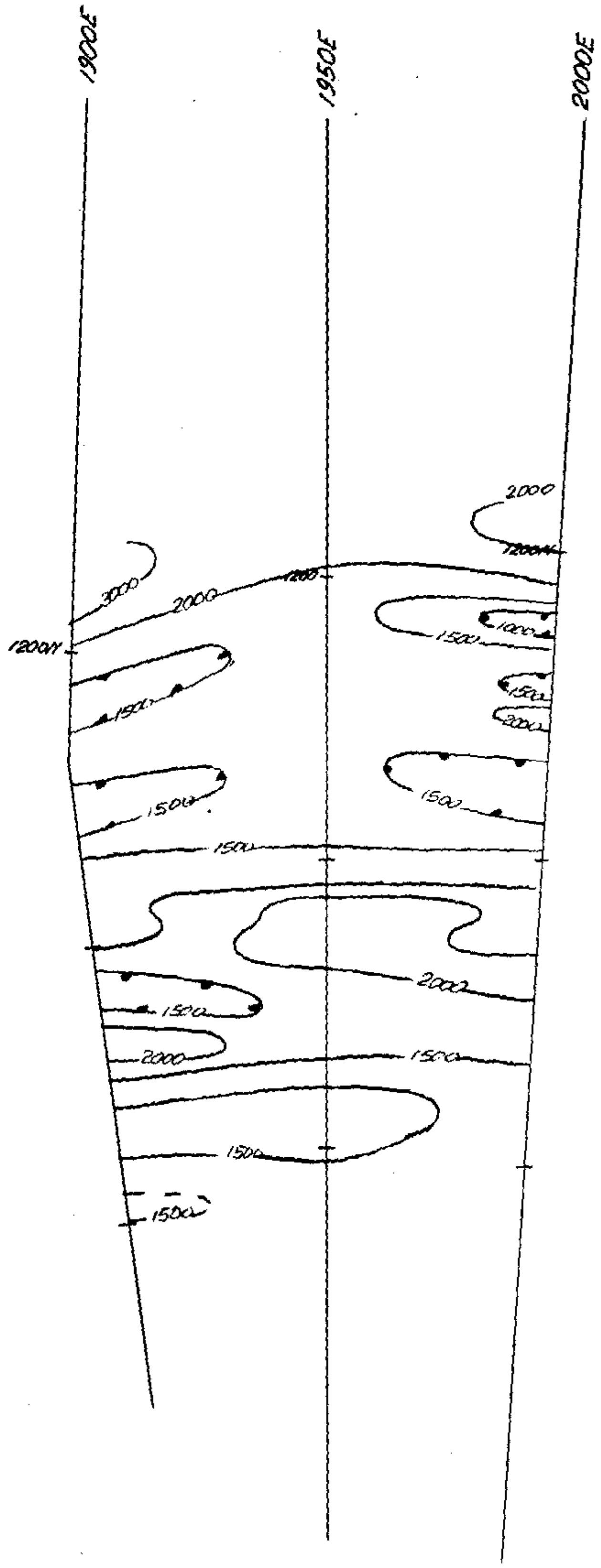

PLATE DR-9
AGNEW TAS-093

AREA 10

The original reconnaissance data on line 2000E showed a general background of about 15 millivolts/volt over the section detailed. Superimposed on this background were a 6 millivolts/volt response at 290N and an 8 millivolts/volt response at 340N.

The dipole-dipole survey extended from 420N to 240N and showed higher general backgrounds of 20 millivolts/volt overall.

A 50% above background anomaly was detected centred at about 345N which shows a broad response of ±20 metres, which generates a weak but definite double peak anomaly for n = 1 to 5. The source depth is less than 30 metres.

Higher chargeability readings defined at 435N for n = 5 do not represent a separate deep seated source, but a complex interference pattern from a source at 540N (see original gradient survey) and the broader source at 300N-330N.

Apparent resistivities are a high 2600 ohm-metres at 345N with resistivities to the north and south thereof being about 25% of this level. The polarization responses are associated with the resistive rock unit.

CONCLUSIONS

1 *The dipole-dipole data has not enhanced the geophysical interest of this zone. However, should geochemical data enhance the interest, then a target some 30 metres below 315N is suggested by the dipole-dipole data. However,*

as this lies midway between the two gradient array maxima at 290N and 340N, drilling of one or both of these maxima is considered preferable as the resolution of the array is more definite as to location in this case.

2 *The decay forms are invariably slower than normal, and little contrast is seen over the anomalies. While other clearly anomalous zones show this effect, a purely compositional variation also is suggested by this phenomenon.*

GENERAL CONCLUSIONS

1 The detailed gradient arrays demonstrate the anomalies located on the reconnaissance surveys to be far more complex in form than inferred on the original survey. Individual chargeability events for the most part have strike lengths less than the detail grid spacing.

2 Some material differences in decay form have been observed from the chargeable material within the anomaly as against the host rocks. In the north, host rocks have abnormally fast decay forms, while in the south they tend to be near-normal. Also, on the northern anomalies (e.g. zone 1) the decay of the chargeable source is materially different to that of the enclosing rocks.

3 Dips are near vertical to south, if the geophysical indications are valid. (These must always be treated with caution.)

4 Maximum depths to source vary between 10 metres and 45 metres, with the vast majority being 20 to 30 metres.

5 None of the sources can be considered to be conductive as such, although some very low (40 ohm-metres) resistivities were recorded. This, together with the observed moderate chargeabilities, implies that the source is essentially discontinuous, i.e. is disseminated, or if 'massive' electrically discontinuous. Also, the resistivity lows and chargeability highs are not coincident, with some resistivity lows showing only moderate (or low) chargeability. This suggests the presence of alteration after the style recorded in the Waxman/Weston deposits.

6 The anomalies defined on the northern part of the grid are considered most prospective on a comparison basis with those located on the Federation and Sweeneys grids. Their apparent complexity appears quite reasonable when the genesis of Waxman-Weston or Sweeneys is considered.

The author looks forward to discussing these results further in the near future.

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.

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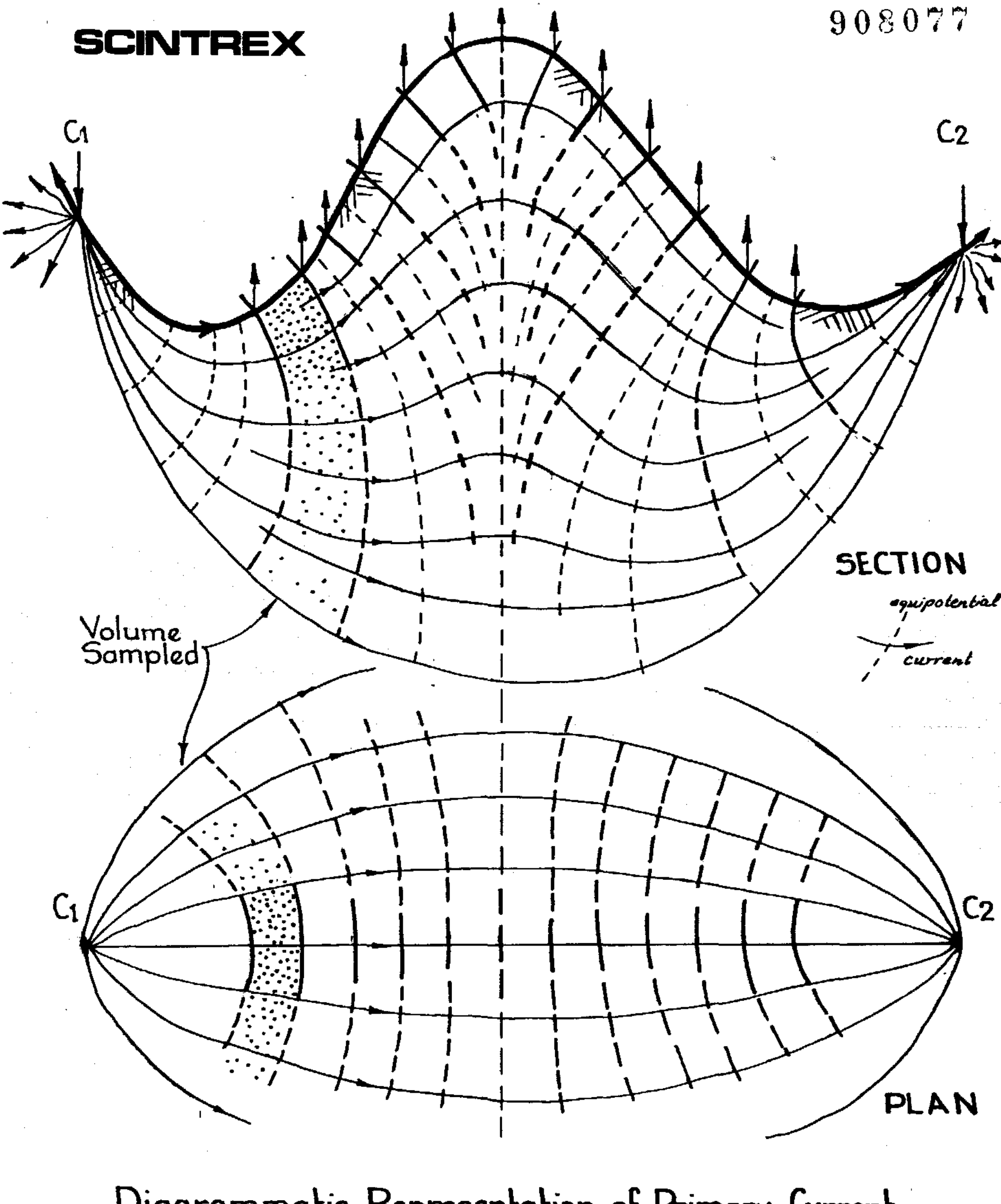

Diagrammatic Representation of Primary Current and Potential Field in Steep Topography.

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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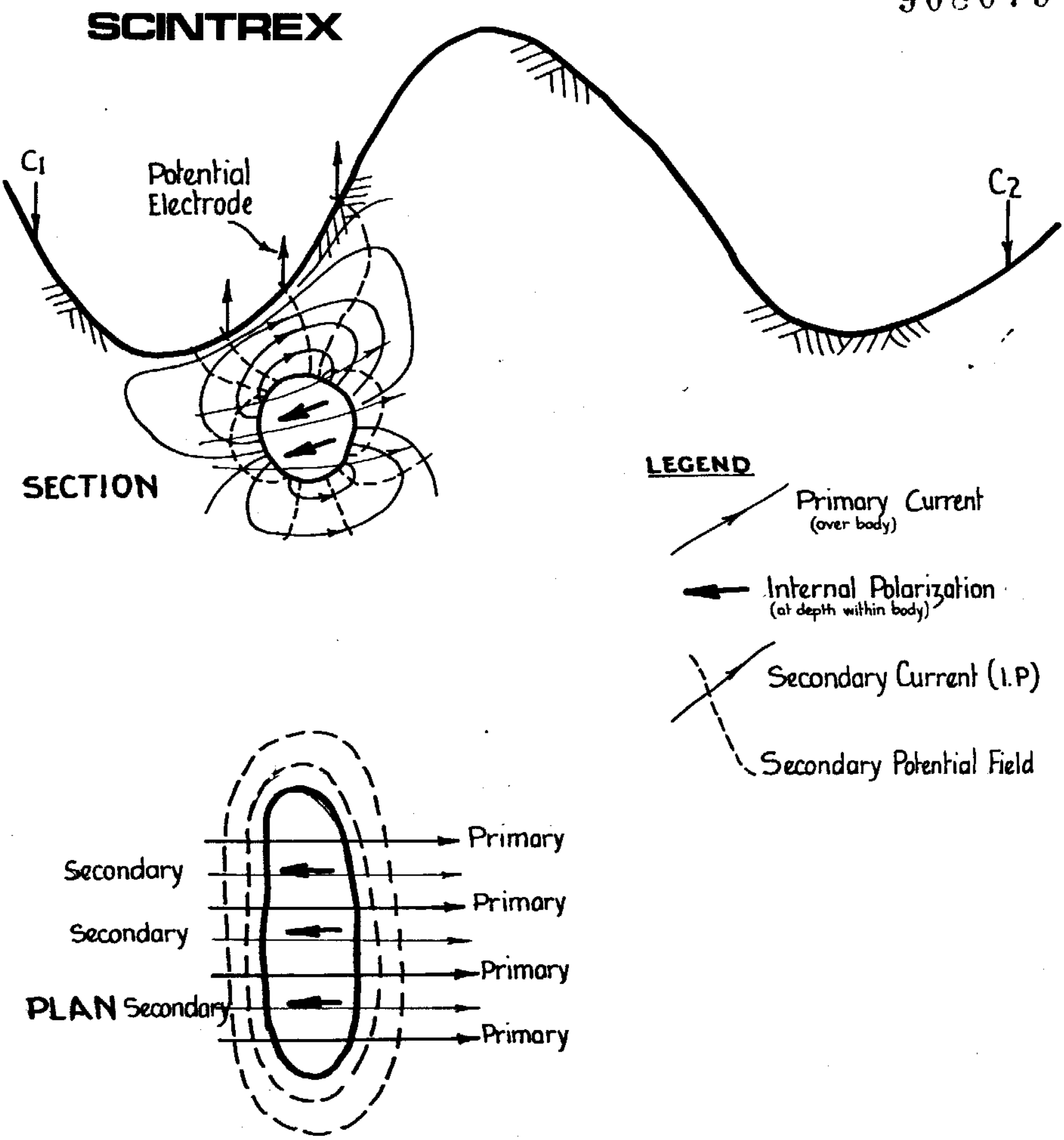

Diagrammatic representation of secondary current (I.P. effect) and secondary potential field in steep terrain.

FIGURE 2.

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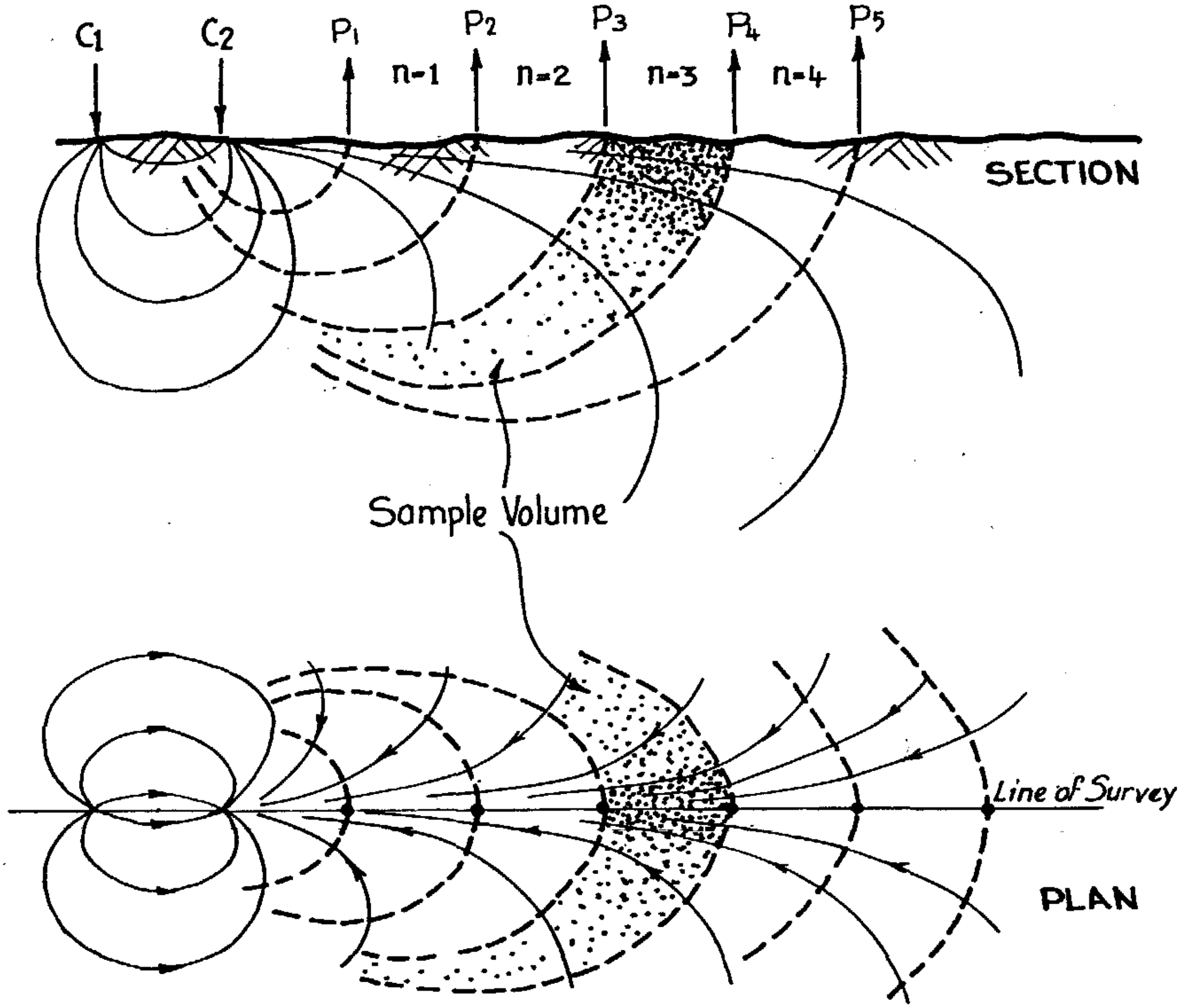


Dipole - Dipole Array
Primary current paths and equipotential field
Showing volumes sampled

FIGURE 3

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

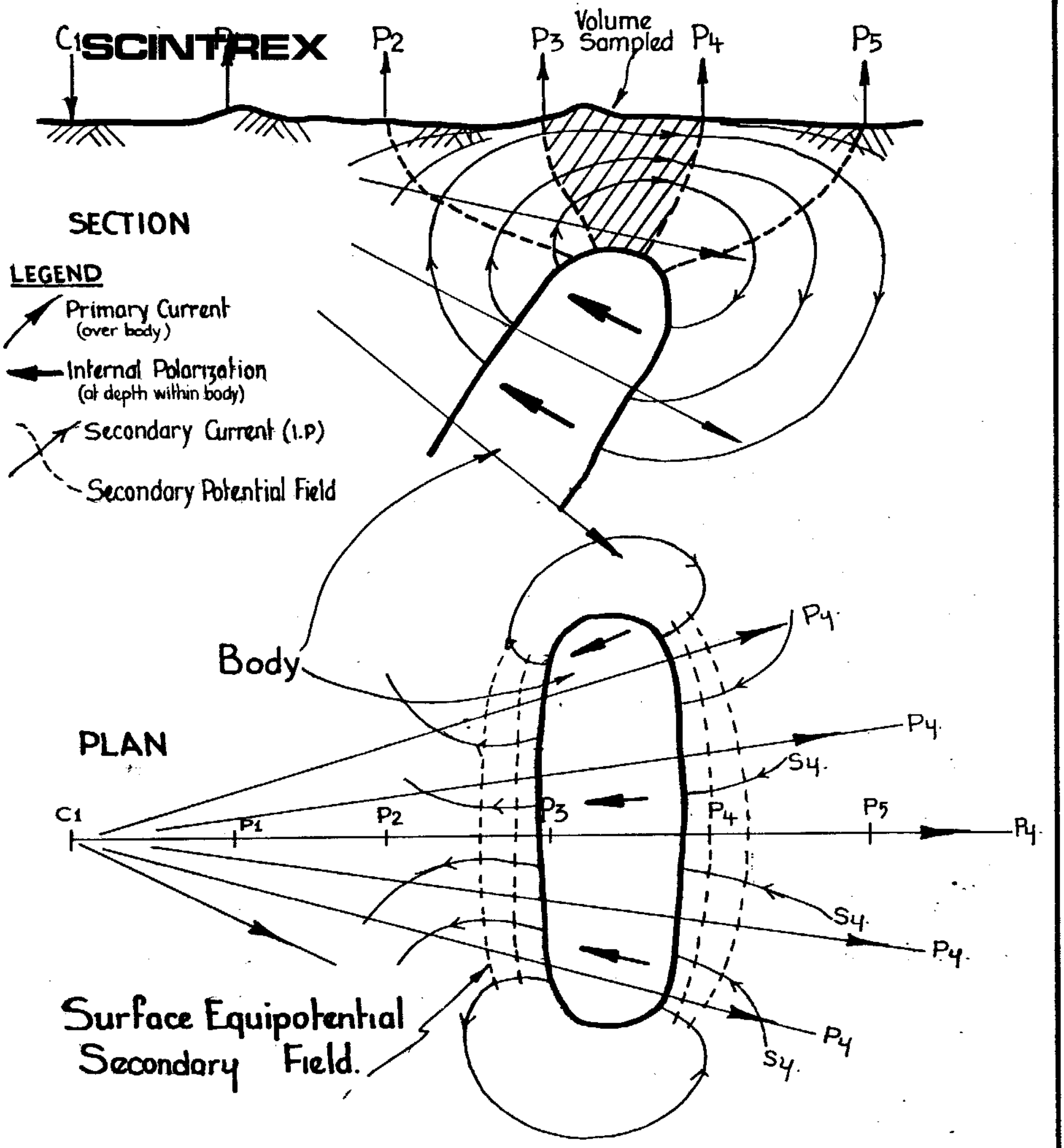
A further characteristic of the array is that where the effective spacing ($n \times a$) is greater than the depth to the source, a 'high' (or 'low', depending on characteristics) will occur as each of the dipoles (i.e. transmitting C_1 and C_2 and potential P_1 and P_2) pass over the source of that 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, 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).

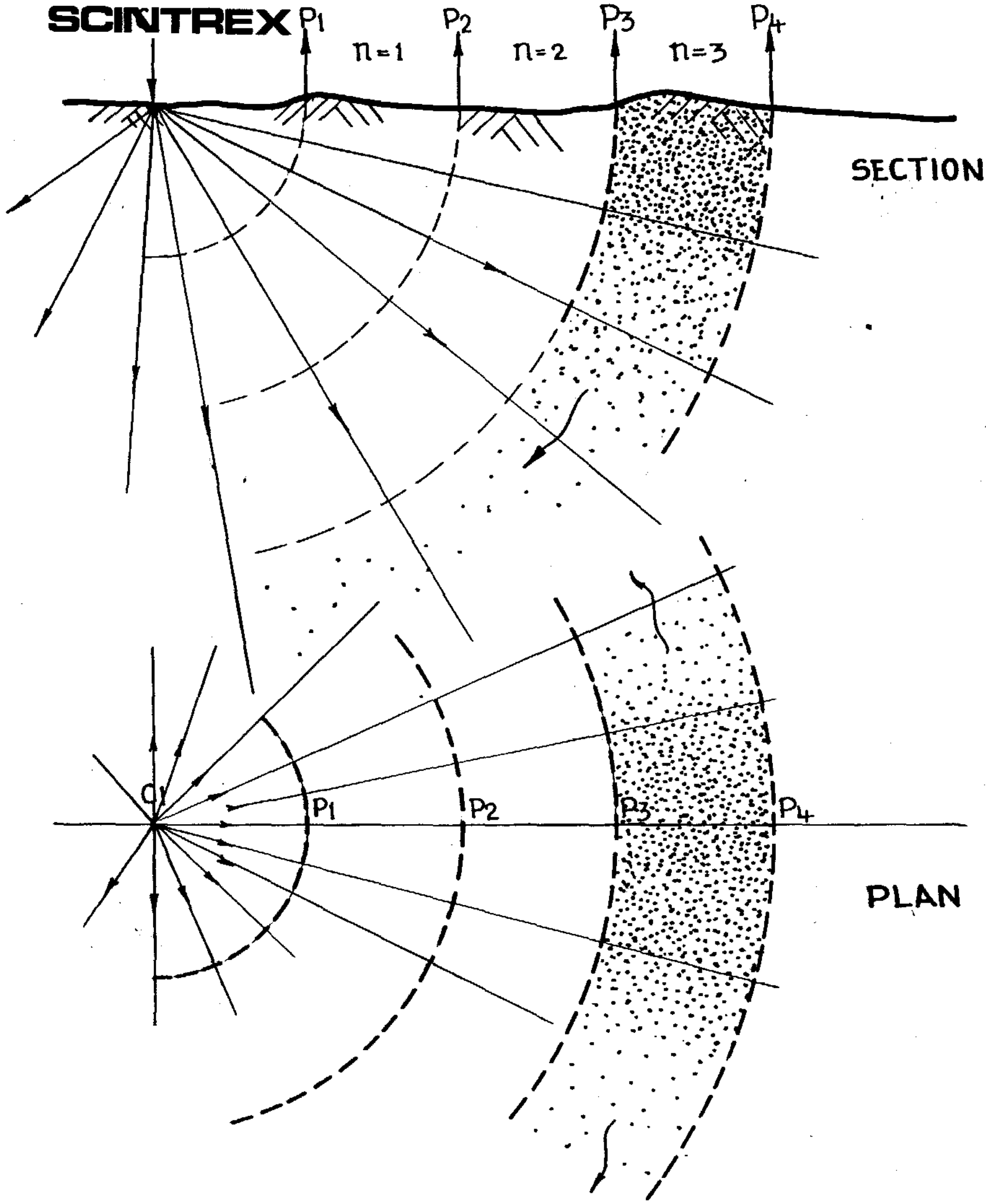
As with the dipole-dipole array, a double peak will result when $n \times a$ is greater than the depth to source, however, with pole-dipole it will be asymmetric. This will be true for both major resistivity features as well as for chargeability features. An example of this asymmetry for different depth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



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.



Current Path and Primary Equipotential Field from Pole-Dipole Array

FIGURE 5

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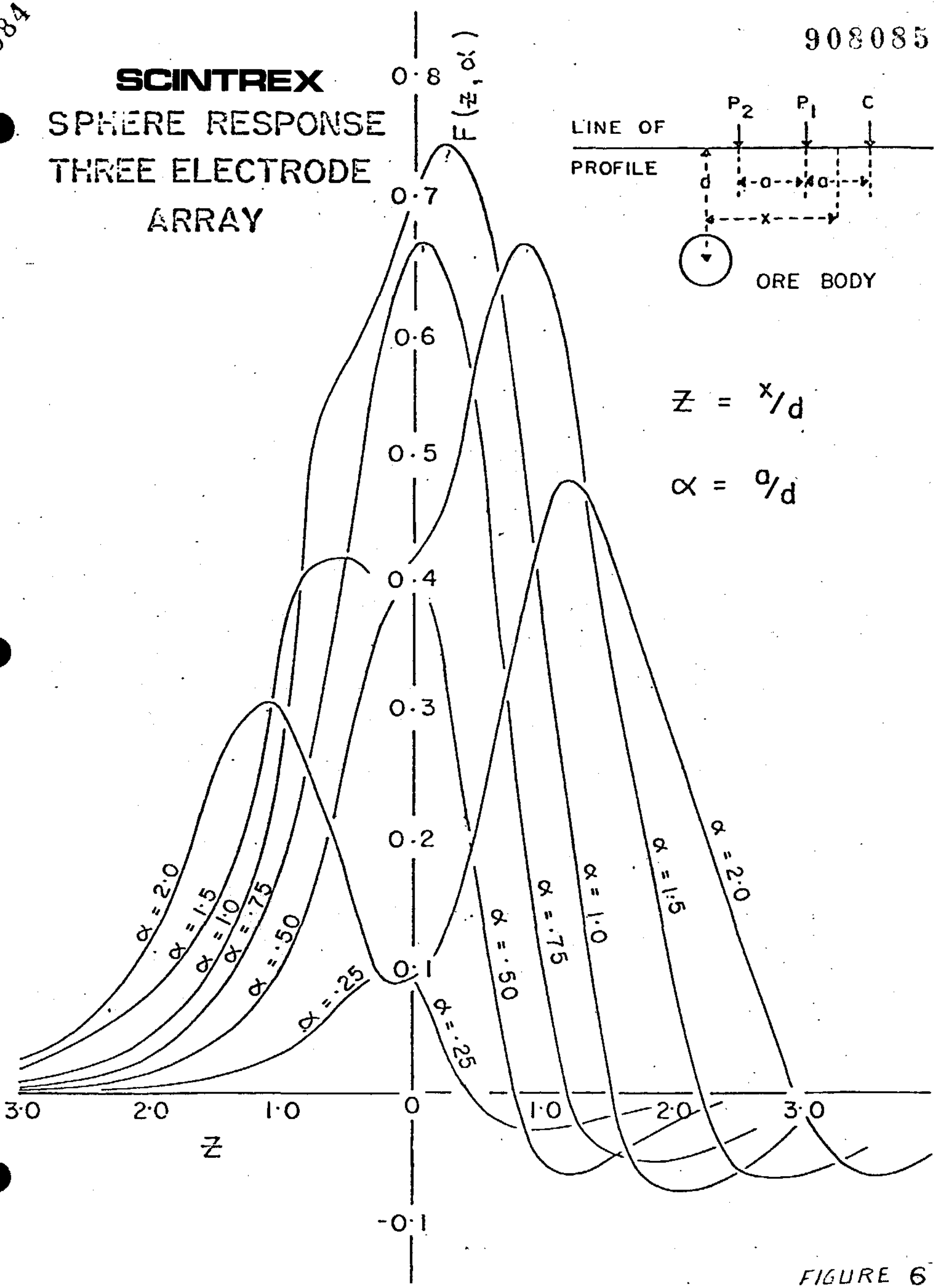


FIGURE 6

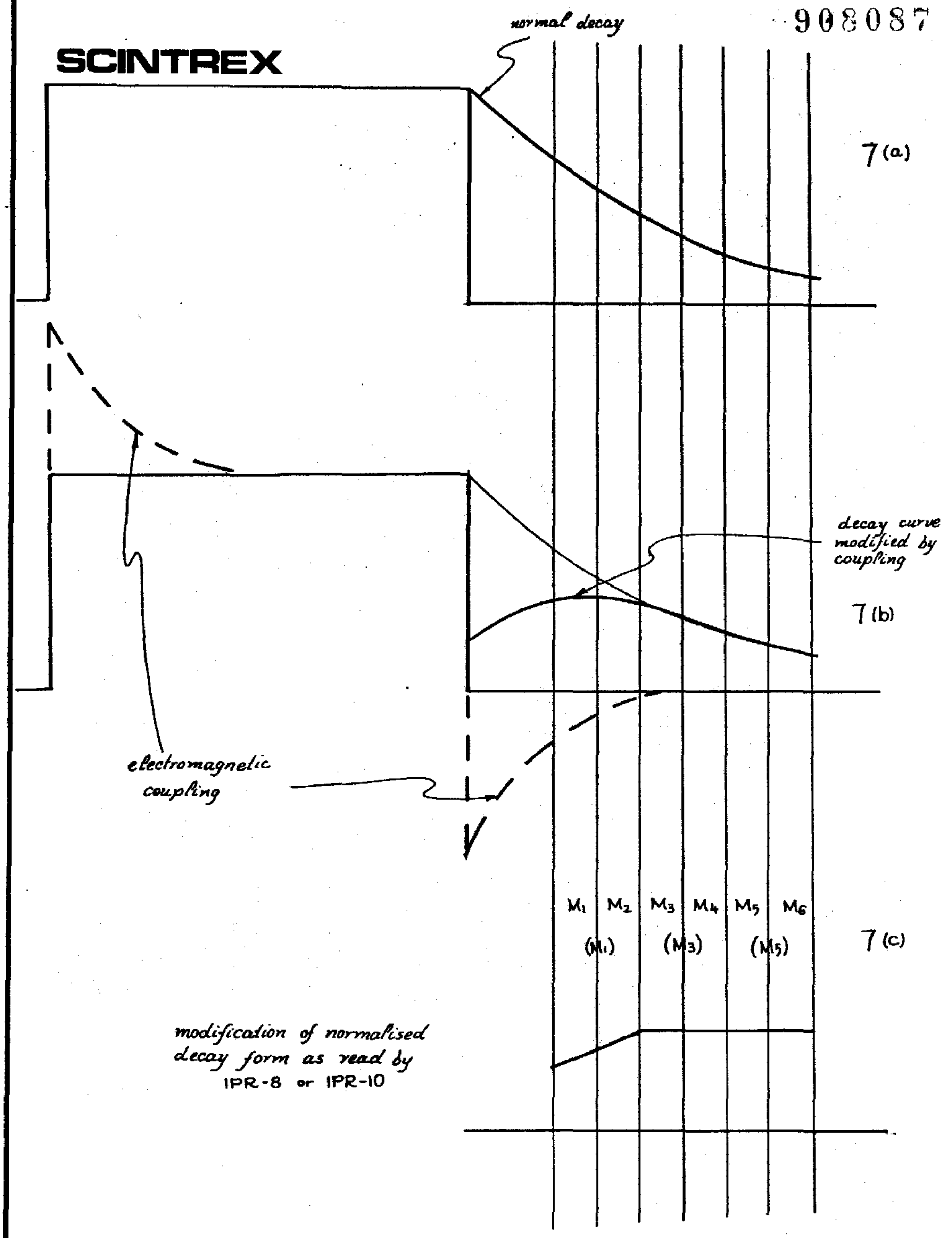
dipole-dipole), but this should be followed-up by detailed dipole-dipole or pole-dipole surveys as the gradient array, while giving 'maximum depths', cannot give 'minimum depths' as moving source arrays can. Similarly pole- or dipole-dipole surveys which have complex or muliptle sources can very often 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



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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TABLE 1

(Table 3.1)

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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"