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REPORT ON  
DETAILED DIPOLE-DIPOLE EIP SURVEYS  
PARSONS HOOD AREA  
NEAR ZEEHAN, TASMANIA  
ON BEHALF OF  
RENISON LIMITED  
22 OCT 1982

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PRIVATE AND CONFIDENTIAL

REPORT ON  
DETAILED DIPOLE-DIPOLE EIP SURVEYS  
PARSONS HOOD AREA  
NEAR ZEEHAN, TASMANIA  
ON BEHALF OF  
RENISON LIMITED

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*SUMMARY*

*Of the twenty-two or so dipole-dipole generated anomalies, some three stand out as being of possible economic interest when evaluated in conjunction with the soil geochemistry and magnetic field data. It is suggested that the anomaly at 2465W on line 6N be investigated by diamond drilling as a primary target, with one of the anomalies at 1750W on line 12N or 1887W on line 14N being considered for drilling as the second best target*

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## DISCUSSION OF RESULTS

For each line the main features of the electrical geophysics is discussed and is followed by brief comments on the relationship with other geodata. Each line is separately discussed.

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## LINE 5

Three set-ups were surveyed using  $a = 25$  metres dipole-dipole for  $n = 1$  to 5. These were centred at 275W, 00 and 275E.

In the west, a sharp contact between resistive (5000 to 10,000 ohm-metres) rocks of low chargeability (5 millivolts/volt<sub>+</sub>) and less resistive rocks (250 ohm-metres <sub>+</sub>) of high chargeability (50 millivolts/volt), was defined at about 050W. Between about 050W and 025E significantly lower resistivities from 2000 ohm-metres to as low as 250 ohm-metres were recorded from a zone of anomalously high chargeability whose background is 50 millivolts/volt. Within this region of high polarization, two distinct zones were defined. The section between 050W and the baseline (00) is characterised by lower resistivities of 1000 ohm-metres, with a significant section as low as 250 ohm-metres to the east (to 025E at depth). The zone west of 025W has 60 millivolts/volt values, and the zone east thereof twice that, with values to 176 millivolts/volt being recorded at 025E on  $n = 2$ . While high values of 75 millivolts/volt were obtained on the  $n = 1$  spacings between 00 and 50E, the very high surface resistivities for  $n = 1$  of over 5000 ohm-metres strongly suggest a "resistive" capping above the chargeable, relatively conductive body at depth. The depth to source is estimated to be 40 metres<sub>+</sub> at 025E. From a purely geophysical standpoint the anomaly is considered to be of primary interest. The decay form,  $\Delta m_n$ , is +12.5% which suggests a coarse grain size to the source.

A significant induced polarization response of 106 millivolts/volt was recorded at or just west of 050E. The interference pattern is seen for all readings on the eastern leg, and while the amplitude decreases to 77 millivolts/volt for  $n = 3$ , at  $n = 6$  135 millivolts/volt was recorded. While the depth to source at 40E-50E is obviously less than 20 metres, the high readings at depth are considered to be due

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to a flat lying source between 100E and 200E (+50 metres). The near surface  $n$  values between 100E and 175E are a high 10,000 to 2000 ohm-metres, decreasing with depth. This, together with lower chargeabilities of less than 10 millivolts/volt near surface, implies a near surface resistive, low chargeability layer of the order of 75 metres<sub>+</sub>. Resistivities within the source are obviously much less than the apparent resistivities of 1000 to 3000 ohm-metres, but the source is still considered to be disseminated.

Moving east the chargeabilities remain well above normal until 350E is reached. Within this section the resistivity of less than 1000 ohm-metres observed between about 175E-200E and 250E are materially lower than seen to the east and west thereof. Within this zone a most significant anomaly of 141 millivolts/volt was recorded at 250E on the  $n = 2$  reading, and lies within a zone of locally anomalously low resistivity of 150 to 400 ohm-metres centred at 237E<sub>+</sub>.

The next significant *maximum* moving east was defined centred at 287E. Here, readings of 74 millivolts/volt ( $n = 1$ ) increased gradually to 88.5 millivolts/volt at  $n = 5$ . The accompanying resistivities while being always lower than background, are nevertheless high at 500 to 2000 ohm-metres, implying an essentially disseminated source. The maximum depth to source is less than 20 metres, while the decay form is near normal. The anomaly is of secondary/tertiary geophysical interest.

To the east, the resistivities increase moderately to 6000 to 10,000 ohm-metres(+), while chargeabilities decrease to 15 millivolts/volt(+), signifying a major rock type change, probably a quartz rich sedimentary or volcanic member.

The western set-up covered the line between 425W and 125W. Between 325W and 125W

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the chargeabilities remain normal to low-normal in amplitude, varying about 5 to 10 millivolts/volt. The resistivities remain within the 1000 to 3000 ohm-metres range for the most part. These characteristics were not observed on any of the sections reviewed above on the central and eastern set-ups, and thus the overall rock type must be unique.

The western flank of the set-up is highly anomalous. Readings of over 100 millivolts/volt but averaging 90 millivolts/volt were recorded from a source located between some point at or west of 450W and 400W. To the east a gradual fall-off in amplitude to normal values was observed over 50 to 75 metres, implying a gradual lessening of chargeable material. The accompanying resistivities show little material change in structure despite the significant induced polarization response, thus the source must be wholly disseminated in nature since the absolute resistivities observed are a high 3000 ohm-metres<sup>+</sup>. Decay forms observed within this source are slower than average with some  $\Delta M_n$  values being +8% to +10%. Thus, the grain size must be coarse. The geophysical interest of this source is secondary as the source may be coarse grained graphite (although it could equally well be coarse grained sulphides).

### *Comparison with other Geodata*

The broad series of significant induced polarization anomalies which was mapped between 100W and 100E had significant magnetic field distortions up to 5000 gamma. Such amplitudes imply magnetite or magnetite plus pyrrhotite to be present within the eastern section of the source. A lesser 2000 gamma(+) response was recorded at 050W(+) within the western section where higher background tin values of 50 ppm were defined within the soils. Thus this series of anomalies remain of secondary(+) economic interest.

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The significant induced polarization anomaly defined at 237E has a single slightly anomalous soil tin value at 175E(+). This would tend to increase the interest of this response.

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## LINE 6

Three 25 metre,  $n = 1$  to 5 dipole-dipole set-ups were centred on this line at 2225W, 2500W and 2775W. This zone was previously covered by a reconnaissance gradient array survey and is described in Scintrex report TAS-074E dated June, 1980. The data is discussed from west to east.

The western set-up covered the line from 2875W to 2650W. The resistivity data is dominated by a low resistivity zone (200 ohm-metres+) extending from 2800W to 2750W and showing a significant 'double peak' effect on higher  $n$  values. The anomaly is associated with some negative values in the data. This feature is purely generated by resistivity changes. On the original gradient data this feature was seen as a distinct resistivity minimum at 2760W within a broad chargeability low from 2600W to 2780W. The western section of the dipole-dipole data is characterised by high 2000 to 3000 ohm-metres resistivity and higher chargeabilities to 60 millivolts/volt. A gradual increase from the low backgrounds seen east of 2850W is indicated. While the source lies to the west of the surveyed line, the original gradient data indicated a narrow source (D1) at 2788W whose maximum depth was 20 metres, a second source (D2) centred at 2860W whose maximum depth was 40 metres, and a third source (D3) whose maximum depth was 35 metres. The dipole-dipole data did not individually resolve these sources, thus the inferred *gradual* increase in chargeable material is probably a multiple sourced-interbedded sequence of gradually increasing sulphide and/or graphite content.

Between *about* 2850W and 2550W the resistivities remain moderate (1000 to 5000 ohm-metres) while the chargeabilities remain low background. (With the exception of the above.)

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Between 2400W and 2550W, significantly higher chargeabilities of up to 70 millivolts/volt were recorded. The most significant values were defined within this anomalous zone centred at about 2475W whose source is about 40 metres<sub>±</sub> wide. The accompanying resistivities at 200 to 300 ohm-metres are some 10% of the average background values outside the zone. The observed decay forms are only slightly slower than normal ( $\Delta M_n = 4\%$ ). While the maximum depth to source is less than 25 metres at 2475W (<sub>±</sub>25 metres), the zone appears to increase in interest with depth as the highest amplitudes were defined on  $n = 3$  and 4 centred between 2500W and 2525W (where the lowest resistivities were seen also).

On the junction of the central and eastern dipole set-ups, a broad, deep-seated induced polarization response was defined at 2312W. While anomalous values of 50 millivolts/volt(+) were recorded on  $n = 1$ , the values increase with increasing  $n$  values to reach over 110 millivolts/volt at  $n = 5$  (below 2350W). The resistivity data shows an almost horizontal layering which may imply some shallow more conductive surface layer to be present, as the anomaly at depth is clearly associated with quite high resistivities. The decay form is one of the slowest recorded, reaching +18%, implying a coarse grained source to be present. Certainly the source is more significant with depth, being broader and more intense. The anomaly is of secondary geophysical interest. The most easterly anomaly located was defined to be off line at 2012W. The response shows high 70 millivolts/volt chargeabilities with slow decay forms of +6%, indicating a coarse grain size. The accompanying resistivities are lower than background, but still high in absolute terms. The original data shows this zone to be a significant 70 millivolts/volt response centred at 2050W and associated with a most significant resistivity low of 400 ohm-metres as against a 3000 ohm-metres background. The source is coarse grained chargeable material within a less resistive host.

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*Comparison with other Geodata*

The significant 130 millivolts/volt gradient array anomaly defined at 2465W and confirmed on the dipole-dipole data as an anomaly of secondary geophysical interest, is seen to be associated with a most significant soil geochemical anomaly of 400 ppm(+) and a magnetic field response of 3000 gamma. This target therefore is considered of primary economic interest. The anomaly centre is 2465W, while the depth to the top of the main target is not greater than 40 metres. The target itself is coarse grained and contained within a host more conductive than the enclosing rocks. The dip would appear steep, perhaps to the east(?)

The other anomalies on line 6 are downgraded in comparison.

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## LINE 7

Three  $a = 25$ ,  $n = 1$  to 5 set-ups were centred at 475W, 225W and 00 to cover the line between 575W and 075E. The data is described from west to east.

The western set-up shows a significant induced polarization response centred at about 562W. The source is certainly broad (50 to 80 metres) with respect to the dipole used (25 metres). Chargeabilities reach over 50 millivolts/volt for the  $n = 2$  and 3 values, the form of which imply a sharp contact to the west, but a gradual fall-off in values at less than  $45^\circ$  to the east on the pseudo-section implies a shallower dip than  $45^\circ$  to the eastern contact. While the data suggests that the source of the anomaly comes within 20 metres of surface at 562W, it also implies the source has greater substance with depth. There is no correlation with the resistivity data which remains moderately high at 3000 to 5000 ohm-metres within and around the chargeable source. This suggests the source to be wholly disseminated. The decay form of  $\Delta m_n = +2\%$  within the anomaly suggests a more or less normal decay form, and thus an 'average' grain size to the source. The response is considered of secondary geophysical interest.

To the immediate east of the anomaly a resistive feature was defined at about 475W-450W at a depth of the order of 50 to 75 metres. While the resistivity reaches 8000 ohm-metres, no distortion is visible in the chargeability data. However, this source may have influenced the form of the data to give an *apparent* shallow east dip. Between 450W and 300W (see below) moderate to low resistivities and background chargeabilities were recorded.

While the central set-up cannot be described as having any significant anomalies,

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there are a number of geological divisions which may be significant.

Firstly a contact between higher background induced polarization values of up to 20 millivolts/volt was defined west of about 275W. There is a clear *decrease* in amplitude with depth from 19 millivolts/volt(+) for  $n = 1$  to 3 to as low as 6 millivolts/volt at  $n = 5$ . While "lower" resistivities of 1800 to 1000 ohm-metres were noted for  $n = 1$ , and higher values up to 5000 ohm-metres for higher  $n$  values, a horizontal zoning is not clear. An explanation would be of a resistive rock unit centred at 300W+ whose intrinsic polarization is low (say 8 millivolts/volt+2 millivolts/volt) flanked by lower resistivity material which above and to the west, has higher chargeability, perhaps due to a disseminated halo. At this stage, however, no geophysical interest can be ascribed to this zone.

Between 275W and 125W(+), moderate resistivity and low background chargeabilities of 11 to 14 millivolts/volt were defined, probably from a quartz rich unit. The resistivity is distinctly layered between 200W and 075W. Near surface resistivities vary about the 3000 ohm-metres mark, while for  $n = 2$  they decrease to 2300 ohm-metres+, after which they increase to 3000 to 4000 ohm-metres. This suggests *horizontal layering* over this section.

The western section of the eastern set-up shows moderate background chargeabilities of 18 millivolts/volt+ and moderate resistivities. (See above) At about 00 a sharp increase in chargeability to 90 millivolts/volt at 25E/50E, and coincident decrease in resistivity to 500 ohm-metres(+) was defined. The source lies at, or close to surface at 50E +25 metres, and shows a gradual decrease in chargeable material to the east and west of the centre. The decay form of +5% indicates a somewhat coarser grain size. The source which lies within 20 metres of surface

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is significantly less resistive than the enclosing rocks, but still cannot be described as being conductive as such. As the coarse grained chargeable source gives high chargeabilities of 90 millivolts/volt, the chargeable material itself almost certainly influences the conductivity observed. This portion of the anomaly is considered to be of primary/secondary geophysical interest. What is significant is that the most conductive section of the anomaly is displaced to the west of the most chargeable section by less than one dipole (25 metres). Thus the most conductive section may not be the most chargeable, presumably due to greater interconnection of sulphides (and/or graphite) within the conductor.

To the east of the above, the resistivities increase sharply to 1000 to 2000 ohm-metres at 50E/75E, however, at surface a 500 ohm-metres reading was observed at 62E for  $n = 1$ . The overall chargeability remains a high 40 to 55 millivolts/volt from the anomaly centre above to 075E due mainly to a double peak effect superimposed on the broad (75 metres to 90 metres) complex source. The eastern side is certainly disseminated in form for at least 25 to 40 metres east of the chargeable axis. Of interest is that these eastern marginal readings show a *fast* decay form of up to -15%, clearly indicating a dramatic change in grain size (or causative source) from that seen in the eastern sector of the anomaly. It would appear that the grain size in the east is fine. Overall the source comes close to surface, certainly within 20 metres. This eastern section of the anomaly is considered to be of secondary to tertiary geophysical interest.

*Comparison with other Geodata*

Strong narrow sourced magnetic field distortions of 5000 gamma(+) were defined at 00 and at 060E. As *slight* increases in tin values above background were also observed at and west of zero, both these anomalies are considered of possible

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economic interest. The anomaly at 025E<sub>+</sub> is considered of primary economic interest..

**SCINTREX***LINE 9N*

Two set-ups were employed on this line centred at 450E and 200E. The line was covered from 100E to about 575E. As for all lines, the  $\alpha$  spacing was 25 metres and the  $n$  values, 1 to 5. The traverse is described from west to east.

The western array is characterised by high chargeability backgrounds of 40 to 50 millivolts/volt and moderate to lower resistivities in the range 1500 ohm-metres to 250 ohm-metres. Superimposed on this anomalous background are a series of anomalies, the most significant of which was centred at 125E. On  $n = 2$  the chargeability reaches 92.7 millivolts/volt and shows a typical interference pattern. A low accompanying resistivity of 64 ohm-metres was recorded coincident with the high chargeability, again associated with a double peak anomaly, albeit somewhat distorted. The decay form is slower than normal with  $\Delta m$  being about +7%, indicating a coarser than average grain size. The geophysical interest of this anomaly is primary to secondary.

Centred at 225E a 50%(+) increase above background was observed accompanied by resistivities of 700 ohm-metres+, twice to three times that observed below and on the flanks. The  $n = 1$  values at 212E and 237E are 82 millivolts/volt and 70.5 millivolts/volt, the former showing a slow decay form (+4.5%) and the latter a fast decay (-7%). The source is a shallow, disseminated source within a unit of slightly higher resistivity than background. The anomaly is of tertiary geophysical interest.

Between about 275E and 375E the chargeability data is distinctly layered, being 25 millivolts/volt+ on  $n = 1$  and increasing to 50 millivolts/volt(+) at greater

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depths. This suggests either a significant cover or horizontal layering at depth. The resistivity data shows decreasing values from 2600 ohm-metres+ for  $n = 1$  to 800 to 900 ohm-metres at depth. Thus the cover, if present, is of lower chargeability (20 millivolts/volt+) and higher resistivity (2600 ohm-metres+) than the underlying rocks. The higher chargeabilities of 50 millivolts/volt at depth together with the low background resistivities are similar to the backgrounds seen to the west, and are only anomalous with respect to the overlying material. This zone is considered of secondary to tertiary interest only.

From 375E to 575E moderate background chargeabilities were recorded within the range 18 to 23 millivolts/volt. The accompanying resistivities varied about the 1200 +200 ohm-metres level and as such are not anomalous.

*Comparison with other Geodata*

The additional geodata has not enabled the geophysical assets to be enhanced, thus all are downgraded.

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## LINE 11N

This line was surveyed between 50W and 175E using an  $a = 25$  metres,  $n = 1$  to 5 dipole-dipole technique.

The resistivity data shows a number of distinct rock units to be present. West of the baseline the resistivities recorded were a low background, generally less than 400 ohm-metres. The accompanying chargeabilities were more than twice background varying about the 50 millivolts/volt $\pm$  level. Thus the rock type could be shales carrying some pyrite and/or graphite. Within this unit a most significant increase in resistivity was noted at 62W on  $n = 3$ , with resistivities increasing almost 10 fold with increasing  $n$  values. The apparent chargeabilities fall to 35 millivolts/volt. This could represent an acid intrusive into these sediments or perhaps an infolded more acid sediment.

East of the baseline the chargeability shows a distinct layering, being semi-horizontal between 00 and 125E, and 45 $^\circ\pm$  to the east thereof. The chargeability varies from 25 millivolts/volt  $\pm$  near surface ( $n = 1$ ) to 50 to 60 millivolts/volt at depth ( $n = 3$  to 5). This "layering" is not mirrored on the resistivity data which shows a more complex pattern, but in general the resistivities are a moderate 2500 ohm-metres  $\pm$ 500 ohm-metres in the central section, and distinctly lower at depth as witnessed by the  $n = 5$  values of 600 to 800 ohm-metres.

The far eastern section east of 175E shows very low background resistivities of 200 ohm-metres  $\pm$ 50 ohm-metres, perhaps indicating a steeply dipping change at about 175E, with lower resistivities and chargeabilities, rather than a dipping contact implied by the chargeability data alone. It is not at all clear whether the higher chargeabilities recorded at depth between 025E and 125E in particular

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could be considered anomalous or not. Certainly they show significantly increased chargeabilities but may be formational and as such are of secondary to tertiary geophysical interest only. The normal(+) decay forms observed indicate average grain size to the causative material.

## *Comparison with other Geodata*

The low tin values recorded in the soils have not enhanced the interest of any features on this line.

**SCINTREX***LINE 12N*

This line was surveyed from 1800W to 1600W using an  $a = 25$  metres,  $n = 1$  to 5 dipole-dipole array centred at 1700W. This section of the line was previously covered during the gradient array reconnaissance stage and is reported on in TAS-074E under anomaly C10.

The profile can be divided into two distinct sections, namely, east and west of 1725W. To the west a most significant conductor was defined at 1737W accompanied by chargeabilities of up to twice background. For  $n = 1$  the values are 62 millivolts/volt and 32 ohm-metres. The depth to source at this point is less than 20 metres. The decay form is more or less normal. The source must also be narrower than the 25 metre dipole used as it is seen only on a single current dipole, also the *actual* resistivity would be considerably lower than the 32 ohm-metres recorded due to dilution. The gradient array data shows this feature to be centred at 1725W, and here it was seen as a significant 250 ohm-metres(+) low against a background of 1000 to 1500 ohm-metres to the east, and up to 20,000 ohm-metres to the west. Of interest is the chargeability within the zone on the gradient array was *depressed* below zero, presumably because the source was seen as an internal polarization anomaly which in turn implies a source extremely close to surface. This response is considered of prime geophysical interest. While dips are difficult to assess, this data would imply an east dip to the source.

To the east of 1725W a distinct layering was observed in both the chargeability and resistivity data. Near surface chargeabilities of 40 to 50 millivolts/volt increase to 60 to 80 millivolts/volt between 1700W and 1650W, but a most significant 200 millivolts/volt for  $n = 5$  at 1612W was recorded. The resistivity data shows

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an extremely high 9500 ohm-metres centred at 1687W for  $n = 1$  decreasing to 1000 to 2000 ohm-metres at depth and to the east. However, for the entire section between 1700W and 1500W significantly lower resistivities of 16 to 400 ohm-metres were recorded on the  $n = 4$  and 5 values. This very clearly demonstrates a layering to be present. The surface layer varies in thickness between 50 metres (+) at 1700W to perhaps 75 metres (+) at 1600W. The surface layer, while being of lower chargeability than the material at depth, is still anomalously chargeable at 40 to 50 millivolts/volt. The decay forms vary by +5% of normal within this zone, indicating a variety of grain sizes, however, the chargeable material must be disseminated in nature.

At depth, two significant anomalies occur within the chargeable less resistive zone. The higher chargeabilities of over 200 millivolts/volt were recorded for  $n = 5$  at 1612W, but anomalous values of 100 millivolts/volt extend up to  $n = 3$ .

The depth to the top of the chargeable section is estimated to be about 40 to 50 metres at this point. The decay form is slow, implying a coarser grain size, while the low *apparent* resistivity of 177 ohm-metres certainly grossly overstates the actual resistivity which is probably less than 10% of this level. This zone is of primary geophysical interest.

A second zone of high interest was defined at 1700W. Here the resistivity falls to 16 ohm-metres at  $n = 4$  and is accompanied by high chargeabilities of 60 to 70 millivolts/volt in the vicinity. The depth to source may be of the order of 60 to 70 metres but local inhomogeneity makes a more precise depth estimate difficult. The decay forms vary but on the whole imply a slightly coarser than normal grain size. The anomaly here is considered of primary geophysical interest. In this

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case the dipole-dipole data has given far superior interpretation on the layering and depth distribution of chargeable material than was seen on the reconnaissance gradient array.

*Comparison with other Geodata*

A significant increase in soil values to 40 ppm tin was defined at, and just west of 1750W. This feature correlates well with a gradient array anomaly of about 70 millivolts/volt centred at 1750W and a sharp contact between resistive rocks to the west and less resistive rocks to the east. The dipole-dipole implies the maximum depth to source to be no greater than 60 to 70 metres, and the source to be of fine/average grain size. A single reading of above 2500 gamma above the background was defined at about 1740W. This anomaly is considered to be of primary economic interest at 1750W. (The location is taken from the gradient array.)

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*LINE 13N*

This line was surveyed between 100W and 100E by a set-up placed at 00.

The apparent resistivity data is dominated by a low resistivity feature centred on  $n = 1$  at 037W. Here, a 44 ohm-metres value was obtained which contrasts with background values to the west of 500 ohm-metres(+) and to the east of 2500 ohm-metres(+). The apparent resistivities for  $n = 1$  are 150 to 100 ohm-metres between 75W and 25W, the zone becomes much wider at depth. (This is not just a function of a double peak effect). The pseudo-section shows a shallower than 45° contrast with a marked resistivity high to the east which strongly suggests a shallow east dip to the source, providing that there is no complex folding or cover present.

The highest resistivities were recorded under the baseline from 025W to 075E where resistivities above 2500 ohm-metres were defined. Generally anomalous chargeabilities of above 50 millivolts/volt were defined within this zone, and these are mostly seen as fast decay forms, implying a fine grained chargeable source.

The background chargeabilities observed over the zone as a whole are anomalously high at 40 to 50 millivolts/volt. Within this zone a distinct high of 70 millivolts/volt was defined within 20 metres of surface at 025E. A distinct 'double peak' response has been generated from this essentially disseminated source whose apparent resistivity of 1350 ohm-metres, while being lower than background is nevertheless still resistive in absolute terms. The decay form is slightly slower than normal. This response is considered to be of secondary geophysical interest at best.

Higher readings for  $n = 5$  at 112E (and above) imply a chargeable source at or east of 188E fairly close to surface. Since this is off the array, no detailed comments can be made at this stage.

*Comparison with other Geodata*

The magnetic field data shows distortions to 2000 gamma between 050W and 100E, while anomalous tin values at 075E<sub>+</sub> and 075W<sub>+</sub> were obtained down slope of, but not on the hill centred at about 040E. The dipole-dipole data implies the major source to lie within 20 metres of surface at 025E, but the whole section between 200E and 125W can be considered to be anomalous. It is suggested that this zone represents a strike extension of the more important sections seen on lines 12N and 14N, and as such is considered of better than secondary economic interest.

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## LINE 14N

This line was surveyed from 1800W to 2000W from a set-up placed at 1900W. This line was previously covered by reconnaissance gradient array.

The dipole-dipole data shows moderate resistivities of 2000 ohm-metres plus, west of 1960W, where a sharp change in apparent resistivities occurs to the east to 100 ohm-metres<sub>+</sub>. Then, east of 1850W resistivities decrease again to very low values of 10 to 20 ohm-metres. From 1800W to the eastern end of the array, higher surface resistivities of above 1000 ohm-metres apparently indicate a horizontal near surface resistor capping a low resistivity unit about 50 to 60 metres below.

The chargeability data shows a change between low chargeability background west of 1950W of 14 to 16 millivolts/volt to backgrounds twice this level to the east thereof. Within this background,  $n = 1$  and 2 values reach 45 to 55 millivolts/volt between 1925W and 1850W. The accompanying resistivities of 130 ohm-metres<sub>(+)</sub> imply the source to be disseminated and to lie within a less resistive rock type. The maximum depth to source is 20 metres. The anomaly is considered to be of secondary geophysical interest only as seen on the dipole-dipole data, but when viewed on the gradient array (anomaly C-6) the anomaly was considered to be of primary interest.

A weak double peak anomaly was defined at 1812W where a 60 millivolts/volt response was recorded on  $n = 1$ . This zone lies on the contact between rocks of low resistivity (9 ohm-metres) to the west, and high resistivity of 3400 ohm-metres to the east. High chargeabilities for greater  $n$  values on the eastern leg of the double peak anomaly may in part be due to a double peak as such, but *may* also be due to chargeable material being close to the contact between the upper (resistive)

and lower (conductive) layers seen east of 1800W. The sole chargeability reading within the 3500 ohm-metres 'cap rock' at  $n = 1$ , 1788W, would imply the resistive layer to have low (20 millivolts/volt) background chargeability, and the lower resistivity material at depth to have higher chargeability in excess of 50 millivolts/volt. The geophysical interest of this response is considered to be secondary at best.

### *Comparison with other Geodata*

The resistivity data suggests a major contact between a resistive rock unit to the west and a less resistive unit to the east at about 1960W. A comparison with line 12N, where the outcrop is known, suggests that this feature is associated with the eastern flank of the "Hornfelsed Tuffaceous Siltstone" unit. The gradient array data shows the chargeability peak to lie at about 1887W, while the dipole-dipole data suggests the source mineralisation extends from within 20 metres of surface to depth. The coarse grained source is associated with local magnetic field distortions at 1900W+25 metres. As the anomaly at 1887W is associated with high surface tin values of 200 ppm, this anomaly is obviously considered of primary economic interest.

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## CONCLUSIONS

- 1 When the magnetic field data and soil geochemistry are considered, one chargeability anomaly stands out as being of by far the most potential. This is situated on line 6N at 2465W. The maximum depth to the top of the source is about 40 metres while the host itself is considered to be disseminated or electrically discontinuous within a host less resistive than the enclosing rocks. A slight east dip is inferred.
  
- 2 Two other targets present themselves as being of primary importance (both slightly less than (1) above). It is suggested that either the anomaly at 1750W on line 12N or 1887W on line 14N be considered as targets. In both cases magnetic field distortions, together with tin geochemistry have enhanced their interest. The dipole-dipole data suggests that sulphides (or graphite?) are within 20 metres of surface, with the main source at about 40 metres. The gradient data implies extension to depth and perhaps a steep easterly dip. While line 13N shows anomalous values also, no drilling is recommended on this line at this time.
  
- 3 An analysis of all the significant dipole-dipole generated anomalies is given below. The interest of each anomaly is assessed purely from an induced polarization point of view, and then assessed from an 'economic' point of view by biasing the data with the available geochemistry (and magnetics).

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*Significant Anomalies*

*R = resistive, L = low resistivity, C = conductive, K = contact  
Py = primary, Sy = secondary, Ty = tertiary*

<u>Line</u>	<u>Station</u>	<u>Source Depth</u>	<u>Inferred Grain Size</u>	<u>Type</u>	<u>Geophysical Interest</u>	<u>Economic Interest</u>
5N	025E	40m (+)	coarse	L	Py	Py(-)
5N	040E+	20m	average	R	Sy	Py
5N	100E-200E+	75m(+)	average	R	Sy	Sy(+)
5N	237E	45m(+)	coarse	L	Sy	Sy(+)
5N	287E	20m	average	L	Sy/Ty	
5N	450W-388W	25-35m(?)	coarse	R	Sy	Ty
6N	2850W-2950W	(See report TAS-074E page 25)			Sy/Ty	Ty
6N	2475W+25m	25-40m(+)	average/coarse	L	Sy	Py(+) (DH)
6N	2315W(+50m at depth)	25m	very coarse	R	Sy	Ty
6N	2050W	40m(-)	coarse	L	Sy	Ty
7N	562W	20m	average/coarse	R	Sy	Ty
7N	025E+)	20m	coarse	L	Py/Sy	Py
7N	075E+)	20m	fine	R	Sy/Ty	Sy
9N	125E	40m	coarse	L	Py/Sy	Sy
9N	225E	20m(-)	fine/coarse	R	Ty	Ty
9N	275E-400E	60-75m		L	Sy/Ty	Ty
11N	025E-125E	60m(+)		L	Sy/Ty	Ty
12N	1737W-1725W (1750W)	20m(-)	fine/average	C	Py	Py (DH)
12N	1612W	40-50m	coarse	C	Py	Sy
12N	1700W	60-70m	coarse/average	C	Py	Sy
13N	025E	20m	average	L	Sy(-)	Sy(+)
14N	1850W-1925W	20m(-)	average/coarse	L	Sy(Py)	Py (DH)
14N	1812W	20m(-)	coarse	K	Sy	

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Respectfully submitted on behalf of:

SCINTREX PTY. LTD.



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MSc, DIC, FIMM, MAusIMM, MAIG, FGS.

Geophysicist

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## DETAILS OF WORK CARRIED OUT

An  $\alpha = 25$  metres dipole - dipole array was used from  $n = 1$  to 5. Three slices below the decay curve were read, with only one ( $M_3$ ) being plotted. The sections of lines surveyed are set down below.

Line 5N    350W to 350E  
Line 6N    2850W to 2125W  
Line 7N    550W to 050E  
Line 9N    100E to 550E  
Line 11N   050W to 150E  
Line 12N   1800W to 1600W  
Line 13N   100W to 100E  
Line 14N   2000W to 1800W

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## METHOD AND EQUIPMENT

The dipole-dipole array was employed in standard fashion with  $a = 25$  metres and  $n = 1$  to 5. The main features of the array are discussed in the attached appendix.

Energisation was effected by a Scintrex IPTA (Australian built) time domain induced polarization transmitter powered variously by an 8HP or 3HP Briggs and Stratton motor generator.

The resultant primary (resistivity) and secondary (chargeability) electric fields were measured using Scintrex IPR-8 time domain receivers on a two second programme measuring three separate slices under the decay curve as follows:

- Slice 1 ( $M_1$ )      130 - 650 milliseconds
- Slice 3 ( $M_3$ )      650 - 1170 milliseconds
- Slice 5 ( $M_5$ )      1170 - 1430 milliseconds

(Note: each section of 520 milliseconds duration)

Each integration has been normalised with respect to the standard induced polarization decay curve established by Newmont Exploration Limited (Dolan and McLaughlin, 1967 "Considerations concerning measurement standards and design of IP equipment." - Proceedings of the Symposium on Induced Electrical Polarization, Berkely, University of California, pp. 2-31)

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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.

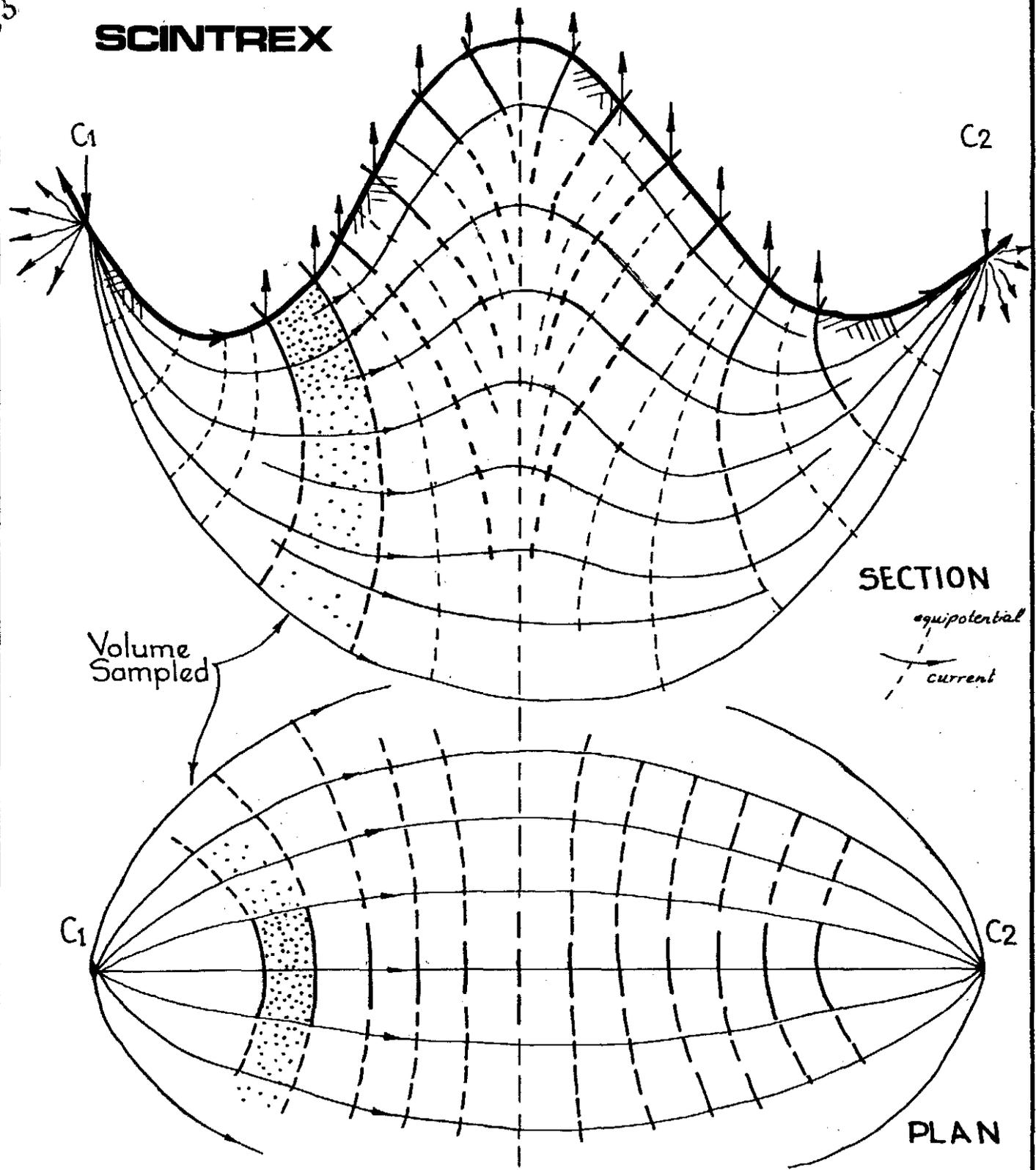
#### DISCUSSION

*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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# SCINTREX



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

## FIGURE 1.

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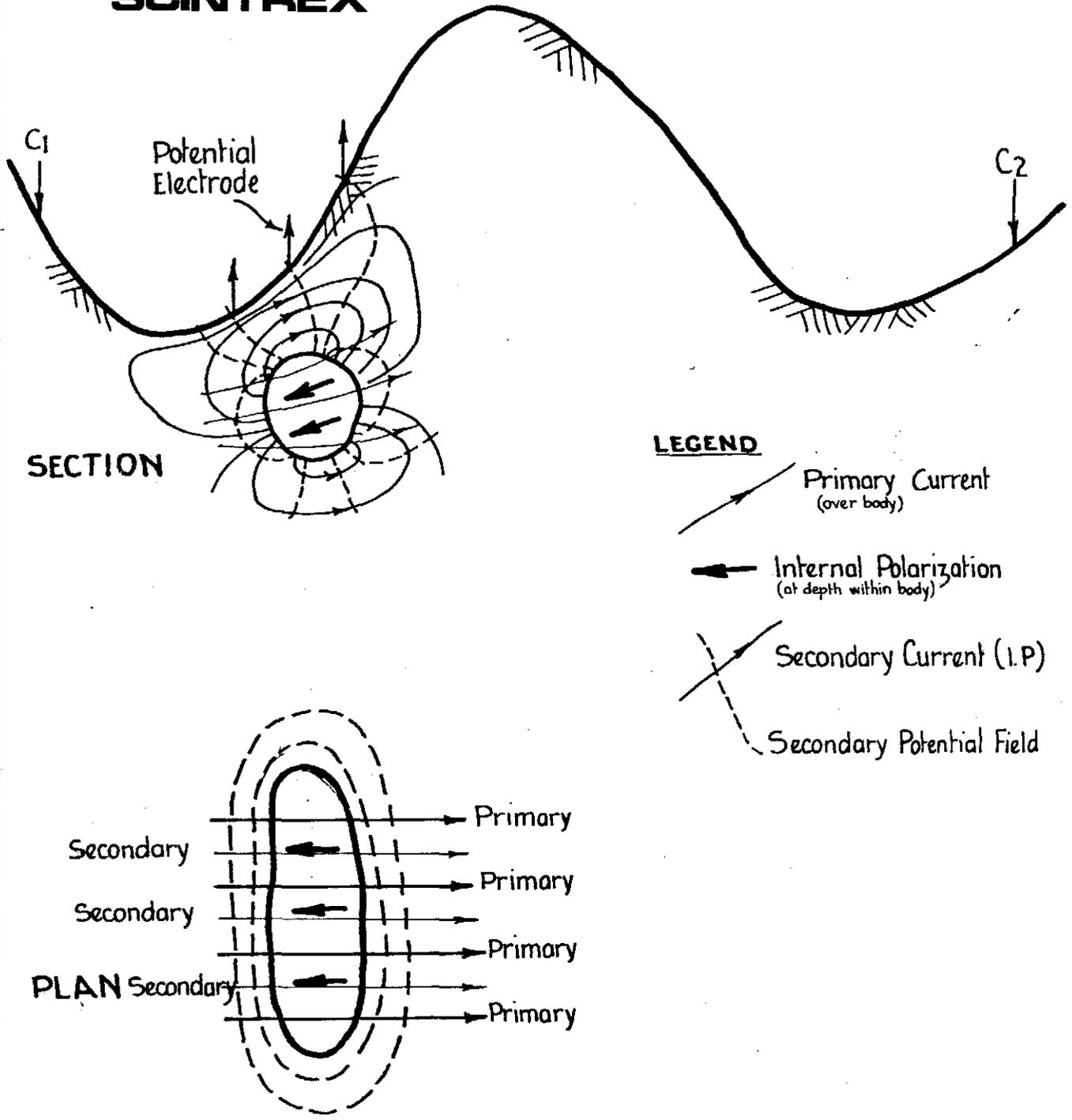
Note particularly that the *source volume* is *normal to slope* and not vertically beneath the potential dipole. Therefore all maximum depths refer to depths below surface *normal to the slope*.

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  $\rho_a$ ) 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

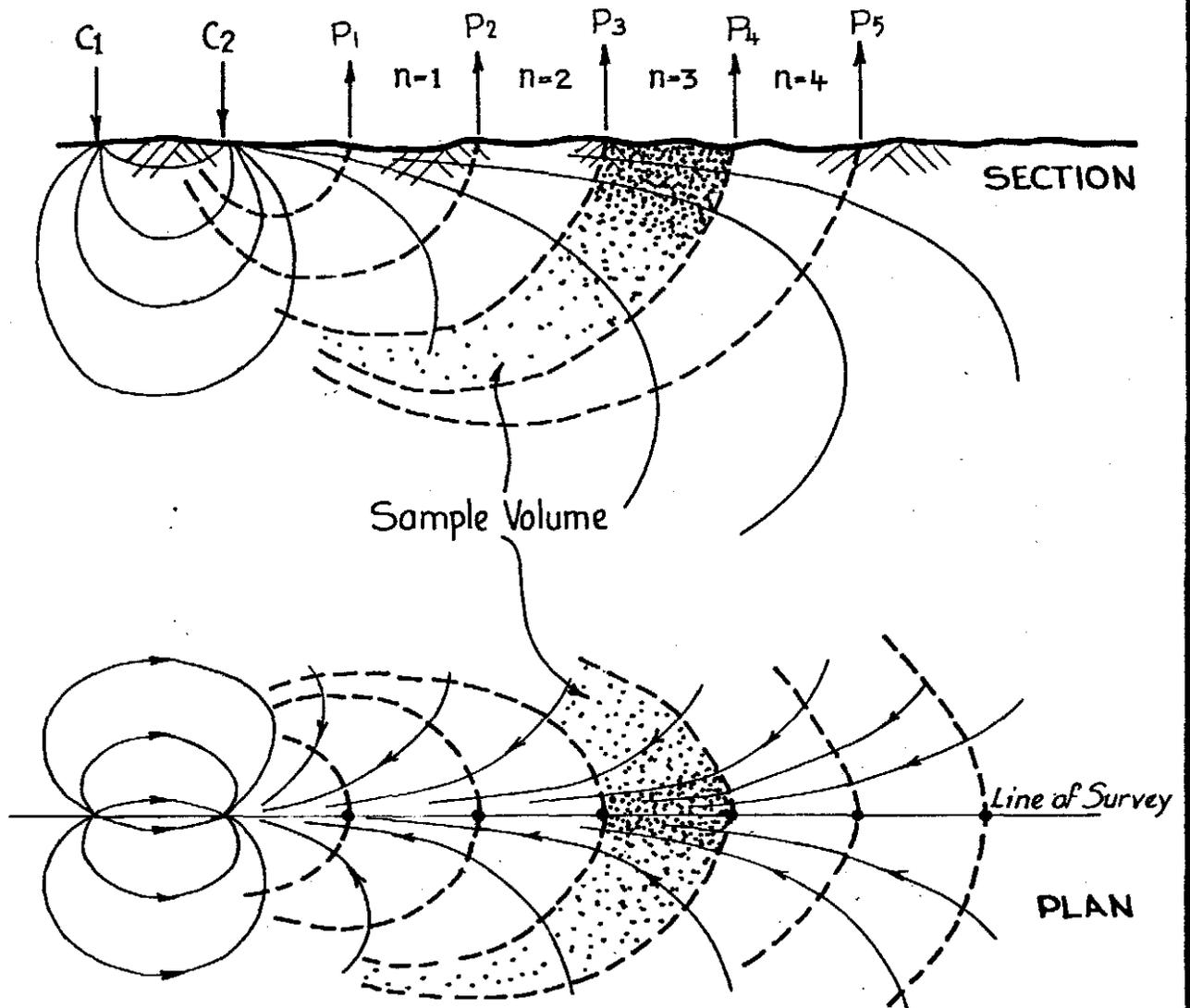
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Diagrammatic representation of secondary current (I.P.effect) and secondary potential field in steep terrain.

## FIGURE 2.

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

FIGURE 3

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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  $45^\circ$  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 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 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  $P_1/P_2$ .

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

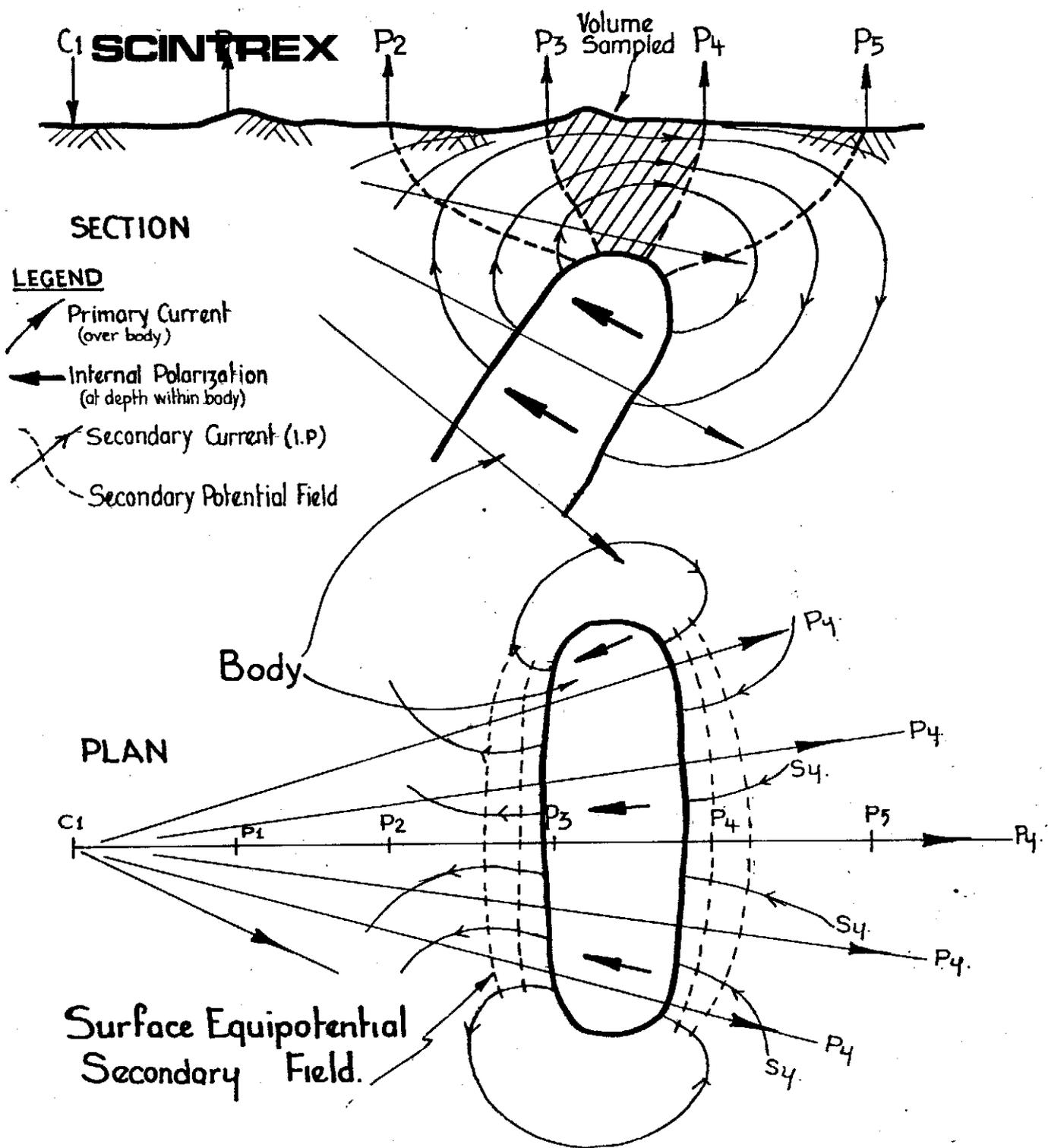
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except that a single electrode is placed 'close' to the potential dipole, with an 'infinite' electrode placed  $10 \times n \times a$  away from the 'pole-dipole' set-up, and, where practical, at right angles to it. The enclosed Figure 5 shows the 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  $45^\circ$  towards the pole source. The chargeability reading is generated in a similar fashion to that described for dipole-dipole (Figure 4).

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

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

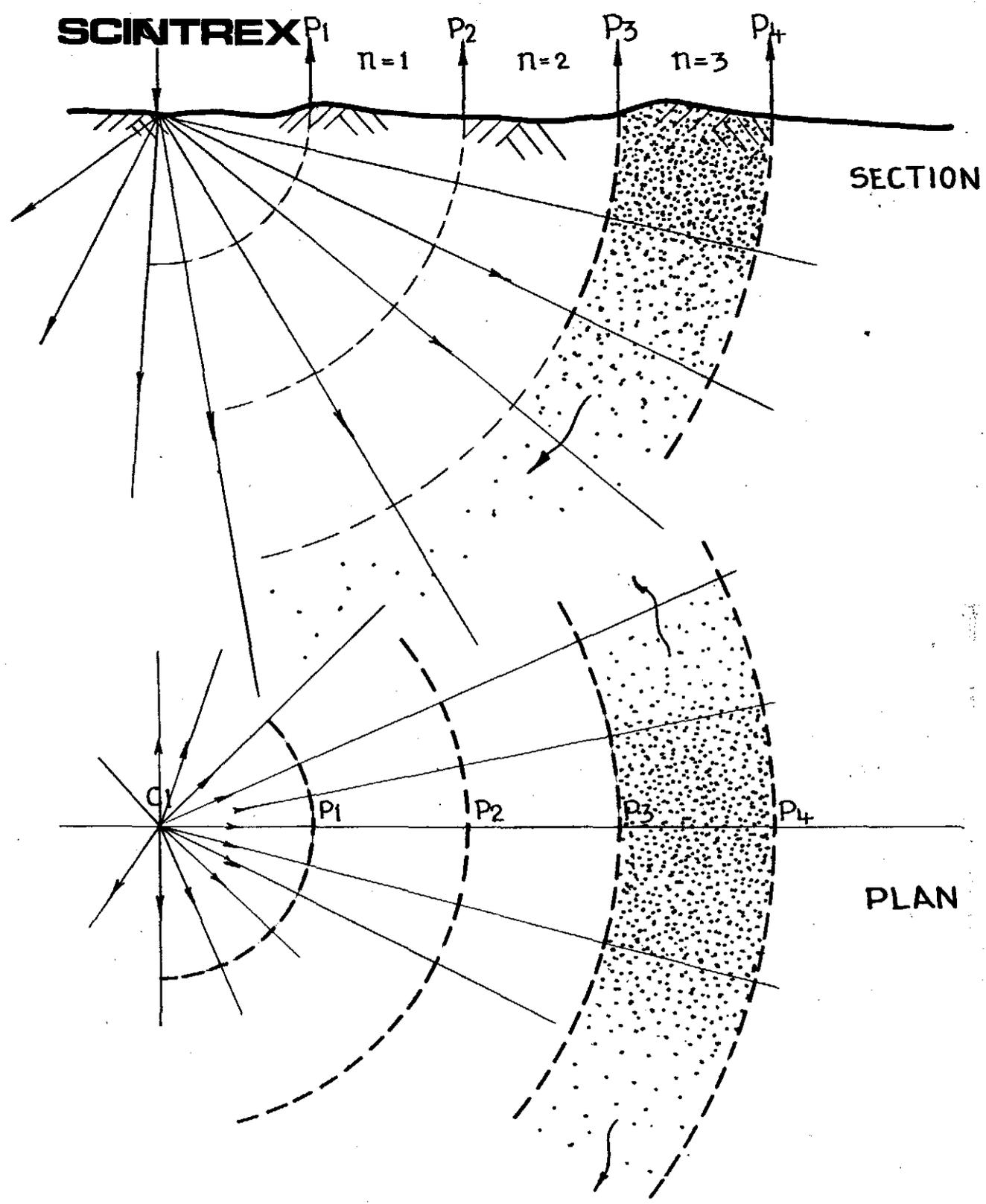
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Current path and secondary equipotential field due to discharge of stored energy (I.P. effect) in the case of Pole-Dipole or Dipole-Dipole.

**FIGURE 4.**

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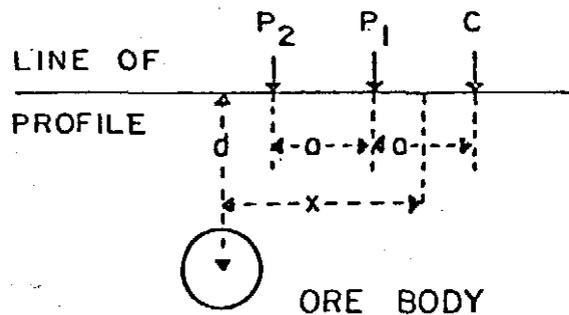


Current Path and Primary Equipotential Field from Pole-Dipole Array

FIGURE 5

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# SCINTREX SPHERE RESPONSE THREE ELECTRODE ARRAY



$$z = x/d$$

$$\alpha = a/d$$

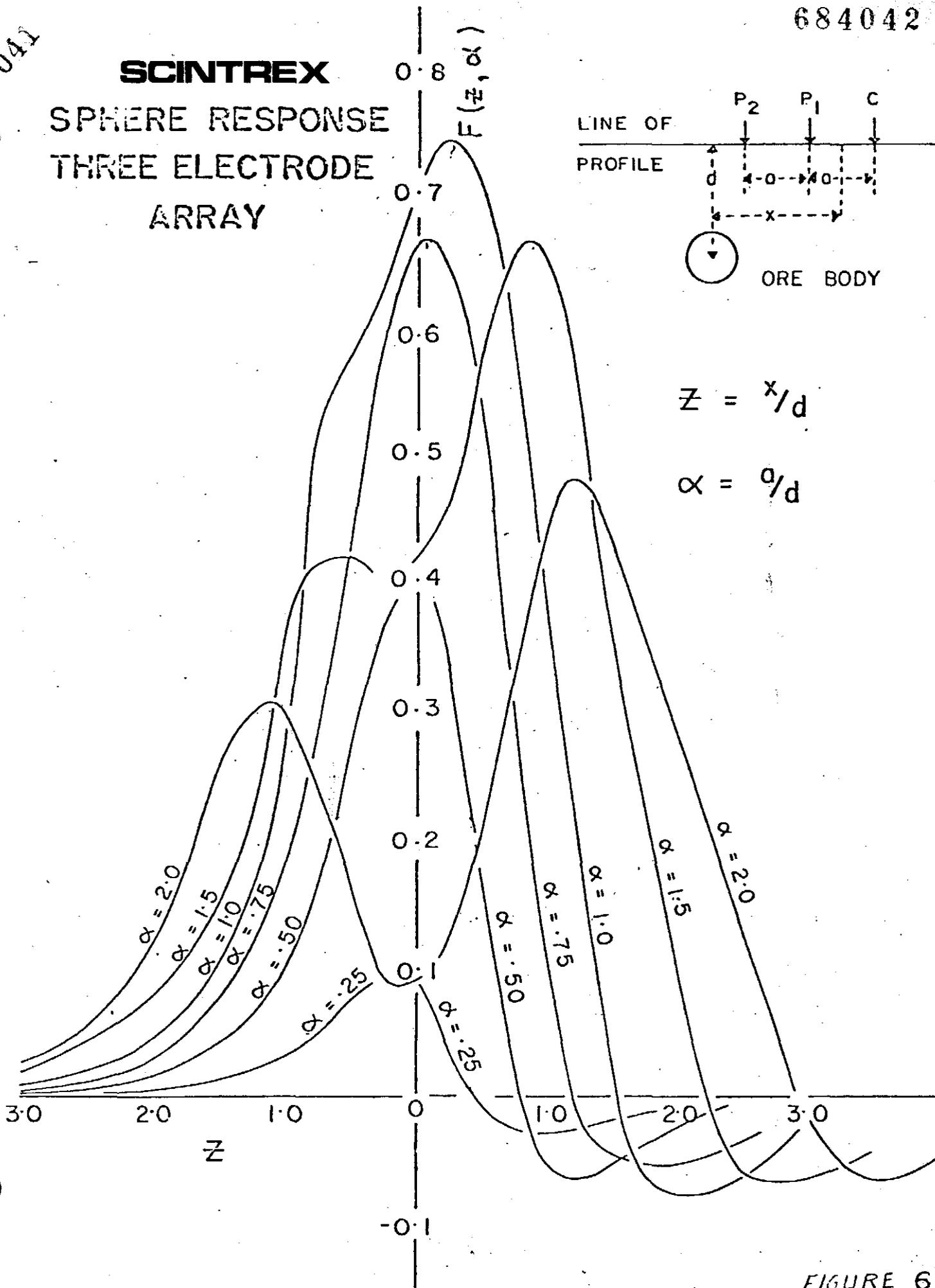


FIGURE 6

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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 multiple 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 response 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  $\Delta M$  infers *slow* decay form and negative  $\Delta M$  *fast* decay form. A superior parameter is  $\Delta M_n$  where

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

which is essentially  $\Delta M$  normalised for the amplitude of the decay.  $\Delta M$  and  $\Delta M_n$  are merely short hand ways to profile changes in decay form and are essentially qualitative and relative.

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

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normal decay

7(a)

decay curve modified by coupling

7(b)

electromagnetic coupling

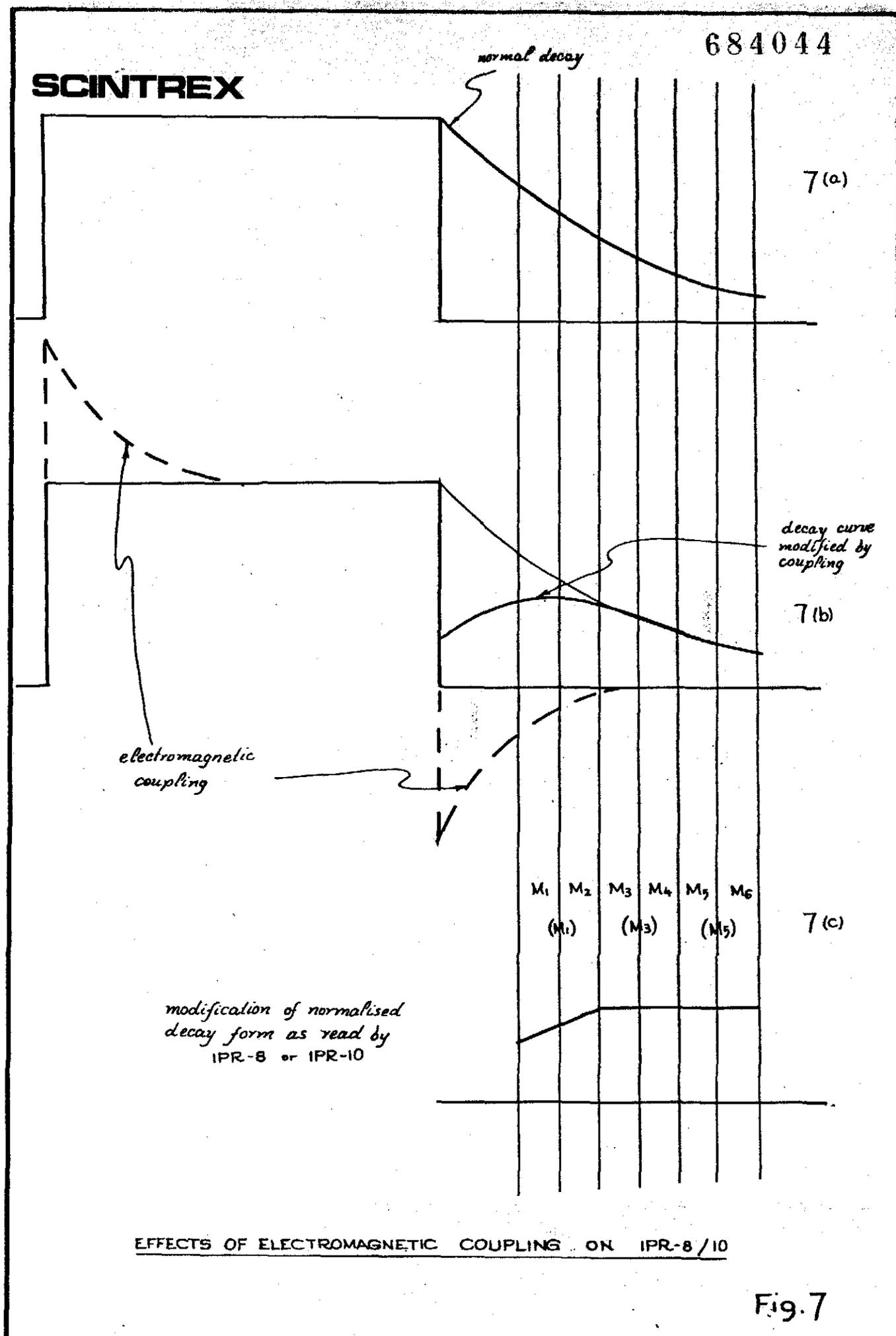
M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	M <sub>4</sub>	M <sub>5</sub>	M <sub>6</sub>
(M <sub>1</sub> )		(M <sub>3</sub> )		(M <sub>5</sub> )	

7(c)

modification of normalised decay form as read by IPR-8 or IPR-10

EFFECTS OF ELECTROMAGNETIC COUPLING ON IPR-8/10

Fig. 7



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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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**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 Pole-Pole (Two-Array)	Virtually eliminates EM coupling	More wire needed	Fair to Poor	Fair	Very Good
PDR (Potential Drop Ratio)	Smaller crew needed Less wire needed than for some arrays Good penetration in nonconductive overburden Sensitive to lateral variations "Common mode" noise rejection	Susceptible to masking by conductive over-burden Complex interpretation	Good	Fair	Poor
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"

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## PERSONNEL AND TIMING

The field work was carried out variously under Scintrex party leaders, R. Bennett and P. List, between 17th - 18th February, and on 19th, 21st, 24th, 28th February as well as 1st to 6th March, 1982.

Field assistants included G. Kennedy, S. Dunmill, K. Brown, W. Tressler, S. Gibbons.