SCINTREX

COMMENTS ON

GRADIENT ARRAY DETAIL AND DIPOLE-DIPOLE DETAIL

AT MT. BLACK AND CONTIGUOUS AREAS

NEAR ROSEBERY, WEST COAST TASMANIA

ON BEHALF OF

ELECTROLYTIC ZINC COMPANY OF AUSTRALASIA LIMITED

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AT MT. BLACK AND CONTIGUOUS AREAS
NEAR ROSEBERY, WEST COAST TASMANIA
ON BEHALF OF
ELECTROLYTIC ZINC COMPANY OF AUSTRALASIA LIMITED

BY

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CONTENTS

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SUMMARY

The gradient and dipole-dipole array detailed work over anomalies located in the earlier Mt. Black reconnaissance survey confirmed the location of most of the responses located in that survey. For the most part the chargeability responses have been shown to be of limited strike length and of variable nature along strike. Their form suggests them to be either disseminated or, if massive, electrically discontinuous in nature, and this, together with their limited strike length, infers the best to be of secondary interest as far as geophysical signature is concerned. As always, however, the ancillary geological and geochemical data is of greater importance than either form or amplitude in assessing the economic importance of the anomalies located in this survey.

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INTRODUCTION

A series of dipole-dipole and gradient array detail surveys were carried out within the Mt. Black gradient array reconnaissance survey area, (described in report TAS-065 dated March, 1979 by the author), and in areas contiguous to the Mt. Black grid known as Langdons and Mt. Sale.

This work, together with areas at Murchison, Bulgobac and White Spur, were surveyed by a Scintrex crew over various dates between 11th April and 14th June 1979. The party was led by Mr. B. Ekstrom to 11th May, 1979 and thereafter by Mr. D. Webb,B.Sc. Second operators over this period included Mr. P. List, Mr. T. Von Strokirch,B.Sc., and Mr. R. Sims.

On site geological superivison and direction was carried out by Senior Exploration Geologist Mr. R. Williams, and Project Geologist Mr. J. Mills.

EQUIPMENT

The equipment used on these surveys consisted of a 2½/3 kilowatt Australian built time domain induced polarization transmitter powered variously by a 4HP and 8HP Briggs and Stratton motor generator. The resultant primary and secondary potential fields so generated were investigated using analog Scintrex

IPR-8 and compatible digital Scintrex IPR-10 induced polarization receivers. While three slices under the decay curve were recorded, only M_3 has been plotted, comments being made on the decay form where significant.

DATA PRESENTATION

The chargeability and resistivity data for the smaller detailed gradient array surveys have been contoured at the scale used for the reconnaissance data, namely, 1:5000. The data profiles are displayed at the horizontal scale of 1:2500, while vertical scales were 1 centimetre = 2 millivolts/volt for chargeability, 1 centimetre = 10 millivolts for self potential, while resistivity was displayed on a 5 centimetre log cycle and expressed in ohm-metres.

The dipole-dipole data is displayed on a standard pseudo-section format. (See appendix for explanation).

METHOD

The gradient array method is briefly discussed in report TAS-065 referred to above, while the dipole-dipole procedures used were quite standard. Additional comments are made in the appendix.

DISCUSSION OF RESULTS

The areas discussed in this report are shown in Figure 1 at the scale of 1:25000. Each area is separately discussed below.

AREA 1

The three lines surveyed were on the western end of the reconnaissance line

378,000N centred at about 379,500E. The original reconnaissance anomaly was discussed on page 10 of report TAS-065. The repeat was surveyed using a 2800 metre current dipole placed on the line line 378000N with a potential dipole of 20 metres moved at 20 metre intervals.

Line 378000N ..... The background chargeability on the detailed array is about 8 millivolts/volt below the original reconnaissance data, reflecting in part the bias of the distant current electrodes and/or the dilution in the latter of the oxidation/overburden. The apparent resistivity on the second detailed array is *greater*, reflecting the changed bias as for chargeability. However, the *form* of the data profiles is very similar, with the apparent resistivity being almost identical. The most material response remains a 9 millivolts/volt above background response at 379725E on line 378000N. The source is considered to have a maximum depth not exceeding 20 to 30 metres and be due to disseminated sulphides (or graphite). A second minor zone at 379550E(+) of 3 to 4 millivolts/volt above the 16 millivolts/volt background of itself is not significant, however, on both the adjacent lines, 100 metres to the north and south, it becomes more substantial.

Line 378100N ..... The response recorded at 379725E on the reconnaissance line clearly relates to a maximum of 6 to 8 millivolts/volt above background at 379750E on this line. The form of the response *suggests* a west dip to the source and a maximum depth of about 40 to 50 metres. A depression in the resistivity to 2500 ohm-metres from 6000 ohm-metres(+) still infers a disseminated source, however, it is either weakly interconnected or lies within a less resistive rock unit.

The minor response on the reconnaissance line 378000N at 379550E has a more

significant correlative on this line of 6 to 8 millivolts/volt above the 14 millivolts/volt background at 379550E. The source is interpreted to be similar to that at 379750E, while the maximum depth is interpreted to be of the same order, namely 40 to 50 metres.

Line 377900N ..... The main response at 379725E on the reconnaissance line is reflected here as a minor broad 4 millivolts/volt above background chargeability in a broadly lower resistivity feature. This response has no material significance. However, the minor feature at 379550E on the reconnaissance line is seen here as a much more significant 8 millivolts/volt response associated with a fall in resistivity to under 3000 ohm-metres from 9000 ohm-metres and 12000 ohm-metres to east and west. The west dipping source is estimated to have a maximum depth of 40 to 50 metres.

AREA 2

Two lines were surveyed to the north and one to the south at 377300N, 377100N and 376900N using a 3000 metres current dipole on line 377000N with electrodes placed at 377700E and 380700E. A 40 metre dipole-dipole survey was also carried out on line 377000N.

Line 377000N ..... A comparison of the reconnaissance line data and the 3000 metres detail, certainly shows the former to have been subject to noise, both positive and negative with respect to background. The anomaly located at 37955 0E is, however, repeated here with a 10 millivolts/volt plus, chargeability response above background centred at 379550E superimposed on a 12 millivolts/volt background, almost half that of the original data. As would be expected, no

significant change in the resistivity profile form was observed, which is as per the original reconnaissance data. The source therefore is interpreted to be wholly disseminated in nature (or if 'massive' electrically discontinuous) and at a depth of 60 metres below surface. The form of the anomaly suggests a west dip. A suggestion of two closely related sources rather than a single source is inferred from the profile form.

The dipole-dipole array was surveyed between 379420E and 379660E on an a = 40 metres, n = 1 to 4 spacing. The data shows a source centred at 379540E whose depth is less than the spacing used, namely 40 metres, and which increases in importance with depth. The contact of the source with the enclosing rocks is twofold, while the absolute level of chargeability between the gradient detail and the dipole-dipole are comparable. The very much lower dipole-dipole resistivities clearly demonstrate a less resistive surface layer. Lower values of less than 1000 ohm-metres either side of 379540E are considered encouraging as they *may?* infer differential oxidation or salts with soils over a sulphide as opposed to a graphite source.

Line 376900N ..... The anomaly recorded on line 377000N is clearly correlated to a similar 10 to 11 millivolts/volt above background response at 379560E. The form of the profile suggests a moderate west dip to the source and a maximum depth to that source of 60 metres. The source is probably disseminated as only a minor depression in the otherwise extremely high resistivity was noted.

Line 377100N ..... Just 100 metres north of the reconnaissance line the amplitude of the anomaly is very mcuh reduced to about 6 to 7 millivolts/volt above background while the source is much broader and is associated with higher than

background resistivities. A wholly disseminated source is thus interpreted below 379570E.

Line 377300N ..... On this line, absolutely no manifestation of the anomaly is seen, and therefore it must close on or just north of 377100N.

AREA 3

Three lines were surveyed to detail anomalies located on the reconnaissance line 378000N at 380690E and at 380980E-381200E. To this end a 2800 metres gradient array was used with electrodes placed at 378900E and 381700E on line 378000N.

Line 378000N ..... The general form of the chargeability data between about 380500E and 380900E is almost identical except for a depression in the chargeability background of about 8 millivolts/volt. The three chargeability responses at 380990E, 381050E and 381110E, however, were not repeated. This is considered to be due to array end effect, magnetic field noise and low Vp. The resistivity data over the whole line, however, while identical in form, is of lower base level, presumed to be due to the current electrode positions in this case. It is considered that the chargeability high on this line is a 'local' high, in close proximity to a major chargeability level change from 12 millivolts/volt in the west to 6 millivolts/volt in the east, which marks a rock type boundary.

Line 377900N ..... This line shows an almost identical profile form to the reconnaissance line repeat, showing the geologic units to be continuous across both.

Line 378100N ..... To the north, higher chargeability readings west of 380800E of 14 millivolts/volt as against 8 to 7 millivolts/volt east of that point, show a much sharper contrast between the two supposedly different rock units.

AREA 4 (Known as Mt. Sale)

A significant above background induced polarization response located on line 378000N centred at about 383760E(± 35 metres) was detailed by a 1200 metres current dipole with electrodes placed at 383200E and 384400E on line 378000N, and lines at 100 metres and 300 metres north and south of, as well as on the original reconnaissance line between about 383600E and 383900E. In addition, dipole-dipole detail was run on the reconnaissance line, and line 377500N.

Line 378000N ..... The chargeability response on the detailed array of some 4 to 5 millivolts/volt above background is much reduced from the 10 millivolts/volt recorded on the original reconnaissance survey. Also the background itself is reduced from about 20 millivolts/volt to 8 millivolts/volt - a very substantial fall. Also, while the resistivity data has an almost identical form, the resistivity is some five fold higher on the repeat data. The dipole-dipole run from 383640E ro 383880E shows lower near surface resistivities to less than 1000 ohm-metres increasing to depth to 2000 ohm-metres(+). However, no significant induced polarization anomalies were recorded on the n =1 to 4, a = 40 metres data.

The interpretation of this data is as follows. The larger current dipole spacing must have emphasised the deeper sections of the source which could be as deep as

60 metres plus to the top of the body. The smaller dipole of the detailed data shows two maxima at 383775E and 383830E each of which has an inferred depth to source of 40 metres or so. Absolutely no significant anomalism was recorded on the dipole-dipole data which may infer masking or a lack of resolution within the dipole-dipole array which beacuse of the width of the source is difficult to account for other than in terms of masking, although the contrast in resistivity for this phenomenon does not appear to be present.

Line 377900N ..... The *general form* of both the chargeability and resistivity data on this line is similar to line 378000N, showing a continuity south. The chargeability data shows two minor maxima of 3 millivolts/volt and 2 millivolts/volt at 383770E and 383815E which are not significant anomalies as such, but bearing in mind the reconnaissance line, may well be at depth.

Line 377700N ..... A significant 8 to 9 millivolts/volt above background response was recorded at 383780E which is coincident with a sharp decline in apparent resistivity to 2000 ohm-metres from over 10,000 ohm-metres to the west. The maximum depth to this feature is about 50 to 60 metres, while the asymmetry infers a west dip to the source. A second minor feature of about 3 millivolts/volt above the 10 millivolts/volt background is also accompanied by a depression in the resistivity. This feature is of relatively minor interest although the 8 to 9 millivolts/volt response may have secondary interest.

Line 377500N ..... A dipole-dipole survey was run between 383680E and 383920E using a 40 metre a spacing and n = 1 to 4. The resultant data shows only low chargeabilities of background amplitude over this section. Therefore, should the chargeable zone be present here, it is probably too narrow to define, or

perhaps too deep.

Line 378100N ..... On this line, 100 metres north of the reconnaissance line, two distinct maxima are seen which show a clear correlation with the response on line 378000N. A minor response at 383740E of 4 millivolts/volt is relatively unimportant, however, at 383820E a 10 millivolts/volt anomaly allied with high 5000 ohm-metres resistivity infers a disseminated sulphide (and/or graphite) source at about 40 metres. Again a west dip to the source is inferred. This is one of the rare cases where a minor but definite self potential anomaly of 85 millivolts is present also. The almost identical apparent resistivity profile between lines 378100N and 378000N infers a continuity of geological units over both lines.

Line 378300N ..... The correlative to the response described above on this line consists of maxima of 7 millivolts/volt and 6 millivolts/volt above the 8 millivolts/volt background at 383790E and 383830E accompanied by a depression in the otherwise rising resistivity. The maximum depths to source are considered to be about 50 to 60 metres in each case, while the sources *may* be near vertical.

AREA 5

This area was investigated by a 2000 metres gradient array with electrodes placed at 380200E and 382200E on line 376000N and seven lines between 375500N and 376500N, centred at about 381150E. Also a dipole-dipole array was centred at 381440E on the centre line 376000N.

Line 376000N ..... The reconnaissance line was re-surveyed between 380870E and

381600E. The main response centred between 381300E and 381550E was confirmed by an above background response of 18 millivolts/volt centred at 381460E. The background at about 7 millivolts/volt is however, half that observed on the reconnaissance survey. While the *form* (as would be expected) is different in detail, the overall anomaly is similar. The interpretation is of a series of chargeable zones decreasing in volume percent east and west of 381460E. The resistivity shows an almost identical form, and confirms the source of the chargeability response to be of a disseminated nature, or if massive, electrically discontinuous. It is difficult to judge the *minimum* depth, however, the maximum depth is of the order of 40 to 60 metres. The dipole-dipole was surveyed using an a = 40 metres n = 1 to 4 spacing between 381320E and 381560E. This shows a broad source centred at 381480E $\pm$20 metres of 20 millivolts/volt, while resistivities are higher at 3500 to 4000 ohm-metres over the chargeable source than to the east and west of it. The depth to source is less than the a spacing used, namely 40 metres.

Line 376100N ..... The gradient array was surveyed from 380680E to 381600E and shows a much reduced response between 381300E and 381600E of 8 to 14 millivolts/volt which shows that the chargeable zone fingers out to the north. A number of minor responses including one of 14 millivolts/volt (about 4 millivolts/volt above background) at 381390E are not considered of material significance, but do infer a depth to source of about 40 metres at this site. The high resistivities of 6000 ohm-metres clearly infer a disseminated source to the anomalism.

Line 376300N ..... This short line was run between 381390E and 381590E and shows a number of minor maxima which may be significant. The first, at or west of 381390E is about 6 millivolts/volt above background, while a second at 381445E

is about 4 millivolts/volt above background with a third response between 381510E and 381570E. All are accompanied by high resistivity which shows that the source is disseminated, and probably represents formational differences.

Line 376500N ..... This line was run between 381290E and 381590E. On the 8 millivolts/volt background an anomaly of 5 millivolts/volt was defined at 381490E ±15 metres, with a sharp 8 millivolts/volt response at 381550E. The maximum depth to these sources is estimated to be 50 to 60 metres and 25 to 30 metres respectively, while both sources have disseminated sources, although the latter shows some reduction in resistivity.

Line 375900N ..... The correlative of the reconnaissance line anomaly is centred at 381450E, but is a reduced 6 to 8 millivolts/volt above the 8 millivolts/volt background. Related, separate sources were defined at 381350E and 381530E. The two most easterly chargeability anomalies are associated with lower than background resistivity, while the western maximum shows no contrast. However, *all* are from disseminated sources and estimated maximum depths are 40 metres, 60 metres and 40 metres, west to east, respectively.

Line 375700N ..... On this line, run from 380870E to 381600E, the most westerly anomaly described above is not present. However, the central anomaly on line 375900N correlates with a 6 to 7 millivolts/volt response at 381460E whose maximum depth is about 40 to 60 metres. At 381550E an 8 millivolts/volt above background anomaly correlates with the less significant response at 381545E. This anomaly is accompanied by a decrease in resistivity to a still high value of just over 2000 ohm-metres at 381530E. The maximum depth to source is about 60 metres. A shoulder at 381590E suggests a separate source.

One isolated high of minor significance was defined between 381020E and 381090E. This anomaly is accompanied by a reduction in background resistivity from 6000 ohm-metres to under 2000 ohm-metres and the source is less resistive than the enclosing material. This feature has a maximum depth to source of about 40 to 50 metres and the form of the anomaly suggests an east dip to that source. This response is not identifiable on either the lines to the north or south.

Line 375500N ..... On this, the most southerly line run, two related 5 to 6 millivolts/volt above the 8 millivolts/volt background maxima were recorded at 381430E and 381470E and are accompanied by a depression to 6500 ohm-metres from the 15,000 ohm-metres plus background. The correlatives on line 375700N are 381550E and the shoulder at 381590E. The maximum depth to source is 40 to 50 metres.

AREA 6

This area was investigated on five short gradient lines surveyed from 382400E to 382700E at 376700N, 376900N, 377000N, 377100N and 377300N. To this end, a 3000 metres current dipole was placed at 380750E and 383750E on line 377000N. Also, three dipole-dipole set-ups were placed on lines 377000N, 377500N and 377700N .

Line 377000N ..... On this, the reconnaissance line, a sharp 12 millivolts/volt response was recorded at 382550E on the original survey. This was flanked to the west by 20 millivolts/volt backgrounds and to the east by background about 4 millivolts/volt less. The anomaly therefore was situated on, or in close proximity to a rock type change, which was not, however, reflected by any material

change in background resistivity. The 3000 metres repeat gave an almost identical result, except that the overall background was about 4 millivolts/volt lower. The dipole-dipole data run at a = 40 metres and n = 1 to 4 gave very similar results, with the source being indicated at a depth shallower than the a spacing used, namely 40 metres, centred at 382520E. The western limit of the double peak anomaly, however, may be influenced by a secondary maximum situated (from the gradient array data) at 382470E. As with the gradient data, the resistivity remains high throughout, however, the chargeability background is much reduced to 6 millivolts/volt to the west as well as the east, which may indicate soil cover in the area.

Line 377100N ..... On this line, only some 100 metres north, no significant anomaly was recorded over the correlative section, although a sharp change in induced polarization background from east to west of 8 millivolts/volt to 15 millivolts/volt conforms well with the levels revealed on line 377000N.

Line 377300N ..... It is highly significant that on this line at 382590E a chargeability response very similar to that seen on the reconnaissance line was recorded *in spite of it not being present on the intermediate line*! Here, a 16 to 18 millivolts/volt above background anomaly was recorded on a falling background of about 14 millivolts/volt in the west to 6 millivolts/volt in the east. The only slight fall in the high 6000 ohm-metres resistivity infers either a disseminated or if 'massive, electrically discontinuous source, the maximum depth of which is estimated to be 35 to 40 metres.

Line 377500N ..... On this line a dipole-dipole survey was carried out between 382320E and 382680E on an a = 40 metres dipole from n = 1 to 4. This data shows

a source at 382360E ±20 metres of 24 millivolts/volt as against a background of 5 to 6 millivolts/volt. The depth to that source is less than the spacing used, namely 40 metres, and there is only minimal reduction in resistivity from the 1500 ohm-metres background in the immediate vicinity of the source. This response *is not* related to the source located at 382590E on line 377300N as the strike projection position on line 377500N is about 382600E (unless there is a sinistral displacement between lines 377300N and 377500N). It could be that this maximum is related to a secondary maximum of 16 millivolts/volt (6 millivolts/volt above local background) at 382430E.

Line 377700N ..... A dipole-dipole survey on this line traversed between 382440E and 382680E using an a = 40 metres spacing and n = 1 to 4. No significant anomalism was recorded although very slightly higher readings were located on the extreme west of the set-up.

Line 378000N ..... On this reconnaissance line surveyed early in the season, no response was recorded over the section of the line which could correlate with the responses recorded on line 377500N at about 382360E

Line 376900N ..... This line, 100 metres south of the reconnaissance line, shows excellent correlation with that line. The gradient chargeability maximum of 18 millivolts/volt centred at 382570E is accompanied by 6000 ohm-metres resistivities and thus is interpreted as a disseminated, or if massive, electrically discontinuous source at a maximum depth of about 30 metres. As with line 377000N, the base level of the chargeability to the east is lower (9 millivolts/volt) than that to the west (14 millivolts/volt). A second smaller maximum of about 3 millivolts/volt above background at 382490E correlates with a similar response

at 382470E on line 377000N.

Line 376700N ..... An almost identical resistivity profile allows excellent correlation between lines 376900N (and 377000N) and this line. This shows that a very small increase in background of about 2 to 3 millivolts/volt is the only manifestation of the larger high recorded on line 376900N at 382570E.

AREA 7

A series of induced polarization maxima located between 382500E and 382800E on line 376000N were investigated using a 1600 metre gradient array with electrodes placed at 381900E and 383500E on the reconnaissance line, and lines at 375700N 375900N, 376000N, 376100N and 376300N.

Line 376000N ..... The reconnaissance line was repeated between coordinates 382300E and 382900E. The chargeability profile form is similar west of 382800E but east of that station a reduced response was observed on the repeat data. The level of the detail is about 4 millivolts/volt less than the original reconnaissance data. The form of the resistivity data is to all intents and purposes identical.

The detailed data shows a series of individual maxima at 382480E, 382570E, 382630E, 382670E and 382720E. The eastern maximum is 8 millivolts/volt above background while the remainder are 10 to 12 millivolts/volt above background. All are accompanied by no material change in the high apparent resistivity and thus are due to either disseminated, or if massive, electrically discontinuous sulphides or graphite. The sharp anomaly form suggests maximum depths to source no greater

than about 30 metres below surface.

Line 375900N ..... The gradient data shows only minor responses of 4 millivolts/volt(±) above a rising west to east background. While these can be related to the more substantial anomalies on line 377000N, they suggest a 'fishtailing-out' of the zone to the south.

Line 375700N ..... This line shows only minor variations in background which rises from west to east. None of the induced polarization responses can be considered significant.

Line 376100N ..... The main group of induced polarization anomalies on line 377000N between 382550E and 382700E can be correlated to higher values between 382550E and 382775E on this line. Individual maxima at 382570E, 382610E, 382700E and 382750E, while not showing a direct correlation with line 377000N, are of similar form. The maximum depth to source is estimated at 40 metres, while the source itself is disseminated in nature.

Line 376300N ..... To the north the chargeability data is interpreted to represent only changes in background, with individual maxima not being able to be correlated between lines.

AREA 8

A significant 8 to 10 millivolts/volt induced polarization anomaly centred at 382000E ±25 metres on line 375000N was detailed using a 3000 metres gradient array with electrodes placed at 380750E and 383750E on line 376000N. Three lines were

surveyed, the centre line being a repeat of the reconnaissance line.

Line 375000N ..... The detailed data shows the anomaly in very similar form and amplitude to the reconnaissance survey, save for a 3 millivolts/volt decrease in chargeability background. The resistivity profile form is almost identical. As before the source is indicated to be both single and broad or perhaps two individual segregations of chargeable material centred at 381990E and 382025E. The maximum depth to source appears to be of the order of 60 to 70 metres in both cases, while the asymmetry suggests an east dip. A slight depression in the otherwise high resistivity infers very minor conduction *between* the two possible chargeability sources.

Line 374900N ..... 100 metres to the south on line 374900N there appears to be an overall increase in background to 14 millivolts/volt (from 8 millivolts/volt) west of 382000E. There is, however, no chargeability anomaly as such on this line.

Line 375100N ..... On this line a single minor maximum of 5 millivolts/volt above background was defined at 382010E which is the most northerly manifestation of the western peak of 381990E on line 375000N and lies on a sharp change in resistivity.

AREA 9 - LANGDONS GRID

A gradient array having a current dipole of 1600 metres and electrodes placed at 379700E and 381300E on line 379000N was used to energise a block which included sections of lines spaced at 100 metres intervals from 378700N to 379200N between 380000E and 381000E.

Line 379000N ..... A comparison of the original reconnaissance data and the detailed gradient data shows not only a much reduced background to 10 millivolts/volt from 20 millivolts/volt for chargeability, but also a reduced amplitude for individual events on that profile. An almost identical resistivity profile was recorded, but also (unlike other areas at Mt. Black) on a lower resistivity background. This would appears to indicate that there is a cover of lower chargeabioity and lower resistivity which the larger array penetrates somewhat more efficiently.

In this case the chargeability data is best viewed for an overall picture in contour form. This shows two approximate grid north south trending induced polarization anomalies referred to as Zone A and Zone B situated respectively in the western central and eastern central portions of the Langdons grid.

Zone 'A' ..... This zone reaches its maximum development on line *378800N* at 380275E where the chargeability reaches 10 to 12 millivolts/volt above the 10 millivolts/volt background. As there is no significant variation from the 6000 ohm-metres resistivity the source is either disseminated or if 'massive' electrically discontinuous. The maximum depth to source is of the order of 60 metres. At 380340E on the same line, a secondary maximum related to the main Zone 'A' was seen as a 7 millivolts/volt above background response, again with no material displacement in the resistivity profile, indicating a disseminated source. 100 metres to the south on line *378700N* three maxima each of about 6 to 8 millivolts/volt at 380260E, 380310E and 380360E were recorded. The maximum depths to source look to be about 40 to 60 metres and the source must be disseminated or electrically discontinuous as there is no material change in apparent resistivity.

On line *378900N* a significant 14 millivolts/volt response above background was recorded centred at 380290E with a 'shoulder' suggesting a secondary source at 380262E. The high resistivities again infer a disseminated or electrically discontinuous massive source, the maximum depth of which is estimated to be 60 metres to 70 metres. A west dip *could* be inferred from the asymmetry of the profile. A dipole-dipole at an a spacing of 40 metres and n = 1 to 4 was surveyed across this anomaly. This shows the centre of the anomalism to be at about 380280E $\pm$20 metres and a maximum depth of the order of the spacing (40 metres). However, it may be significant that the n = 3 value gave the *largest* reading and that the dipole-dipole amplitudes for chargeability are less than for the gradient array data, inferring a dilution by near surface material. On the n = 1 spacing, lower resistivities were noted over the most chargeable section, perhaps inferring the presence of salts in the soils, or of some oxidation. However, at depth the dipole-dipole data shows similar resistivities to the gradient array.

A further 100 metres to the north on line *379000N* a maximum chargeability of 10 millivolts/volt above the 10 millivolts/volt background was recorded at 380255E. This equates to the maximum at 380290E on line 378900N, while a distinct, separate, but related peak of 8 millivolts/volt above background at 380190E is considered the correlative of the 'shoulder' referred to above on line 378900N at 380250E.

A further minor maximum of 4 millivolts/volt at 380350E equates to a similar minor peak at 380390E on line 378900N.

100 metres north on line *379100N*, two relatively moderate responses each of

about 6 millivolts/volt above background at 380220E and 380300E are the considered northerly extensions of the maximum on line 379000N at 380190E and 380255E. As to the south, the source is disseminated or electrically discontinuous in nature, where the estimated depth is no greater than 30 metres.

On line *379200N* two rather sharp maxima of 6 to 7 millivolts/volt above background at 380210E and 380310E were recorded. The high accompanying resistivities again infer a disseminated/electrically discontinuous source. The maximum depths are estimated at 30 to 40 metres, and both correlate directly with similar maxima to the immediate south. A further like response at 380400E cannot be seen to the south.

Zone 'B' ..... This response unfortunately, makes its most dramatic appearance on line *379100N* at 380670E where it is open to the north. The 18 to 20 millivolts/volt above background response is the most significant recorded on Langdons grid, has an estimated maximum depth of 25 to 30 metres, a west dip to the source, while the source is disseminated of if massive, electrically discontinuous.

On line *379000N* the response is a much reduced 6 to 8 millivolts/volt above background accompanied by a slight depression in resistivity to 4000 ohm-metres. The maximum depth is estimated at about 40 metres. On line *378900N* an almost identical chargeability response at 380690E again has an estimated maximum depth of 30 metres. The response on line *378800N*, the most southerly line on which the anomaly can be identified, is 7 to 8 millivolts/volt and has a slightly deeper maximum depth at 40 to 45 metres.

CONCLUSIONS

1 - Noise has been noted on the reconnaissance gradient array surveys as opposed to little or no noise on the detailed re-runs. This has been put down to magnetic storm activity which occurred over those periods when this phase took place, together with the lower Vp readings in the original data. This was particularly noticeable in Area 3, line 377000N between 380950E and 381200E.

2 - Generally the detailed work did not show significant strike continuity for the anomalies located. This may infer (but not prove!) that the chargeable sources in the area as a whole are of low sulphide/graphite concentration and limited strike extent.

3 - The 'mini-contour' interpretations of the gradient set-ups at the 1:5000 scale of the reconnaissance survey show the interline correlation between chargeable zones well.

The detailed conclusions on each of the areas is as follows:

4 - In *AREA 1* (378000N/±100 metres at 379600E ±300 metres)..... Moderate responses were recorded from disseminated sources at maximum depths to source of 40 to 50 metres. Unless additional corroborating data is available these anomalies of themselves would be of secondary interest at best.

5 - In *AREA 2* (37700N±100 metres & +300 metres at 379500E ±200 metres) ..... The significant 10 millivolts/volt response observed at 379550E is confirmed and is seen to close to the immediate north, but crosses lines 376900N at 379560E as a similar response. The source is disseminated or if massive, electrically

discontinuous and lies at a maximum depth of 60 metres, and dips to the west. This response is of secondary to primary geophysical interest.

6 - In *AREA 3* (378000N ±100 metres at 380850E ±350 metres) ..... The response located at 380700E on the reconnaissance survey is put down to a 'local' variation or a rock type change, while substantial local anomalies at 380950E-381150E were due to 'noise' only generated by array end effect exaggeration, magnetic field noise, coupled with low Vp.

7 - In *AREA 4* (378000N ±300 metres, ± 100 metres at 383800E ±150 metres) ..... The 10 millivolts/volt response recorded on the reconnaissance array is confirmed as a much reduced response on a much lower background. The original reconnaissance data inferred either a 'wide' source or two distinct, close bodies. The detailed data showed all lines to be crossed by two parallel chargeable sources showing only a decrease in resistivity of significance on line 377700N at 383780E. At this site the 8 to 9 millivolts/volt response is considered of secondary interest, as is a similar 8 to 10 millivolts/volt response on line 378100N at 383820E. The latter is wholly disseminated, while the former may have some weak interconnection between sulphide (or graphite) grains to account for the recorded depression in resistivity to 2000 ohm-metres. The maximum depth to source in each case is 50 metres(±).

8 - *AREA 5* was investigated by detailed gradient array from about 380750E to 381600E on lines 375500N, 375700N, 375900N, 376100N, 376300N and 376500N and between 381300E and 381600E with dipole-dipole on line 376000N. The major response between 381300E to 381550E and centred at 381460E is confirmed and is intrepeted as being due to a series of chargeable units. To the north and

south this response is much reduced in magnitude and is variable in form. As the strike length of this feature is limited, and its source disseminated, it is considered to be of secondary importance as a geophysical target.

9 - *AREA 6* ... This area was investigated by a series of gradient lines on 376700N, 376900N, 377000N, 377100N and 377300N with dipole-dipole detail on 377000N, 377500N and 377700N all centred at about 382550E.

The original sharp anomaly at 382550E on line 377000N is confirmed and can be traced south across 376900N at 382570E to terminate between 376900N and 376700N. This anomaly terminates to the immediate north of reconnaissance line 377000N as no trace of it is seen on line 377100N, although the form of the resistivity data suggests geological continuity. However, the zone re-appears as a major response on line 377300N at 382590E before being lensed out to the north before line 377500N is reached, or sinistrally displaced some 230 metres to cross line 377500N at 382360E. In all the above cases, the source is disseminated or if massive, electrically discontinuous and is less than 30 to 40 metres below surface. The anomaly is of secondary geophysical interest.

10 - *AREA 7* ... This was investigated using a 2600 metres gradient array on lines 375700N, 375900N, 376000N, 376100N and 376300N centred at 382600E ±300 metres. The detailed work shows that the source on the reconnaissance line fishtails out to the immediate south of the reconnaissance line, crosses line 376100N to the north of the reconnaissance line and disappears into a changed background on line 376300N. The sources are considered to be disseminated chargeable material graphite and/or pyrite in narrow zones at maximum depths

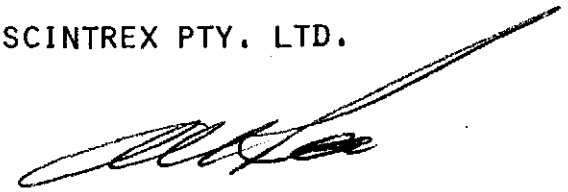
to source of 30 to 40 metres. As such they are not, on geophysical grounds at least, considered of potential economic interest. Positive geological and geochemical data would be required to modify this conclusion.

11 - *AREA 8* ... The significant response recorded on the reconnaissance line 375000N from 381960E to 382250E lenses out to the north and south. This disseminated or electrically discontinuous source lies at a depth of 60 metres(±), and is of limited strike length, and therefore is of limited potential economic interest.

12 - *AREA 9 - LANGDONS GRID* ... This section was surveyed between 380000E and 381000E and 378700N and 379200N. Two approximate grid north south trending zones were defined on the six gradient lines surveyed. *Zone 'A'* reaches its maximum development on lines 378800N and 378900N at 380275E and 380290E but can be seen on a lesser scale on the whole grid. The source is disseminated or electrically discontinuous and lies at a maximum depth of 60 metres. *Zone 'B'* reaches its maximum development on the most northerly line surveyed over the anomaly at 380670E, and as such is open to the north. The disseminated and/or electrically discontinuous source has a maximum depth of the order of 30 metres. The anomaly can be traced south to line 378800N at 380650E always as a lesser response. Zone 'A' on lines 378800N and 378900N and Zone 'B' on line 379100N are of secondary interest from a geophysical standpoint.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.



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

GEOPHYSICIST

SCINTREX

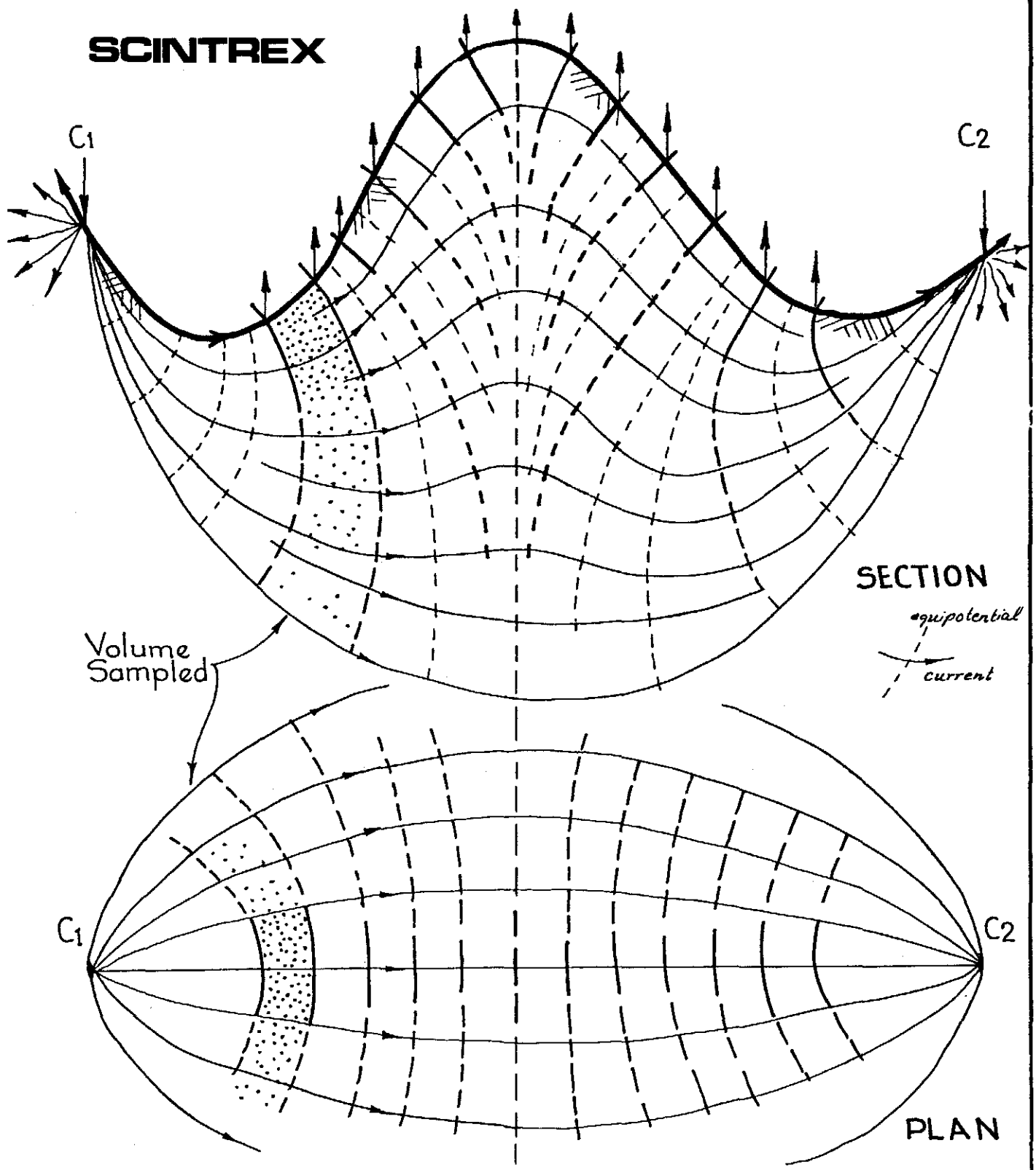
APPENDIX

SOME COMMENTS ON THE GRADIENT ARRAY AND DIPOLE-DIPOLE ARRAY IN THE CONDITIONS MET ON THE MT. BLACK, WHITE SPUR (AND CONTIGUOUS AREAS) EIP SURVEYS.

In the case of the surveys discussed in the report it is vitally 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 in the present case *only* the geologist will be able to relate the data to geology due to the complexity of the geology, structure and topography at a number of sites, together with the variation in the geophysical signature of the known orezones. For this reason, brief, simple comments follow on the salient features of the various array types used, and how the data relates to the volume of underlying rock which influences it.

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,



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

FIGURE 1.

the readings become *increasingly biased by* that electrode.

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, in this case, 40 metres. Figure 3 displays the current pattern in section and in plan for a dipole-dipole array. The equipotentials P_1 and P_2 tap a volume as shown in this diagramm whose characteristics are read on the n = 1 station and plotted as a single point midway

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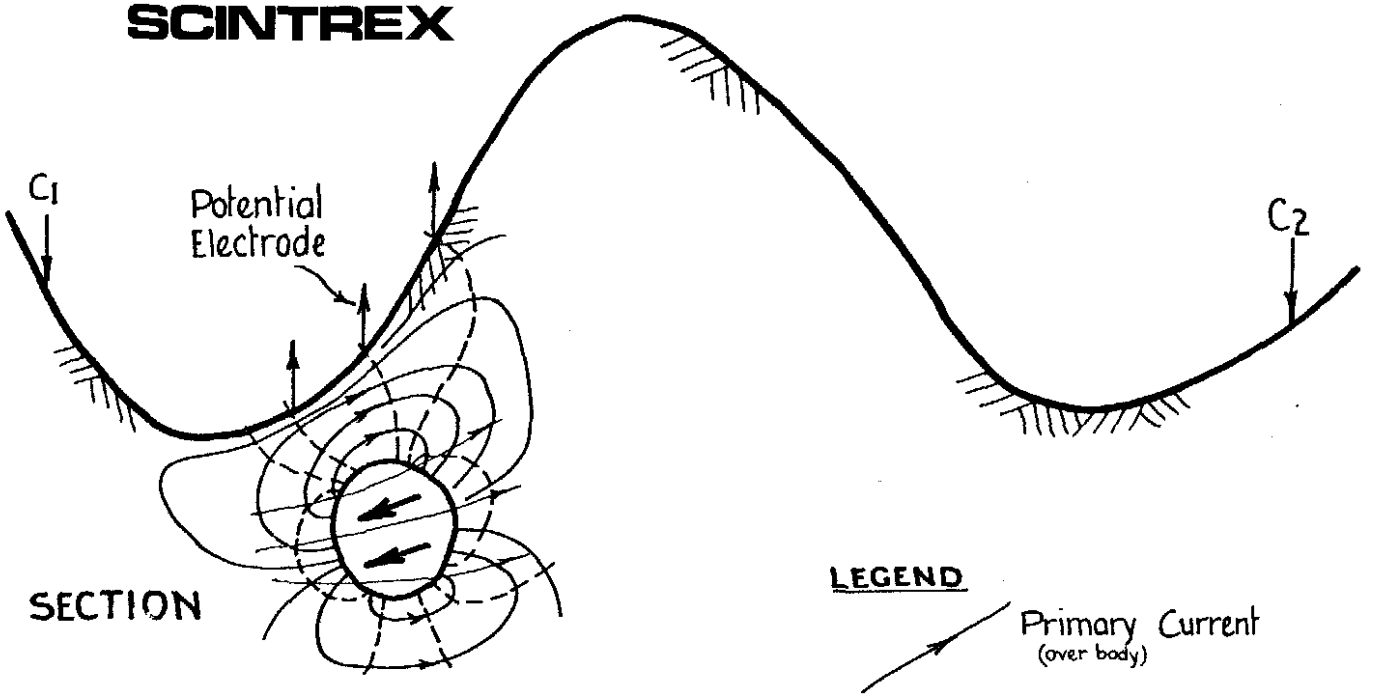

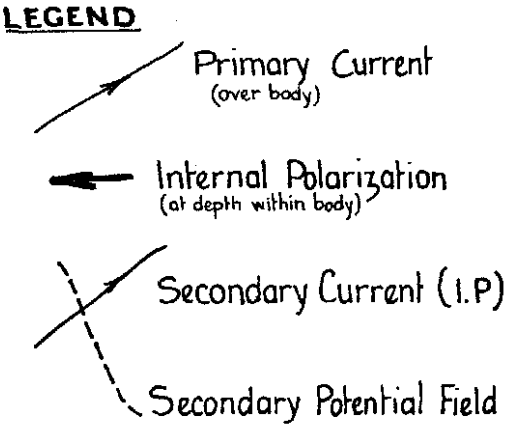

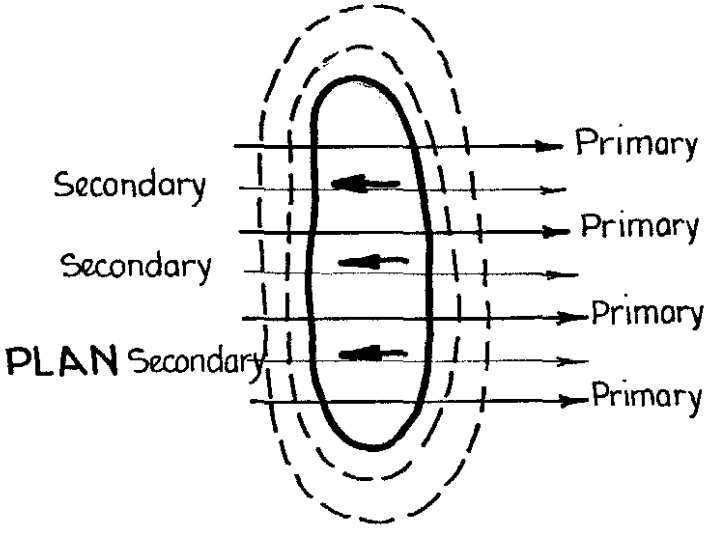

Diagrammatic representation of secondary current (I.P.effect) and secondary potential field in steep terrain.

FIGURE 2.

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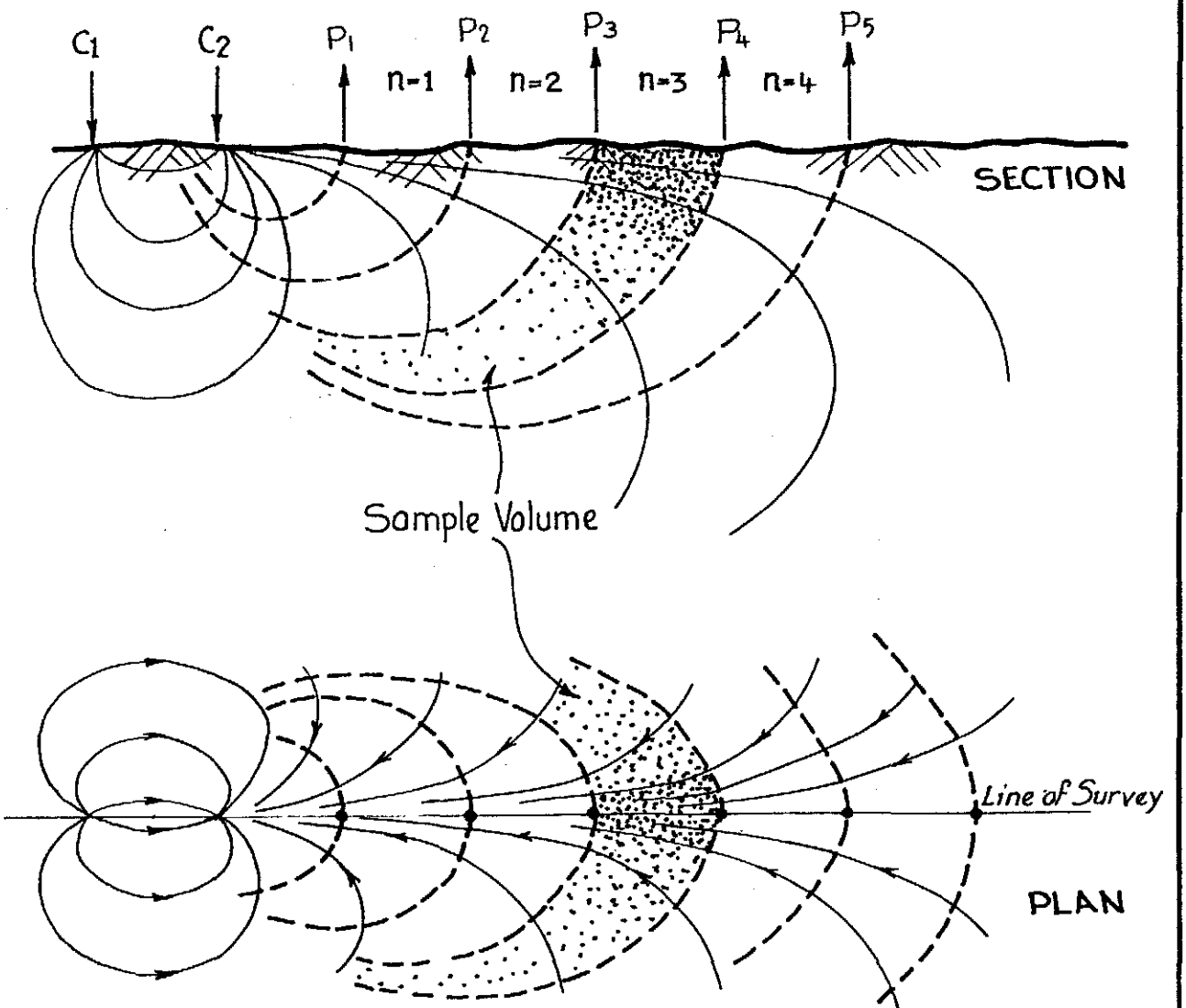


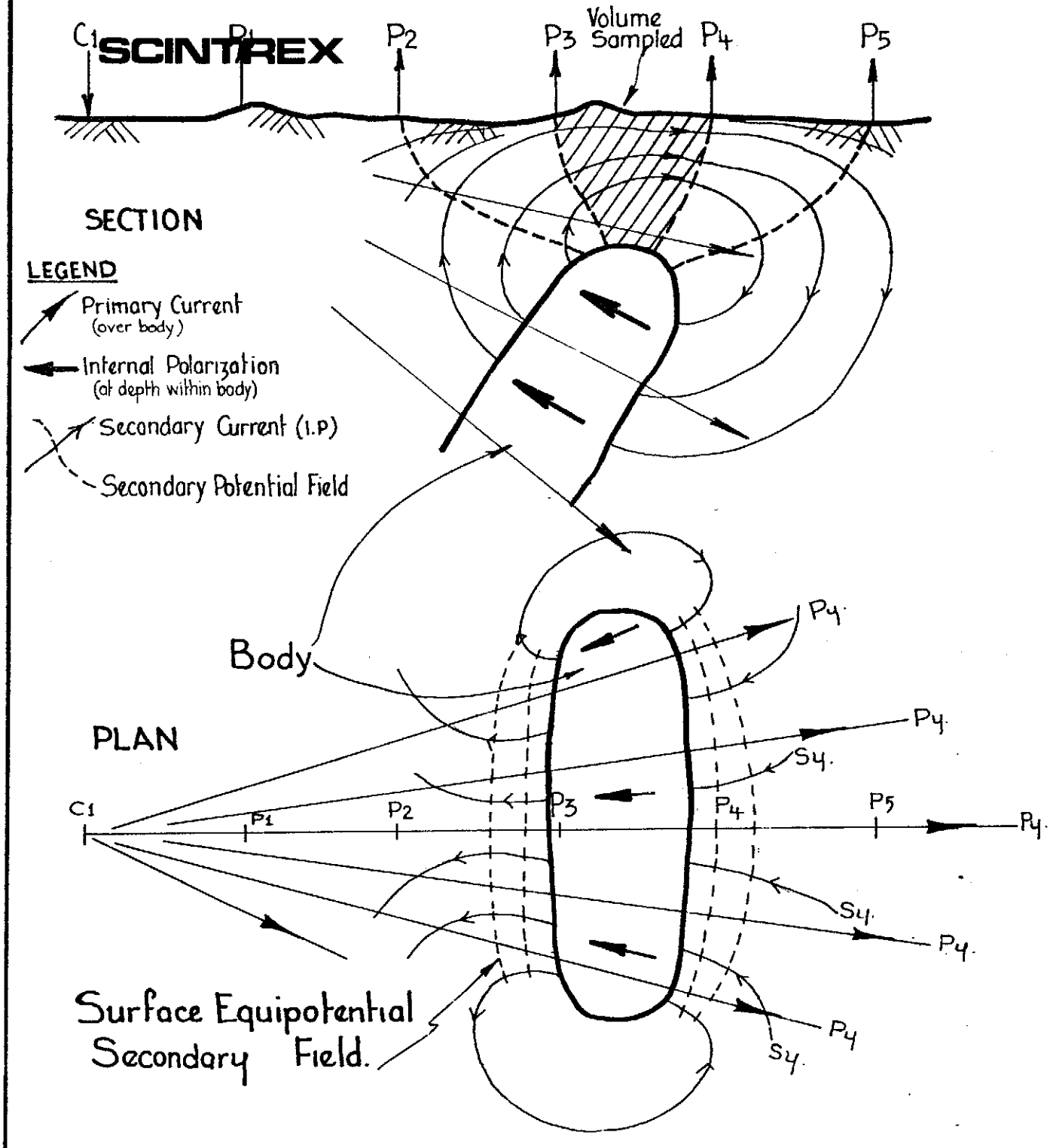
Dipole - Dipole Array
Primary current paths and equipotential field
Showing volumes sampled

FIGURE 3.

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 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 interface pattern over the source. 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 necessarily 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



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.

that they represent 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.

Terrain Effects:- The survey area is steep in many places. The enclosed Table I shows the dipole-dipole array is subject to greater topographic effects. Whereas the location of the gradient anomaly sources can be easily deduced, those for dipole-dipole are far more difficult to compute in difficult terrain. However, in the present case, where the slope was fairly uniform over the section of interest, (even when 'steep') and most sources were not greater than twice the a spacing used, no undue distortion should be present.

Depth to Source:- The depths to source are always taken normal to local slope for both arrays.

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TABLE 1
(Table 3. 1)

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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"