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A REPORT ON
GRADIENT ARRAY ELECTRICAL INDUCED POLARIZATION,
SCHLUMBERGER ELECTRICAL SOUNDINGS
AND MERCURY SPECTROMETER (SOIL) SURVEYS
OVER THREE AREAS OF MT. TYNDALL
ON BEHALF OF
THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.

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OVER THREE AREAS OF MT. TYNDALL
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BY

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SYDNEY, N.S.W.

OCTOBER - DECEMBER, 1974

TAS - 025

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S U M M A R Y

Gradient array electrical induced polarization surveys carried out over the Area 'A' and Howard's Anomaly grids in the Mt. Tyndall exploration area, defined significant anomalies worthy of intensive further investigation. A number of drill targets are suggested based on estimated total sulphide content.

Lines 34N and 36N on the Tyndall grid showed a southerly continuation of the supposed fault and the induced polarization anomalies associated with that supposed fault on lines to the north.

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11th January, 1974 Sydney

The Mount Lyell Mining & R'way Co. Ltd.,
Queenstown Tasmania.

TAS-025

Attention: Mr. K. Reid, Chief Geologist
Mr. K. Wells, Senior Geologist, Exploration

Dear Kerry and Keith,

Please find enclosed three copies of report TAS-025 covering Area 'A', Howard's Anomaly and lines 34N and 36N.

You will note that I have not enclosed the usual appendices in the back as I'm sure you have enough of these by now to paper the entire Mt. Lyell offices!!

I expect to airfreight the section including the seven plates about Wednesday. You have copies of the main plates anyway which will suffice for now.

Also omitted is Appendix 'P' which I will send down with the plates.

Future reports will be designated as follows:

TAS-025A - Madame Howard, TAS-025B - Basin Lake, TAS-025C - Little Owen and West Sedgwick extensions.

I expect TAS-025A to be completed early next week and TAS-025B about 20th January. Drafting and contouring is at present the hold-up. I trust these dates will prove satisfactory. TAS-025C will of course have to await Bengt's future exploits!.

Best of luck in your current drilling programme.

Best personal regards


A.W. HOWLAND-ROSE

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INTRODUCTION

On some 15 production days between 28th October, 1974 to 8th November, 1974 - 20th to 22nd November, 1974 and 27th to 28th November, 1974, Scintrex Pty. Ltd. executed various geophysical surveys over Area 'A', Howard's Anomaly and southern Tyndall grid areas, all within the Mt. Tyndall exploration area. The production records are summarised in Appendix 'P'.

These surveys were undertaken at the request of Mr. K. Reid, Chief Geologist of the Mount Lyell Mining and Railway Company Ltd., and were under the geological supervision and direction of Mr. K. Wells. The Scintrex Pty. Ltd. field party was under the immediate direction of Senior Party Leader, Mr. B. Ekstrom, with additional assistants provided by the Mount Lyell Mining and Railway Company Ltd., and Scintrex Pty. Ltd. Scintrex Pty. Ltd. Staff Geophysicist Mr. G.J. Elliott, B, App, Sc (Geophys)

provided local geophysical direction, while the project was under the overall direction of Mr. A.W. Howland-Rose, MSc.

Appendices on methods and equipment have been omitted. These are available to Mt. Lyell in previous reports.

GEOPHYSICAL SURVEY METHODS USED

1 - Gradient Array Electrical Induced Polarization

More comprehensive descriptions of the gradient array electrical induced polarization method are contained in previous survey reports on the Mt. Lyell area. What follows is a brief summary of the major factors.

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

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

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

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

Each current dipole block should be considered separately. As would be expected, the continuity along strike is generally good, especially in the chargeability data. However, "end on" current dipole blocks cannot be expected to give identical data due to the different base levels of the current dipoles, and, in zones close to the current poles, the data will not

sample identical volumes on the overlap between current dipoles. This phenomenon will result in more extreme divergence of data as the current dipole is approached. However, these factors are entirely predictable.

2 - Mercury Soil Sampling

The Scintrex HGG-3 Mercury Vapour Spectrometer is briefly described in the appended paper.

The mercury spectrometer was used in the soil analysis mode rather than in the soil gas mode.

The occurrence of mercury in nature and loosely bonded form in soils over areas of active mercury emission has been known for over ten years, but the availability of instrumentation of sufficient speed of analysis and accuracy has only recently become available to make use of this phenomenon as an exploration tool. The purpose of the present work was to map the occurrence of weakly bonded mercury in the soils.

The procedure adopted in the analysis was as follows:

- 1 - Approximately 3 millilitres of sample is ground in an agate mortar. Experience in the Perth laboratory has shown that grain size is not critical. However, the sample should be fairly finely ground and also be fairly uniform in grain size.

- 2 - Approximately 0.5 millilitres of the ground sample is heated in a 1 inch pyrex test tube.
- 3 - The air line to the HGG-3 is connected to the test tube. It is important that there is an air inlet into the tube as well as the air line to the HGG-3 i.e. a two hole rubber bung is used to close off the test tube, with one hole carrying the air line and the other acting as an air intake, preferably through a glass tube 4 to 5 inches long.
- 4 - The sample is heated for 10 seconds. A Ronson butane multifill torch using a blue centre flame approximately 1 centimetre long was found to give the best results.
- 5 - The air is drawn slowly through the HGG-3 using the stirrup pump provided. The maximum meter deflection is recorded directly in millivolts.

During the analyses, any sample that was significantly higher than background was immediately re-run. The repeatability of the samples was generally ± 1 small division i.e. ± 10 millivolts on the 0 - 300 millivolt scale and ± 100 millivolts on the 0 - 3000 millivolt scale.

The soil mercury analyses carried out using the Scintrex HGG-3 are shown in the accompanying plates. The reading is given

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in instrument divisions (millivolts). 1 millivolt being equivalent to 1/250 ng/Hg as calibrated against standard quantities of mercury. The approximate p.p.b. equivalent is $\frac{\text{reading in millivolts}}{37}$.

During the course of these sample analyses, frequent calibrations of the instrument were carried out against standard amounts of mercury vapour over the range of samples analysed.

In order to familiarise Mt. Lyell with the nature of the Scintrex HGG-3 mercury spectrometer system and with the nature and meaning of the data obtained with this system, some remarks are set down below which it is hoped will enable you to assess the method and its application in the Mt. Lyell area.

Theoretical considerations infer, and practical work clearly demonstrates, that mercury soil sample data is best displayed in contour form rather than profile form, as it is essentially a "halo" phenomenon. It is therefore vitally important with the mercury soil sample method to apply the technique to area as opposed to lines. When this is done the areal nature of mercury dispersion from a source beneath alluvium or oxidised material becomes readily apparent. A brief examination of the data suggests that the optimum spacing in this area is

25 metres along and between sample lines.

"Normal background" values with the standard sample used for the analyses varies between 25 and 40 millivolts. It has been found that in areas where mercury is present in significant quantities within the ores present in the area, the general background may vary from 5 to 10 times this level for some kilometres around known deposits. As mercury in relatively large quantities is present in the Mt. Lyell ores, high backgrounds in the area are not unexpected, although they were considerably higher than has been observed in other areas. This could well be because the sample areas are in close proximity to areas of active emission.

Anomalous responses in excess of 300 millivolts are considered highly significant in other zones of known mineralisation. Therefore the many significant responses above this level are obviously of prime interest, especially when accompanied by adjacent readings of smaller magnitude. In all test areas to date, anomalies of this magnitude have invariably been associated with known mineralisation, very often accompanied by zinc. However, to date, such surveys have been carried out in areas where economic mineralisation was known to be associated with mercury. Although sources other than sulphides are known to exist for mercury, such as thermal areas, shales biotites, chlorites, fluorite, barite, etc., these are at this

stage considered unlikely on account of the geology known to date, or on the grounds of the magnitude of the anomalies located.

The nature of the source is such that the maximum values recorded in soils represent the area where mercury from the source material becomes fixed in the soils by weak bonding to organic matter or in certain circumstances, as native mercury. However, this does not necessarily mean that the source lies immediately below the maximum value, but rather that the peak value represents the nearest point of access of the vapour to the surface from the source. Faults, fissures, etc., are often noted in the area of high soil mercury, but are not the source merely the access. Thus additional work using a sulphide detecting method must be employed to locate and define the extent of the sulphide source.

The anomalies considered of greatest significance are those having not only the greatest absolute values, but those having also a broad halo of lower amplitude for some hundreds of metres surrounding the peak value. Unfortunately the limited extent of the cover did not permit the setting for these areas to be identified.

Each area is described under a separate heading.

I - AREA 'A'DISCUSSION OF RESULTS

Both the data profiles presented on Plate 1 and the contour interpretation of the chargeability data presented on Plate 2 utilise a horizontal scale of 1:2400 (1 inch = 200 feet). On Plate 1, the vertical scales used were 1 inch = 10 milliseconds for chargeability and a two inch log cycle for resistivity, expressed in ohm-metres.

The initial reconnaissance gradient survey utilised a 6000 feet current dipole with electrodes placed on lines 6N at 1075E and 4925W. An additional section on the western ends of lines 9N and 10N was surveyed using electrodes placed at 600E and 4125W on line 10N. In both cases the potential dipole utilised was 50 feet. The L/M ratio has not been plotted as no significant variations from the normal were recorded.

A proton precession magnetometer survey carried out over the grid area has not been drafted as the level of the total magnetic field remained generally about 62,600 gammas. Where significant changes in this level were recorded with respect to the induced polarization data, comments have been made in the text.

Some mercury soil sample data is included from test surveys conducted over the area (C-053).

Of the four properties - magnetic field, apparent resistivity, apparent chargeability and mercury levels in the soils - only the apparent chargeability data could be meaningfully shown in contour form.

The contour interpretation of the chargeability data infers an approximate grid north-north-west/south-south-east strike between lines 2N and 4N. The main feature is a dominant induced polarization anomaly, narrow and open to the south, which lies semi-parallel to, and 600 - 1000 feet west of, the baseline on all lines up to and including 8N. All other anomalies are significantly smaller than this anomaly in magnitude, width and strike length.

Each line is discussed in detail below.

Line 2N The most significant response of 50 milliseconds above background was defined centred at 575W. At this point a 90% depression in the high local resistivity background was observed. However, in absolute terms, the 1000 ohm-metres apparent resistivity is still very high. The source material therefore, although significantly more conductive than the enclosing host rocks is still "resistive". The interpreted source therefore, is a disseminated sulphide (or graphite) body.

The maximum depth is considered to be 50 feet and the source is considered to have a steep dip, probably to the east. Although the overall width is 200 feet, the zone of greatest sulphide (and/or graphite) concentration is centred under the anomaly peak and is less than 50 feet in width. No significant disturbance in the magnetic field was recorded over this zone.

A relatively minor response was recorded at 1925W where a 10 to 12 millisecond above background anomaly is interpreted as coming from a disseminated source. A second very minor increase in apparent chargeability coincident with an 80% fall in apparent resistivity was recorded at 1725W. A very slight distortion in the total field gives an almost identical response of about 100 gammas and 50 gammas respectively over the above two anomalies. The source therefore contains either magnetite or pyrrhotite. The response at 1925W is considered to be equivalent to that seen on line 4N at 2375W, but on that line no magnetic correlation was recorded.

Line 4N: On this line at 875W, the major response referred to above is of the same order, shows a similar 90% reduction in resistivity, has the same inferred east dip, but is significantly narrower. The width of the greatest concentration of sulphides is less than 25 feet, while the overall width of the sulphide zone is less than 100 feet. The maximum depth is 25 to 50 feet.

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Two smaller anomalies of about 12 and 10 milliseconds were recorded at 2200W and 2375W, again from disseminated sources. The maximum depths in both cases are considered to be of the order of 25 feet and the dip vertical to steep west. The most westerly is the correlative of 1925W on line 2N, while both merge into a single broad response between 2375W and 2575W on line 5N.

There were no distortions in the magnetic field which remained at about the 62,600 gamma level.

Line 5N: On this line the major anomaly was recorded between 525W and 975W, with distinct peaks at 575W, 725W and 900W. The depths to the sources again appear not greater than 25 to 50 feet. In this case the anomaly shows no contrast with the enclosing rocks, unlike their correlatives to the south. The profile form suggests an east dip.

Between 2375W and 2575W a 15 millisecond response from a very shallow source (less than 25 feet) was defined. At 2525W a 75% depression in the resistivity infers weak relative conduction from the source material, but this is not surprising due to the extremely resistive 20,000 ohm-metres resistivities to the immediate west.

A narrow anomaly of 10 milliseconds at 2075W is interpreted as coming from a source less than 50 feet in width, having

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an east dip, and being not greater than 25 feet in depth. This response probably correlates with a minor anomaly at 2425W on line 4N, and almost certainly with a response of similar magnitude on line 6N between 2150W and 2325W. The source is sulphides (or graphite) in a disseminated form. No significant magnetic anomalies were recorded.

Line 6N: Between 225W and 1175W, the major anomaly reaches its maximum width. Steep gradient in the chargeability data on the flanks infers a fairly sharp boundary, and also a shallow depth to source (25 - 50 feet). Individual anomalies within this broad response at 675W and 275W both infer shallow depths to source. Only a very broad depression in apparent resistivity to 3000 ohm-metres was noted over the anomaly, inferring the source to be of a disseminated or, if massive in parts, electrically discontinuous nature.

A small, 12 millisecond anomaly defined at 1625W, and only clearly seen on this line, is interpreted as coming from a disseminated source having a width of less than 40 feet and a maximum depth of 25 feet. The symmetry of the profile form suggests a near vertical dip.

The anomaly centred at 2225W is considered to be due to a disseminated source having a maximum width of 180 feet and correlates with 2275W on line 5N. This response cannot be

traced north of this point.

Small, 8 millisecond responses centred at 2650W and at 2825W on line 7N may be the most northerly extension of the anomaly recorded between 2500W and 2750W on line 6N which can be traced south (see above and Plate 2). The maximum depths for the disseminated sources are considered to be 25 feet.

Line 7N: The major anomaly is slightly less chargeable than on the line to the immediate south, and is also slightly narrower, being recorded between 325W and 900W, with less concentration of chargeable material as far as 1100W. The very steep anomaly gradients recorded on the flanks and over individual highs within the major response, infer a shallow depth to the top of the causative material of 35 to 70 feet.

Other than the two relatively minor responses referred to above at 2650W and 2825W, only a minor anomaly at 3300W may be of significance (see below)

No significant distortions in the magnetic field were recorded.

Line 8N: This line marks the last anomalous response over the major feature traversed from line 2N. The sharply defined anomaly was recorded between 575W and 1200W, with the major response between 575W and 850W, where 25 milliseconds above

background was recorded. There is no significant depression in the apparent resistivity data which clearly infers a disseminated source to the anomaly. The maximum depths indicated range between 35 feet and 50 feet.

A significant 12 millisecond anomaly recorded centred at 350W from a source less than 140 feet in width and disseminated in nature, could be related to the minor 5 millisecond anomaly recorded at 200W on line 7N.

The highest anomaly of some 50 milliseconds above background recorded in the area, was defined at 3175W, together with a 65% depression in the apparent resistivity data to about 2500 ohm-metres. The interpreted source is not greater than 25 feet in width, has a maximum depth of less than 25 feet and a disseminated, or if massive, electrically discontinuous source. The asymmetry of the anomaly shape suggests a vertical or steep east dip to the source.

At 1750W and 1650W, 100 gamma and 60 gamma magnetic responses were recorded, neither of which occur in the vicinity of anomalous induced polarization response.

Line 9N: A narrow 10 millisecond response at 075W, and open to the east, is considered to be caused by a relatively near surface response, which, as the relatively minor depression

in the apparent resistivity curve inferences, is interpreted to come from a non-conductive source.

A minor chargeability high recorded at 650W of 5 milliseconds above a high 18 millisecond background could represent the most northerly extension of the anomaly recorded at 625W on line 8N.

The most westerly response observed was a 6 millisecond anomaly recorded from within a broad 250 feet wide low at 3325W. This anomaly is no doubt the correlative of that recorded on the previous line at 3175W and on 10N at 3225W.

A narrow near surface source is postulated for the 500 gamma response recorded at 900W. There is no change in chargeability over this section, although the apparent resistivity does increase somewhat over this zone.

Line 10N: A broad zone of anomalous polarization was recorded between 900W and 1200W. The 5 millisecond level above background is considered of moderate interest only, and is probably the the most northerly extension of the halo around the major anomaly recorded due south.

At 2500W a single 6 to 8 millisecond response was defined

from a source interpreted to be 100 feet in width and to have a maximum depth to source of 50 feet.

Within a broad response of some 8 milliseconds above background between 3100W and 3400W a significant 15 millisecond anomaly was defined at 3225W. The maximum depth to the 60 - 70 feet wide source is considered to be of the order of 80 feet or less. A 60% depression in apparent resistivity to 2500 ohm-metres infers only the weakest conduction within the host. This anomaly is considered the on-strike correlative to that seen on line 9N at 3325W and line 8N at 3175W.

Mercury Soil Survey

On lines 5N, 6N and 7N, soil samples were taken and analysed for mercury content. Most values lie in the 1000 to 3000 millivolts level, about 37 to 80 p.p.b., which is considered to be high. Further work has been carried out in the area which is not at the time of writing available to the author. However, the values recorded are all some 10 to 30 times the "normal backgrounds" recorded elsewhere. These results could well be a halo effect across strike of, and along strike of the major induced polarization anomaly which is centred within the high mercury values recorded on these lines. Further comments will be made after evaluation of additional work in the area.

CONCLUSIONS

- 1 - The background apparent chargeabilities in the range of 10 to 15 milliseconds are considered entirely normal for the region.
- 2 - The very high background apparent resistivities of 2000 ohm-metres to in excess of 10,000 ohm-metres are also considered within the normal range for the region.
- 3 - An examination of the L/M ratios in the area clearly indicate no electromagnetic coupling present in the area.
- 4 - The magnetic field remained remarkably undisturbed within the area surveyed, and those anomalies which were located, with one exception, were not associated with the inferred presence of sulphides as indicated by the electrical induced polarization data.
- 5 - The most prominent induced polarization response located in the area has the following characteristics:
 - a) Strike from 2N to 8N, a distance of over 3500 feet, and is open to the south.
 - b) Can be traced by higher than background readings along strike to line 10N.
 - c) Varies in width from 1000 feet on line 6N to 150 feet

on line 2N.

- d) The maximum depth is estimated to be 25 - 100 feet.
- e) Steep dips are inferred, perhaps to the east.
- f) The source is interpreted as consisting of disseminated sulphides (or graphites) of the order of 2% to 5% averaged over the entire width of the anomaly. Only the weakest conduction is inferred by the high absolute resistivities recorded everywhere

6 - A second significant response was defined on line 8N at 3175W and bears a close resemblance to the anomaly on line 49 (see TAS-016) which yielded sphalerite, galena chalcopryite in pyrite. Considerably smaller responses were defined on lines 9N and 7N, and significantly an increased response on line 10N at 3225W which is open to the north. However, only on line 8N does the anomaly warrant examination by diamond drilling should this be warranted on geological and/or geochemical grounds. The maximum depth is estimated to be 35 to 50 feet.

7 - The other relatively minor responses referred to in the text are nevertheless significant anomalies, and should, where possible, receive careful attention in the follow-up geochemistry recommended below.

8 - The very limited mercury soil survey revealed values considered of significance as judged against surveys elsewhere. However, the survey was not extensive enough to establish true backgrounds in the area. Further work is proceeding.

RECOMMENDATIONS

- 1 - It is recommended that the major response recorded in the area be tested by diamond drilling in two positions as follows:
 - a) On line 4N at 875W, the target lies normal to the local slope, at a depth of not greater than 100 feet. As the profile symmetry suggests an east dip, a west dipping hole is suggested, providing the geology does not suggest the contrary.
 - b) The substantial anomaly on line 6N between 250W and 1175W should be investigated by diamond drilling also. The 1000 feet width of the target on this line may require more than one hole. The dip of the body cannot clearly be ascertained although the maximum depths are as stated in the text, namely 25 - 100 feet.
- 2 - The significant response at 3175W on line 8N should also be investigated further, either by diamond drilling or by trenching, for although the limits of the 50 feet

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potential dipole used cannot accurately ascertain depths less than half that dipole, the maximum estimated depth of 35 to 50 feet may be excessive. Experience on line 49 suggests a depth between 10 to 25 feet.

- 3 - Where possible, the smaller relatively less substantial anomalies are strongly suggested as targets for further investigation by auger geochemistry and, if found to be meaningful in the area, mercury soil geochemistry.

II - HOWARD'S ANOMALYDISCUSSION OF RESULTS

The data profiles and contour interpretation of the chargeability data are shown on a horizontal scale of 1 inch = 200 feet, while the profile presentation uses a vertical scale of 1 inch = 10 milliseconds for chargeability and a two inch log cycle for the resistivity, expressed in ohm-metres. The data profiles are displayed on Plate 3 and the contour interpretation of the chargeability data on Plate 4.

Plate 5 displays the results of the Schlumberger electrical soundings carried out over five locations within the grid area.

A proton precession magnetometer survey of the area carried out by the Mount Lyell Mining and Railway Company Ltd., has been plotted on Plate 3 at the scale of 1 inch = 200 gammas. Comments on this data have been made with respect to their bearing on the induced polarization data.

Only the results of the present survey are discussed in this report. Previous geophysical surveys in the area have been discussed by various authors in some detail.

The only data amenable to presentation in contour form was the chargeability data. All other data is presented in profile

form only.

The area was surveyed using a gradient array, the details of the current dipoles are as follows.

<u>Lines</u>	<u>Current Electrodes</u>	<u>Dipole</u>
15N, 16N & 17N	850E & 3150E on line 16N	4000 feet
18N, 19N, 20N, 21N & 22N	1550E & 4450W on line 20N	6000 feet
23N, 24N, 25N & 26N	4950W & 1050E on line 24N	6000 feet

In all cases the potential dipole used was 100 feet and thus depths and widths cannot be resolved better than half this dipole. All interpreted depths and widths which follow are subject to this proviso.

Each line is discussed separately below:

On line 15N the anomalous response extends from 820W to 1350W with chargeabilities in excess of 20 millisecons over this width, and a distinct peak at 1250W of 10 millisecons or so above this level. The very sharp sides to this response indicate a relatively sharp contact of the source and enclosing material and a shallow 100 feet depth to source. On this line, a 60% depression in the resistivity is seen over the width of the chargeable response, but the absolute values of the

resistivity of 2000 ohm-metres do not infer a "conductive source". The nature of the source is therefore interpreted to be disseminated sulphides (or graphite), or if massive, electrically discontinuous. The maximum sulphide concentration over the width is considered to be about 2% by volume.

The substantial induced polarization response referred to above is not associated as such with any material distortion in the magnetic field, although a 100 gamma anomaly was recorded from a source on, or in close proximity to, the western contact of the source of the induced polarization anomaly.

A very sharp increase in the magnetic level from 62,650 to 63,100 gammas occurs east of 600W which is not correlated with any material change in the low normal induced polarization background of 5 to 8 milliseconds, or resistivity. Thus the source is not considered to have any material economic potential.

On line 16N the response is the largest recorded in the area, and reaches over 40 milliseconds above normal background at 950W. The eastern contact of the source with the enclosing host rocks is inferred to be sharp and the maximum depth to the source about 150 feet. The asymmetry suggests a west dip but this is a guesstimate at best.

The most significant portion of the anomaly was defined between 800W and 1200W and over this section, the resistivities reach a relatively low 500 ohm-metres, inferring at best, weak conduction within the source over the greatest concentration of sulphides (as indicated by the coincident maximum chargeability values). Thus some minor interconnection between the causative sulphide (or graphite) source material occurs. A maximum concentration of sulphides of 4% is suggested at 950W.

Two to two and a half times background chargeabilities extend out to 1500W and are still considered significant, but the apparent resistivities over this section are ten times higher than to the east, therefore the source is inferred to be wholly disseminated in nature.

There is no distortion in the total magnetic field over the entire width of the induced polarization response. Therefore the source does not contain significant quantities of either magnetite or pyrrhotite.

To the immediate east of the anomaly over a zone of relatively low chargeability background and increased apparent resistivity, a substantial magnetic response which is considered to have no economic significance, was recorded.

The response is last seen on line 17N between 650W and 1400W

with the greatest response of 40 milliseconds between 950W and 1250W being coincident with the lowest (500 ohm-metres) apparent resistivities. Thus some very weak conduction is suggested within the greatest concentration of sulphides as seen on line 16N. The maximum suggested concentration over the 300 feet wide central core of the source is 3% by volume. Either side of this, the source becomes more resistive and less concentrated. The maximum depths to the source are estimated to be of the order of 100 to 150 feet and the attitude cannot be gauged from the profile form.

A gradual rise from west to east in the total magnetic field was noted over the induced polarization response from 62,700 gammas to 62,900 gammas. This is however not considered of significance.

An extremely sharp change from 62,700 gammas at 625W to 63,900 gammas at 600W was recorded. This change is due to a near surface (but substantial) magnetic unit, which may be in contact with the eastern margin of the chargeability source. Apparent resistivities increase over the magnetic unit.

Line 18N A relatively minor 20 millisecond response recorded between 1400W and 1520W is associated with high apparent resistivities of 2500 ohm-metres. The interpreted source is considered not to be deeper than 50 feet, of a disseminated

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sulphide (or graphite) nature, and to have a maximum width of the order of the dipole used, namely 100 feet.

No other anomalies are considered significant.

There is no correlation between the apparent chargeability and the substantial distortions which occur in the total magnetic field. The induced polarization response was recorded within a relatively quiet area. Between 200W and 1025W the field increases to about 1000 gammas above local background, but background chargeabilities remain about normal. There is however an up to threefold increase in resistivity over the magnetically active zone. An increase from background to 400 gammas above background occurs east and west of 1625W. However, again there is no correlation with induced polarization data. The magnetite present therefore is not polarizable, neither does the source for the induced polarization anomaly contain significant quantities of magnetite.

Line 19N Between 700W and 1900W a series of 8 to 10 millisecond anomalies were recorded which are considered to be due to disseminated sources having maximum depths of the order of 60 to 100 feet. Their positions and maximum widths are as follows:

<u>Position</u>	<u>Width</u>	<u>Comments</u>
750W	100 feet	Resistive source

<u>Position</u>	<u>Width</u>	<u>Comments</u>
950W	120 feet	
1250W	50 to 70 feet	
1450W-1650W	200 feet	
1850W	50 feet	

It is not possible to gauge the significance of these zones on geophysics alone, but they pale into insignificance compared to the major anomaly described to the south.

A 1200 gamma above background anomaly recorded centred between 1950W and 2100W is associated with low background chargeabilities of 8 to 10 milliseconds and a 100% to 140% increase in apparent resistivity.

Elsewhere at 1150W, 800W and 150W, narrow substantial 800 to 2000 gamma responses from shallow subsurface sources are generally associated with more resistive rock units of lower than normal to normal apparent chargeabilities.

Line 20N A significant induced polarization response of 20 milliseconds above background was recorded between 1650W and 1750W. The 5000 ohm-metres apparent resistivities show no depression over this zone, and therefore the source is inferred to be of a disseminated nature. The profile form suggests a maximum depth of 150 to 200 feet. However, should the source

not have a sharp contact with the enclosing host rocks, the depth will be considerably less than this.

A maximum induced polarization response at 1700W is coincident with lower than surrounding magnetic field strength of about 300 gammas. The source therefore contains less magnetic material than the enclosing rock types.

There are numerous responses of varying strength from 200 gammas to in excess of 1100 gammas from shallow to surface sources over the entire traverse length. In all cases resistivities were higher and chargeabilities lower over these zones.

Line 21N A broad low amplitude response of 8 to 10 milliseconds was recorded between 2400W and 1800W which may correlate with the previously described anomaly between 1550W and 1900W on line 20N. The depth cannot be gauged from the profile form.

The magnetic field is extremely active over this line, but this is nowhere considered of potential economic interest.

Line 22N Within a twice background zone of high chargeability between 1950W and 2800W, two distinct maxima were observed, neither of which shows any resistivity contrast with the enclosing host rocks. The chargeability maxima having the shallowest source is centred at 2130W, Thus the response is

interpreted to come from a disseminated source having a maximum depth and width of 100 feet.

The second of the responses is centred at 2550W, and is broad and diffuse, and lies on the resistive eastern side of a very sharp apparent resistivity contrast. This contrast is due to a marked change in rock type at this point. No maximum depth can be interpreted from the data.

The two above chargeability peaks are associated with significant reductions in total magnetic field of about 500 gammas. These chargeable sources are therefore deficient in magnetic material relative to the enclosing rock types.

East of the above described zone a 10 millisecond anomaly defined at 1450W can be traced as far north as line 25N. The source on this line is disseminated in nature, and has a maximum depth of about 100 feet. The sulphide content is about 1% over the 150 feet width. This anomaly lies within a broad magnetic low.

Line 23N The above described anomaly is seen on this line as a 20 millisecond above background response centred at 1750W. There is no change in the apparent resistivity over this section which infers a disseminated causative source. The maximum width and depth is estimated to be of the order

U34

of 100 feet and 50 feet respectively. As has been noted elsewhere this response has a lower than immediate background magnetic field. Other substantial magnetic anomalies have no expression as chargeable sources and are therefore of no potential economic interest.

West of 2200W the chargeable background remains between 17 and 20 milliseconds, about twice normal.

Line 24N A 10 to 14 millisecond above background chargeability anomaly centred at 1870W is considered to be the correlative of the anomaly seen at 1750W on the previous line. The interpreted maximum depth and width of the disseminated source is 100 feet and 150 feet respectively. A slight increase in magnetic field was recorded from a narrow source within the centre of this anomaly.

A second broad anomalous response was recorded between 2800W and 3400W which reaches over 28 milliseconds at 3100W. The apparent resistivity follows a sympathetic profile form which strongly suggests that the causative chargeable material is contained within a rock unit of higher intrinsic resistivity than the enclosing rocks. The maximum depth indicated by the profile form of 200 feet is considered excessive as a homogeneous source making a sharp contrast with the enclosing rock types is not suggested by the data. The magnetic field

over this anomaly is reduced by about 600 gammas above the relatively high 63,000 gamma levels to the immediate east and west. Thus, the induced polarization source is deficient with respect to the enclosing rock types.

Line 25N On this line the last above described anomaly has a similar profile form of slightly lesser magnitude. The source, however, shows no contrast with the enclosing rock types. A gradual decrease in sulphide content to the east and west from the maximum estimated, 1% (by volume) at 2700W, is suggested by the profile form. It is therefore not possible to estimate maximum depth from the gradient data. The source has no significant magnetic characteristics with respect to the enclosing rock units.

A relatively minor response of 3 milliseconds above background at 1950W is considered to be the most northerly manifestation of the anomaly seen on the previous line at 1870W. A substantial 1200 gamma anomaly was recorded over this response, therefore, the causative material may, at least in part, be due to magnetite.

Other substantial increases in magnetic field have no reflection in the induced polarization level.

Line 26N has no significant induced polarization anomalies. The substantial increase in magnetic response east of 2100W

is not considered of economic interest.

The Contour Interpretation: The contour interpretation of the induced polarization data is presented on Plate 4. This clearly shows a number of anomalous zones contained within an 1800 feet wide zone whose background ranges from 10 to 15 milliseconds, and to the east and west of which the background is less than 10 milliseconds. In the south this zone is positioned in the centre of lines 15N and 16N, while in the north the zone is centred on the western sections of the lines surveyed. The relative importance of each of the significant induced polarization anomalies can clearly be seen on this plan.

The most significant response both in terms of width and magnitude was recorded between lines 15N and 18N. The anomaly is open to the south, but is closed to the north of 18N. The background resistivities to the immediate east and west are of the order of 3000 to 7000 ohm-metres while the background chargeability is generally of the order of 10 milliseconds. It is this anomaly which should receive the most careful follow-up.

The Electrical Soundings: The electrical soundings confirm the depths as ascertained by the maximum depth method. On line 18N the major zone has an estimated depth of about 40 feet at about 14.5W. However, on most depth determinations,

inhomogeneities within the units or within the near surface layers , precluded a precise interpretation.

CONCLUSIONS

- 1 - The background chargeabilities within the area of interest are slightly less than those observed elsewhere in the region.
- 2 - The range of apparent resistivities recorded in the area were as recorded elsewhere in the region.
- 3 - The L/M ratios were normal and nowhere infer electromagnetic coupling or capacitance coupling.
- 4 - Unlike Area 'A', a significant variation in the observed total magnetic field was recorded. The field had the following characteristics:
 - a) increased in intensity to the east and the south.
 - b) was generally associated with higher resistivities
 - c) significant chargeability anomalies were invariably associated with no change in total field or a reduction in the local high magnetic field.
 - d) the maximum depths to the top of the sources of the magnetic anomalies were invariably shallow, ranging from surface to 100 feet.

Nowhere does the magnetic data appear to have any bearing on the potential economic interest of any of the induced polarization anomalies.

- 4 - All the induced polarization anomalies located in the Howard's Anomaly grid are inferred to have sources of a disseminated nature, as little to no material reduction in apparent resistivity was observed.
- 5 - The most significant response was recorded on lines 15N to 17N and is open to the south.
- 6 - All other significant responses recorded are of lesser magnitude both in induced polarization level and width, and occur north along strike.
- 7 - The 50 feet potential dipole used in Area 'A' resulted in a much improved resolution of depth and lateral extent of anomalies than the 100 feet potential dipole used in this area.
- 8 - Due to lateral inhomogeneities and homogeneities within the overburden, the electrical soundings did not significantly improve the depth estimates as ascertained by the "maximum depth" method.

RECOMMENDATIONS

- 1 - The anomalies recommended for further investigation by diamond drilling assuming that the economic potential is proportional to the sulphide content, are as follows:

Of Primary Interest

Line 16N between 850W and 1100W

Of Secondary Interest

Line 23N centred at 1750W

Line 22N centred at 2130W

Line 24N centred at 3100W

In all the above cases the depths to source are relatively shallow and lie in the range 50 to 150 feet. The angle and direction of diamond drilling will depend on the geological information required and the topography and access of each area of interest. Therefore no specific drill site recommendations have been made at this time.

- 2 - As with all the geophysical data, the final assessment of these anomalies must be geological. Therefore all significant chargeability anomalies referred to in the text will require additional geological and geochemical data to confirm or dismiss their potential economic interest.

III - SOUTHERN EXTENSION TO MT. TYNDALL GRIDDISCUSSION OF RESULTS

The data profiles for the two lines surveyed this season, lines 34N and 36N, together with lines 38N, 40N and a section of 34N surveyed in the 73/74 season (already presented in Report TAS-018C) are presented on Plate 6 at the horizontal scale of 1 inch = 200 feet with vertical scales of 1 inch = 10 milliseconds for chargeability, while the apparent resistivity is presented in ohm-metres on a 2 inch log scale. The total magnetic field data is displayed at the scale of 1 inch = 200 gammas.

In addition the resistivity for the above mentioned lines has been contoured and added to the resistivity contour plan for the main grid (Plate 2, Report TAS-016) and is now shown as Plate 7.

The current dipoles used to survey the above lines are as follows:

<u>Lines</u>	<u>Electrodes</u>	<u>Dipole</u>
40N and 38N	5000W & 1000E on line 40N	6000 feet
36N and 34N	4450W & 5500E on line 36N	5000 feet

The potential dipole used was 100 feet.

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Lines 38N and 40N are discussed in report TAS-016 on pages 23 to 25 inclusive. All four lines show similar apparent chargeabilities and apparent resistivities. The chargeability anomaly located at 1050W and 1250W on line 38N at about 2375W and 2500W on line 36N respectively to line 34N where the western anomaly is centred at 3400W, while the eastern anomaly may be centred at 3125W. The one feature which can be traced south from line 44N in the vicinity of the chargeability anomalies on all lines south of this line, is a resistivity low (see Plate 7) the co-ordinates of which are as follows:

<u>Line</u>	<u>Station</u>
40N	500W
38N	1100W
36N	2250W
38N	3175W

The fall in apparent resistivity is about 70% in all cases, and could represent the manifestation of a fault zone. Of significance is the location of the various induced polarization anomalies in the vicinity of this low. On lines 40N and 38N a chargeability response is coincident with it, while on line 36N no chargeability anomaly is seen over the line. On line 34N a narrow (less than 50 feet) shallow (less than 50 feet) source is estimated for the response recorded, which is some 40 to 50 feet offset to the east of the apparent resistivity low.

J42

Invariably on each of the above four lines the western of the anomaly pairs on each line is not accompanied by any material depression in the apparent resistivity profile. Thus the source is considered to be disseminated or electrically discontinuous sulphides.

None of the anomalies described above are associated with significant distortions in the earth's magnetic field, therefore, magnetite makes no contribution to induced polarization response recorded.

A summary of the significant induced polarization anomalies is set down below:

<u>Line</u>	<u>Station</u>	<u>Width</u>	<u>Depth</u>	<u>Interpretation</u>
40N*	680W	100'	100'	Disseminated
40N*	460W	180'	100'	Weakly conductive
38N	1050W	100'	80'	Weakly conductive
38N	1250W	150'	140'	Disseminated
36N	2370W	50'	100'	Disseminated
36N	2500W	150'	100'	Disseminated
34N	3125W	40'	50'	?
34N	3400W	200'	?	Disseminated

All the above are considered significant anomalies.

One relatively minor response was recorded on line 34N at 225W

(* Revised from Report TAS-018C)

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associated with a minor depression in the apparent resistivity data. At this juncture this anomaly is not considered of significance.

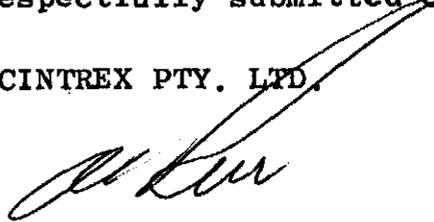
CONCLUSIONS AND RECOMMENDATIONS

- 1 - The additional data obtained on lines 34N and 36N continue the trends observed on the two lines to the immediate north. The resistivity and chargeability base levels remain similar.

- 2 - The anomalies located in the area, and listed in the text, are considered significant, and careful further examination therefore is strongly recommended.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.



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

GEOPHYSICIST

APPLICATIONS BRIEF
72-3

MERCURY VAPOUR
ANALYSIS IN EXPLORATION

SPINTRIX

U45

Mercury Vapour Analysis
In Exploration

Published By



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MERCURY VAPOUR ANALYSIS IN EXPLORATIONINTRODUCTION

The suggestion of the use of measurements of trace amounts of mercury as a guide to the location of sulphide ore deposits was first made by the Russian, A. A. Saukov (1), in 1946. Since Saukov's original work, many others have studied the abundance of mercury in nature, the association of mercury with sulphide ores and methods by which very minute quantities of mercury can be measured in air, soil, rocks, water and plants.

The most abundant of the mercury bearing minerals is cinnabar (HgS). Native mercury is also found and sulpho-salts like tetrahedrite are known to have important mercury contents. Other sulphides of base metal deposits contain mercury in amounts ranging from parts per million to as much as one or two percent. (2) The mercury content of sulphide-free rocks is usually less than a few hundred parts per billion (1 ppb = 10^{-9}). Soils usually contain less than 100 ppb and water less than 1 ppb of mercury. Normal atmospheric air contains about 1 nanogram (10^{-9} grams) of Hg per cubic metre although higher concentrations can be observed near mercury occurrences, sulphide deposits and volcanic exhalations.

Given that sulphide ore bodies contain much higher concentrations of mercury than host rocks, the success of the use of mercury as a trace element for the discovery of such deposits still requires some mobility of the mercury outwards from the deposits to form a "halo".

The chemical and physical details of the migration processes of mercury are not yet fully understood. At the time of deposition of a hydrothermal ore body or during metamorphism of either hydrothermal or syngenetic ore deposits, mercury may migrate upwards into the adjacent host rocks. There is also evidence that mercury can be liberated during tectonic activity. During weathering and oxidation, mercury ions, metallic mercury or mercury vapour may be liberated from the sulphides. A theoretical understanding of the oxidation processes, transport in ground waters and subsequent deposition requires a thorough knowledge of the aqueous chemistry of mercury, which, indeed, is still at the basic research stage.

An ideal pathfinder element for geochemical exploration is one which (i) occurs in anomalous quantities in many types of deposits and (ii) has sufficient mobility to result in a 'halo' of anomalous concentration much



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larger in extent than the deposit itself. The literature published over the last twenty-five years indicates that mercury has both of these properties.

High concentrations of mercury are, of course, found in mercury ores. More importantly, above normal amounts of mercury are also found in many sulphide ores containing gold, silver, tin, copper, lead and zinc. It appears that mercury is also a useful pathfinder element in searching for barite and fluorite (3).

A whole new field for the use of mercury in exploration lies in the domain of geothermal resources. Many observers (4) have noted high contents of mercury in volcanic fumaroles, hot spring gases and waters, and the sediments around such sources. On a world-wide basis there is a close association of known geothermal reservoirs with mercuriferous belts. (5)

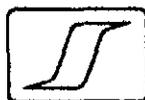
There is evidence (4) that at least some waters associated with petroleum contain high amounts of mercury so that mercury methods may have application in petroleum exploration.

MEASUREMENT TECHNIQUES FOR MERCURY

The use of mercury as a pathfinder element in geochemical exploration, as for any other element, requires the development of sufficiently sensitive sampling and analytical techniques which can be economically applied. Although chemical separation and colorimetric determinations of mercury have been made in the past, most high sensitivity measurements are now carried out using atomic absorption techniques.

Atomic absorption instruments designed to measure the concentration of mercury in a sample of air by recording the degree of absorption of ultra-violet radiation at a specific frequency have been known for some time. Most of the early instruments consisted of single cell designs in which the radiation from an ultra-violet source (such as a mercury lamp at 2537 Angstroms) is passed through a chamber containing the sample and picked up by a photocell. A decrease in the output of the photocell was taken to indicate absorption by mercury.

These simple instruments were inadequate since small fluctuations of the light source would cause variations in the output of the photocell which could be mistaken for concentrations of mercury. In addition, gases other than mercury vapour which have a broad ultra-violet absorption spectrum could absorb some of the light and cause spurious observations.



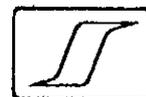
The next stage in mercury spectrometer design was developed in the late 1960's and involved the use of twin cell circuits to overcome the above mentioned problems. These instruments divide the sample in half, remove the mercury from one half by chemical means and compare the outputs of the two absorption cells. In this way, both lamp fluctuations and absorption from interfering substances are overcome and sensitivities of one part per billion could be obtained for gases or for solid samples from which the mercury was vaporized by heating.

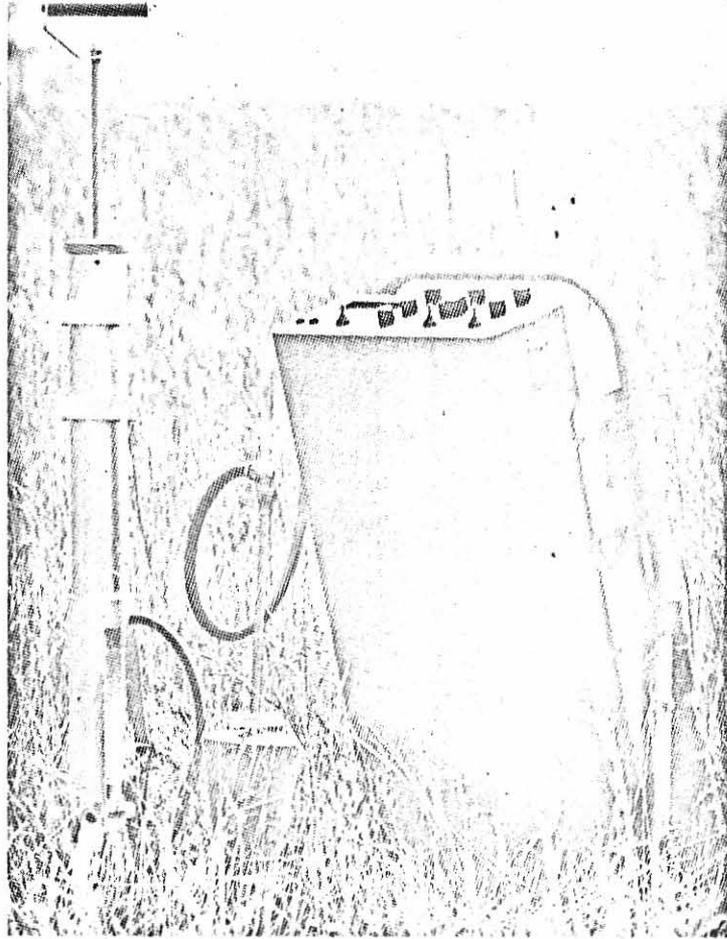
It was recognized that further sensitivity in the twin cell approach was limited by the necessity to divide the sample and that further precision could be had by using two wavelengths in the same sample. While mercury has a very sharp absorption spectrum (at 2537 Angstroms, the wavelength of a mercury vapour lamp) other interfering gases have much broader absorption spectra.

Barringer (6) has described one approach to the dual wavelength technique. In this method a mercury lamp is heated to provide a broad wavelength source. Part of the radiation is split off and passed through a cell containing saturated mercury vapour. After passage through the cell the centre of the thermally broadened line is effectively absorbed yielding a filtered beam having no 2537 Angstrom component. Mechanical means are used to recombine the beams for passage through the absorption chamber. By comparing the photocell output for the filtered beam with that of the broad beam, a differential measurement can be made so that the absorption due to mercury alone is apparent. This is a useful technique but is limited in precision because of the use of moving parts.

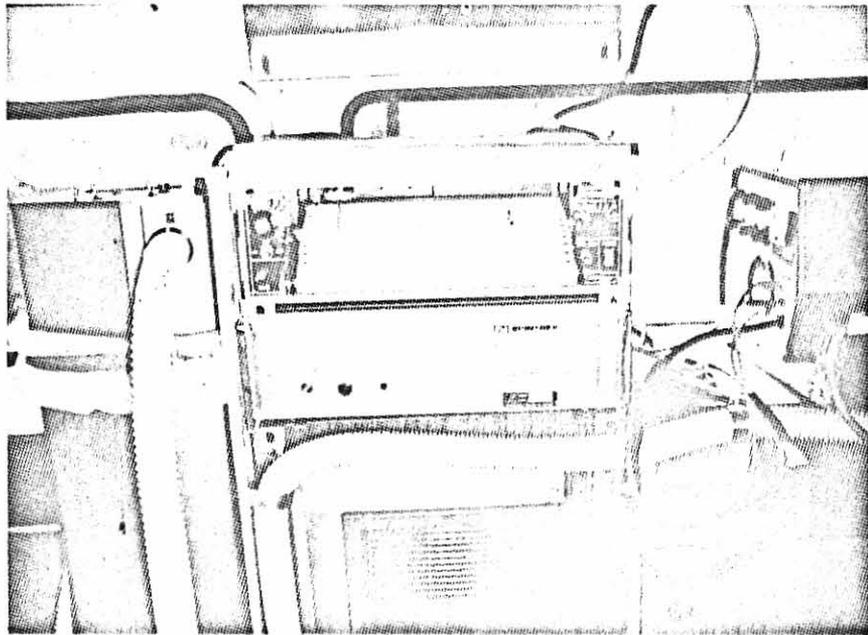
Scintrex Limited developed and has applied for a patent covering the application of the "Zeeman Effect" for modulating the emission of the light source in gas spectrometers. The Zeeman Effect describes the shift in wavelength of a monochromatic light source when placed in a magnetic field. In the Scintrex Mercury Spectrometers a powerful electromagnet is placed around an unheated mercury lamp which naturally emits light having a wavelength of 2537 Angstroms. The magnet is cycled off and on to provide 2537 Angstrom light for one half cycle and a slightly different wavelength for the other half cycle. A measurement is made to differentiate total absorption made at 2537 Angstroms from non-mercury absorption at the shifted wavelength.

Using Zeeman modulation the wavelength shift can be made very rapidly and without any moving parts, thus allowing sensitivities better than one part in 10^{12} . In Scintrex Mercury Spectrometers, lamp intensity changes are controlled by using modern electronics for stability. In addition, reference photocells reacting to part of the light beam provide electronic scaling. The use of Zeeman modulation has allowed Scintrex to design precise, portable and less expensive Mercury Absorption Spectrometers.

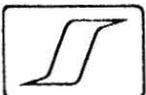




Scintrex HGG-3 Portable Mercury Vapour Spectrometer With Probe And Pump For Soil Gas Measurements



Scintrex HGM-2 Mercury Vapour Spectrometer Mounted In A Vehicle For Continuous Sampling Of Mercury In Atmospheric Air



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THE APPLICATION OF SCINTREX MERCURY SPECTROMETERS
IN EXPLORATION

Atmospheric Air Sampling

The Scintrex HGM-2 instrument is a continuously sampling atmospheric air Mercury Spectrometer having a sensitivity of 1 nanogram of Hg in one cubic metre of air. The analogue output is displayed on a chart recorder and has a three second time constant. The HGM-2 is normally installed in a vehicle or aircraft when used for exploration purposes.

It appears that exploration surveys using atmospheric air mercury sampling are best carried out in locations where hot arid conditions prevail since these conditions are most amenable to liberation of mercury vapour from the soil. Wind dispersion can be a problem, particularly for airborne surveys.

To date, atmospheric gas mercury anomalies detected at ground level, while they are several times background, are not sufficiently large that one would expect to detect them from the air using a 1 nanogram per cubic metre instrument. Using the Scintrex technique future improvement in sensitivity is quite possible.

Airborne or vehicle-borne mercury surveys offer the possibility of covering large areas at a low unit cost so that they are a very appealing exploration technique.

Soil Gas Sampling

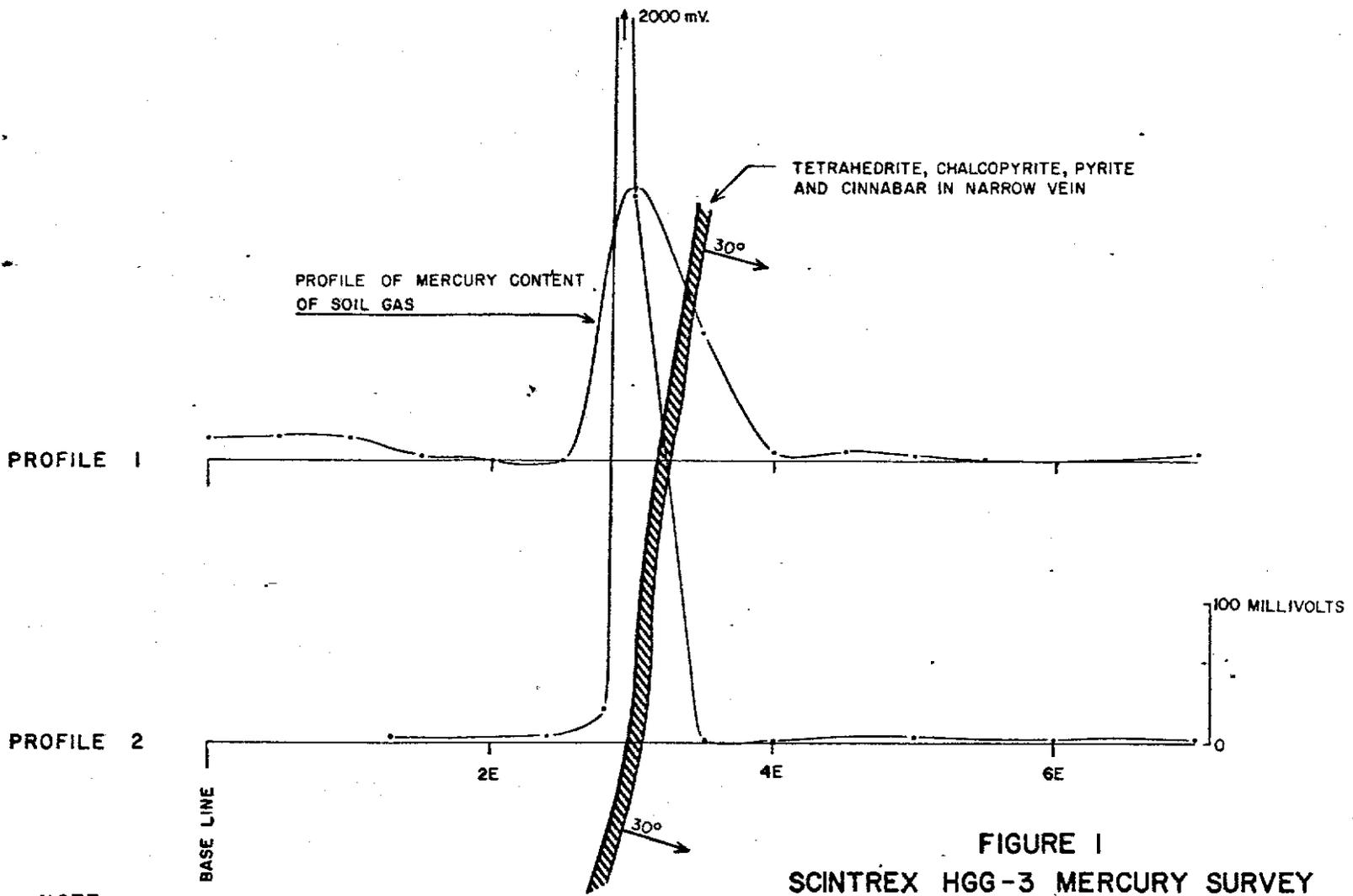
The Scintrex HGG-3 instrument is a portable mercury spectrometer capable of instantaneous sampling of the mercury vapour in soil gas to an accuracy of .05 nanogram in a 1/4 litre sample. The field procedure involves an assistant who makes holes in the soil up to 30 cm deep using a stake. The operator then inserts a probe (tapered to keep atmospheric air out) into the hole, pumps a sample into the spectrometer and takes a reading instantaneously.

Where soil conditions permit proper sampling, soil gas mercury surveys are more effective than atmospheric gas surveys. Soil gas surveys allow better repeatability as well as operation under a variety of atmospheric and topographic conditions. Using the HGG-3 with stations each 30 metres along grid lines, as much as 5 line kilometres of soil gas sampling can be carried out in one day.

Soil, Rock and Plant Samples

Samples of soil, rock and plant matter can be analyzed for mercury content using either of the HGM-2 or the HGG-3 spectrometers, although the latter is more portable and simpler to use in the field.





NOTE
 1 NANOGRAM Hg IN 1/4 LITRE
 SAMPLE CELL EQUALS 100
 MILLIVOLTS SCALE DEFLECTION

0 100
 FEET

5 cm

FIGURE 1
SCINTREX HGG-3 MERCURY SURVEY
CLYDE FORKS, ONTARIO
DIRECT SOIL GAS MEASUREMENTS

328054

To avoid organic substances, soil samples are collected from the 'B' or 'C' horizons, placed in plastic bags and transported to the spectrometer within a reasonable short time so that there are neither losses nor contamination by mercury. Rock samples must be crushed while plant material must be dried and then ground. The samples can then be treated by direct pyrolysis although in some cases a simple chemical digestion may be advantageous. Using this method, an average of 150 samples can be treated in a normal working day.

CASE HISTORIES

Mercury Vapour in Soil Gas Survey, Clyde Forks, Ontario, Canada

Figure 1 shows the results of two profiles surveyed for mercury in soil gas using the Scintrex HGG-3 Mercury Spectrometer.

The test area is a known mercury prospect near Clyde Forks, Ontario. The host rock is Precambrian sediments of Grenville Age and the mineralization consists of disseminated tetrahedrite, chalcopyrite, pyrite and cinnabar in a narrow vein dipping at about 30° . It is noted that tetrahedrite contains about 4% by weight of Hg.

The profiles speak for themselves. Background levels are very low and distinctly anomalous observations are seen in the area where the mineralization outcrops.

Mercury Vapour in Soil Gas Survey, Keel, Ireland

The Scintrex HGG-3 Portable Mercury Spectrometer has now been used extensively in Ireland. Figure 2 shows some profiles taken over the Keel lead-zinc deposit.

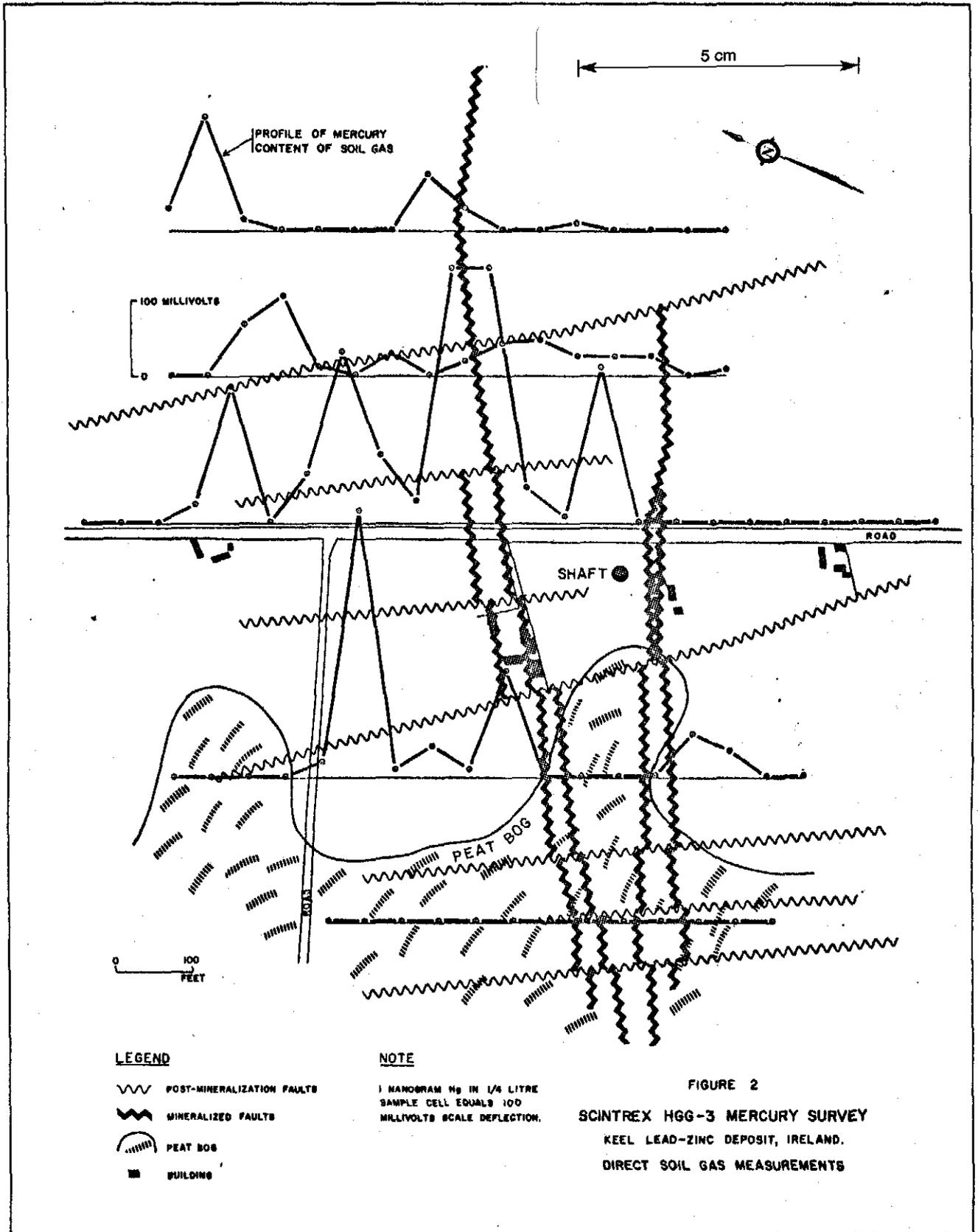
Low background values of a few millivolts are seen in areas away from the deposit which are not shown on the plan. Anomalous concentrations of mercury in the soil gas are seen in the area of mineralized faults, however, in the western profiles, low values are seen in an area where a peat bog overlies the deposit.

Mercury Vapour in Atmospheric Air Surveys, West Pilbara, Australia (7)

Figures 3 and 4 show the results of work carried out with the Scintrex HGM-2 Mercury Vapour Spectrometer installed in a Land Rover truck.

Surveys carried out in areas where no sulphide mineralization is known showed backgrounds of 1 to 2 nanograms per cubic metre. In the case of the showing and gossan at Lulu Creek and Sherlock Station respectively, the





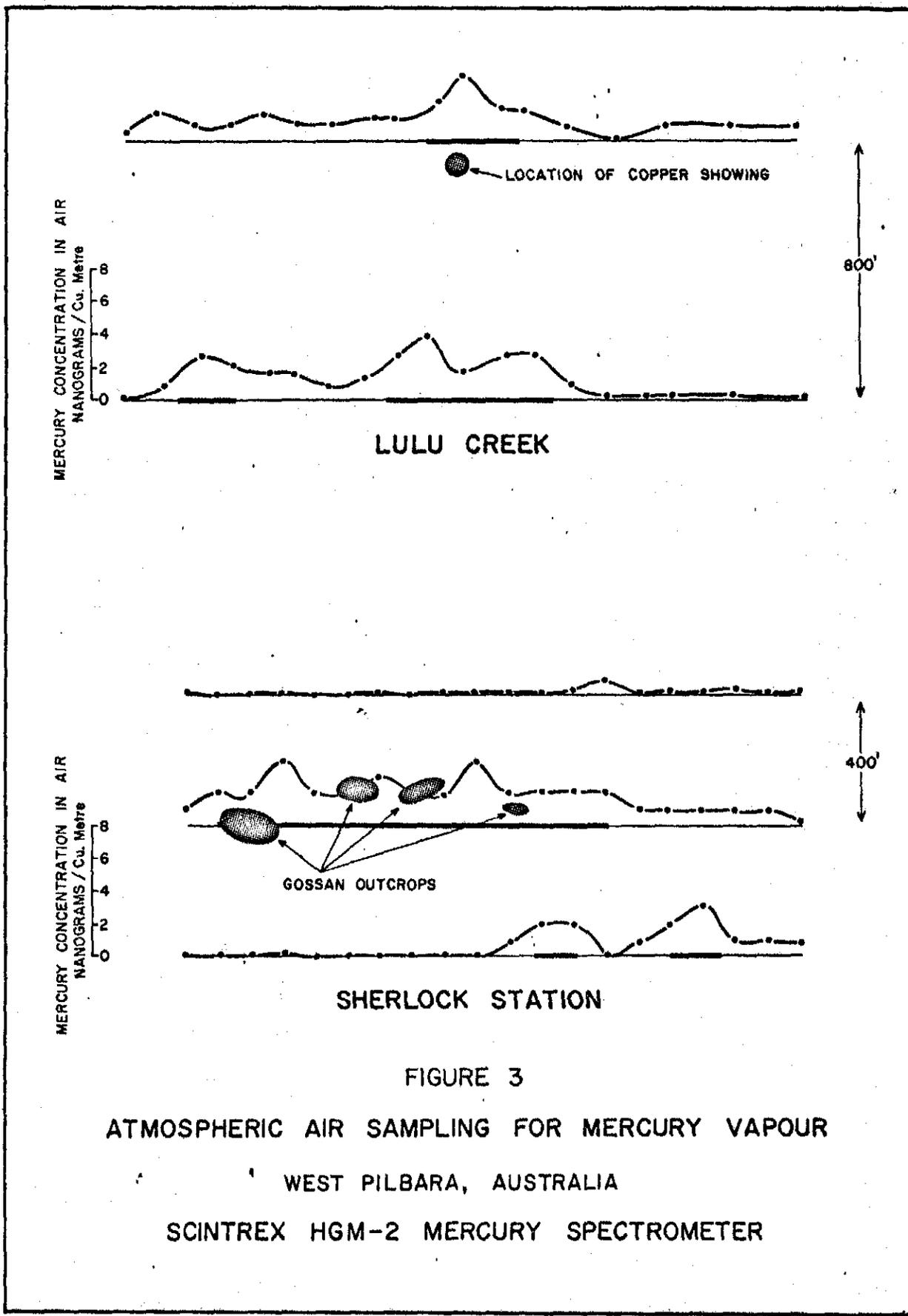


FIGURE 3
 ATMOSPHERIC AIR SAMPLING FOR MERCURY VAPOUR
 WEST PILBARA, AUSTRALIA
 SCINTREX HGM-2 MERCURY SPECTROMETER



mercury vapour anomaly reached as high as 4 nanograms per cubic metre and was decidedly above background of 1 nanogram per cubic metre or less.

Figure 4 shows a plan map of the area of the Mons Cupri copper-zinc deposit. Testing for mercury at Mons Cupri had previously been carried out using soil and rock samples. The general conclusion reached from that work was that some mercury was present but that the technique was ineffective as a prospecting tool. Results from the HGM-2 survey at Mons Cupri indicate that atmospheric air sensing spectrometers mounted in vehicles may be useful, at least in some areas.

Testing at Mons Cupri was carried out over a period of several days. In the area off the plan and for some miles out around the deposit, the mercury backgrounds were found to be 1 to 2 nanograms per cubic metre. Each time the area of the deposit was approached, however, concentrations ranging between 2 to about 8 nanograms per cubic metre were observed, although amplitudes did vary depending on atmospheric conditions or time of day. The result is a decided halo of mercury vapour in the air which is considerably larger than the area underlain by copper-zinc mineralization.

Mercury in Soil Survey, Eastern Canada

The HGG-3 Portable Mercury Spectrometer can be used for analyzing soil samples for mercury. In the fall of 1972, a mercury soil geochemical survey was carried out over a lead-zinc deposit in Eastern Canada on behalf of Norman Paterson and Associates and Derry, Michener & Booth. We are indebted to these companies for permission to publish these data.

Figure 5 shows the profiles for mercury and lead in the soil on one cross-section of the deposit. Both are decidedly anomalous at a place where the overburden is thin.

Figure 6 shows the mercury and lead results on another cross-section parallel to, up slope and about 1200' away from that shown in Figure 5. At this location, the mercury content of the soil is anomalous while there is no lead geochemical anomaly. It is to be noted that the body is 400' deep at this location.

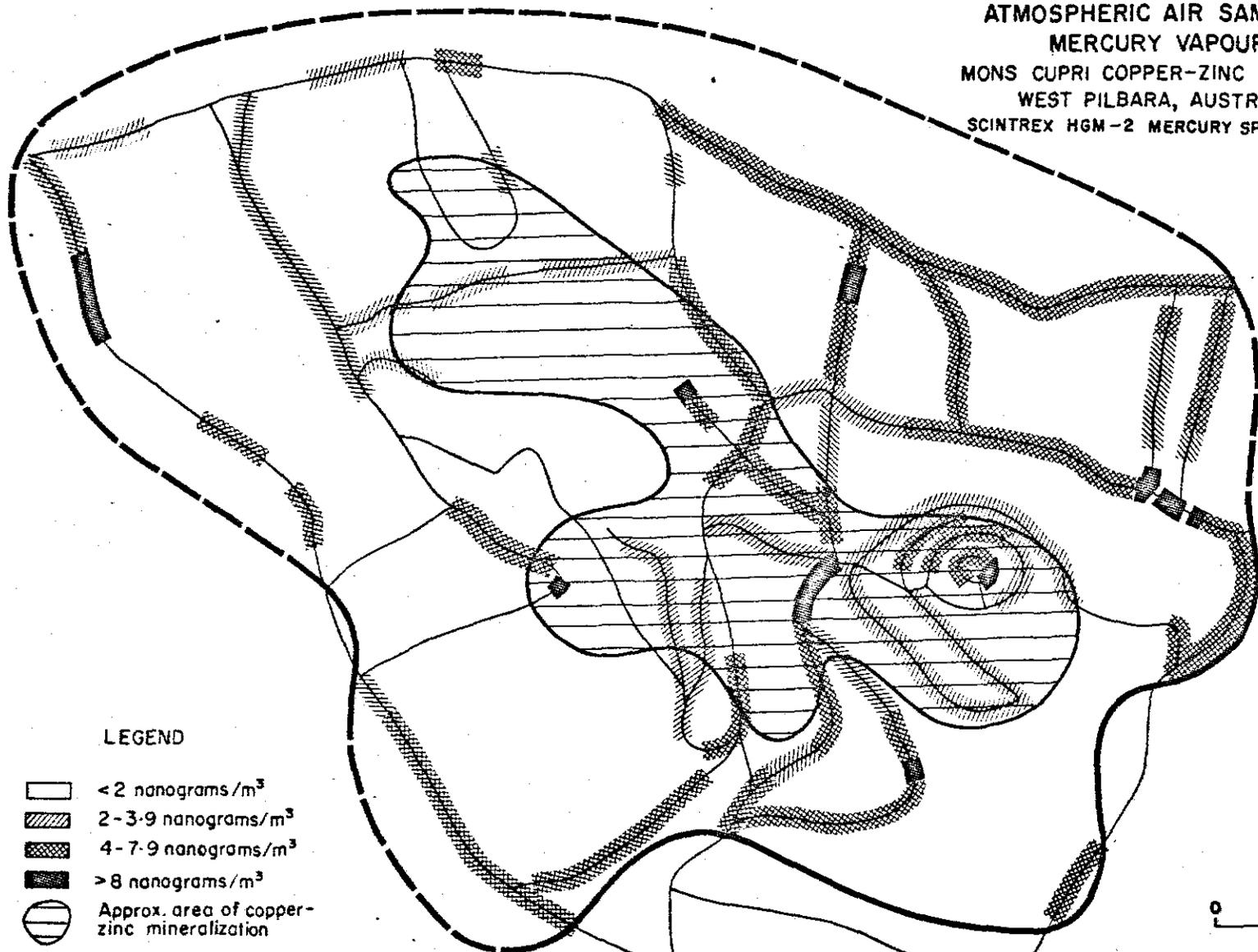
SUMMARY

At the time of writing, the use of mercury vapour analysis in exploration is really gaining momentum. For several years, many explorationists have seen the potential of the method but only a limited amount of work has been done. Now that sensitive instruments, highly selective for mercury are available in a portable and low-cost form, it would appear that an increasing number of field surveys are warranted.



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FIGURE 4
ATMOSPHERIC AIR SAMPLING OF
MERCURY VAPOUR
MONS CUPRI COPPER-ZINC DEPOSIT
WEST PILBARA, AUSTRALIA
SCINTREX HGM-2 MERCURY SPECTROMETER



LEGEND

-  < 2 nanograms/m³
-  2-3.9 nanograms/m³
-  4-7.9 nanograms/m³
-  > 8 nanograms/m³
-  Approx. area of copper-zinc mineralization
-  Approx. area of mercury vapour halo in air
-  Roads

0 500
FEET

5 cm



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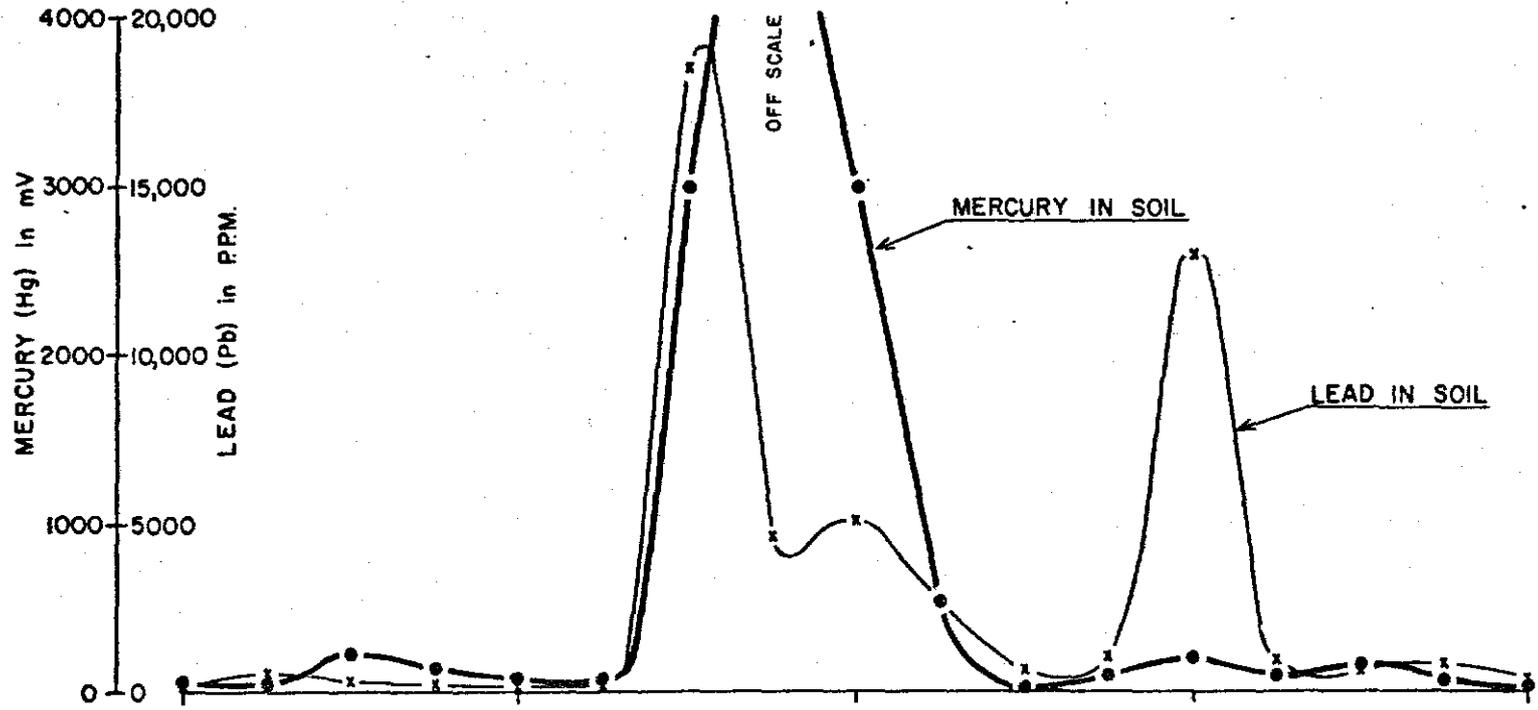


FIGURE 5
 MERCURY SOIL GEOCHEMICAL SURVEY
 LEAD - ZINC DEPOSIT, EASTERN CANADA
 SCINTREX HGG-3 MERCURY VAPOUR SPECTROMETER

0 100
 FEET

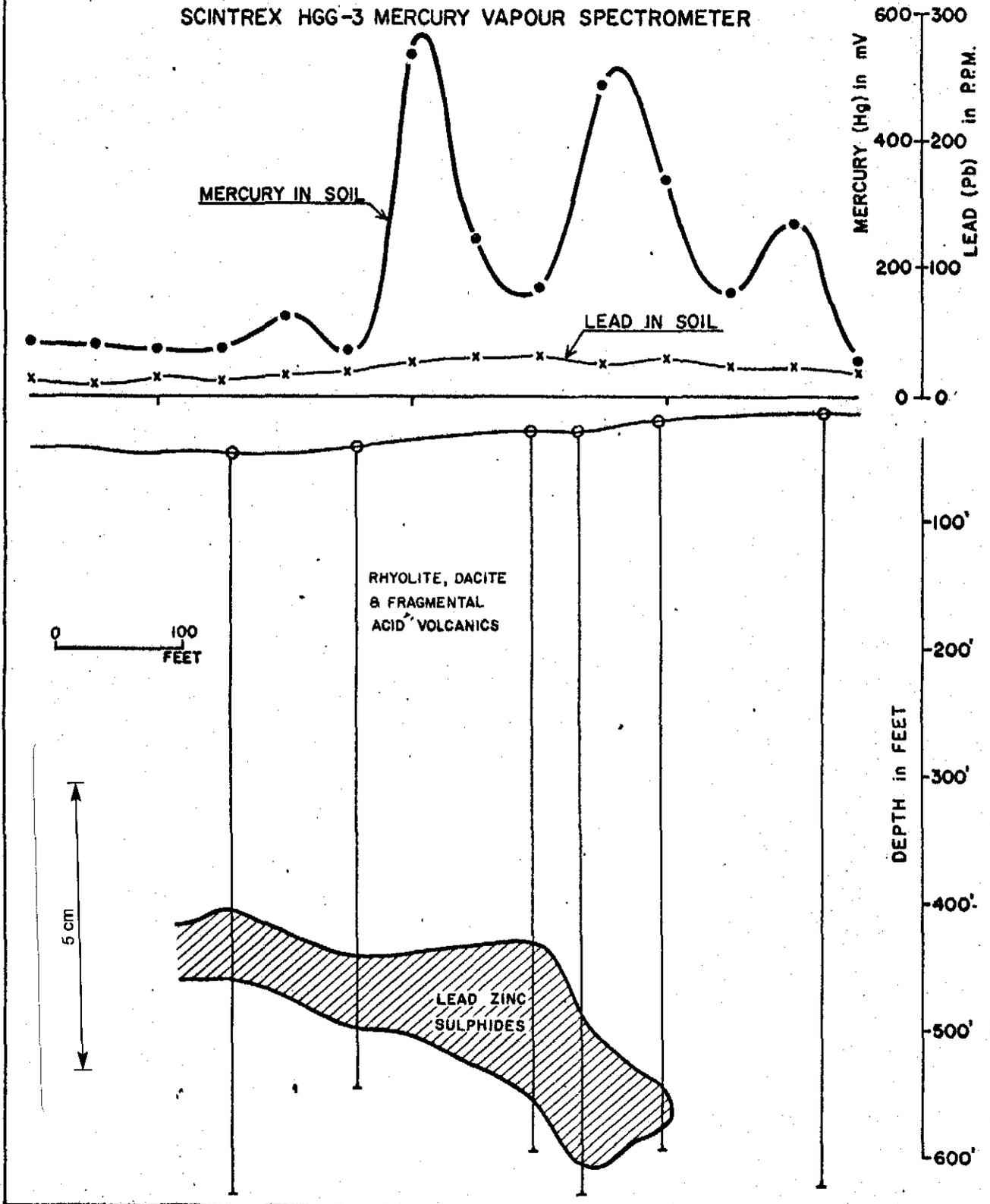
5 cm

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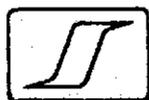
328061

FIGURE 6
MERCURY SOIL GEOCHEMICAL SURVEY
LEAD - ZINC DEPOSIT, EASTERN CANADA
SCINTREX HGG-3 MERCURY VAPOUR SPECTROMETER



REFERENCES

- (1) Saukov, A.A. (1946) "Geochemistry of Mercury" Akad Nauk, U.S.S.R., Min. Geochem. Series, No. 17.
- (2) Jonasson, I.R. and Boyle, R.W., "Geochemistry of Mercury and Origins of Natural Contamination of the Environment", CIM Trans. 75, 1972, 8-15.
- (3) Friedrich, G.H. and Pluger, W.L., "Geochemical Prospecting for Barite and Fluorite Deposits", CIM Special Volume No. 11.
- (4) White, D.E., Hinkle, M.E., Barnes, I., "Mercury Contents of Natural Thermal and Mineral Fluids". U.S.G.S. Paper 713, "Mercury in the Environment".
- (5) "Geothermal Exploration", a Scintrex Publication, Applications Brief 72-1.
- (6) Barringer, A.R., "Transaction I.M.M. (Section B), Vol. 75, Page 120, 1966.
- (7) "Mercury Vapour Analysis as an Exploration Tool", a Scintrex Publication by Roger W. Gedde, M.Sc.

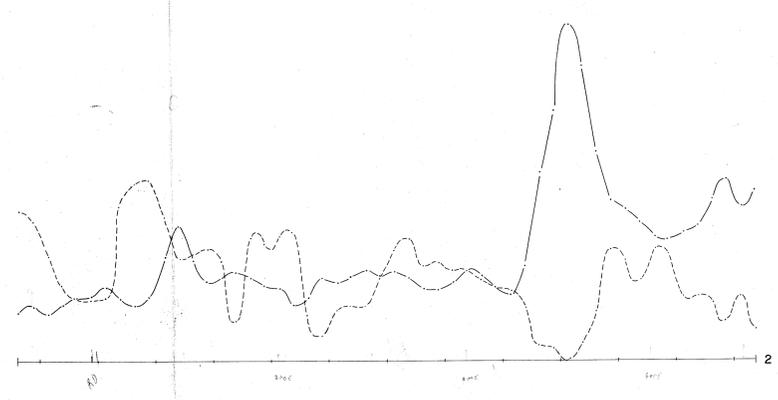
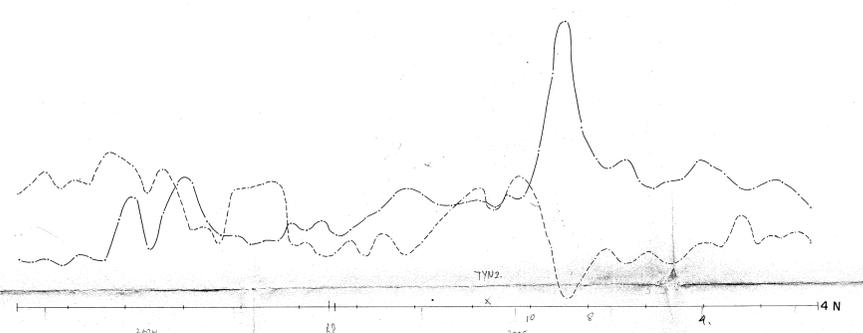
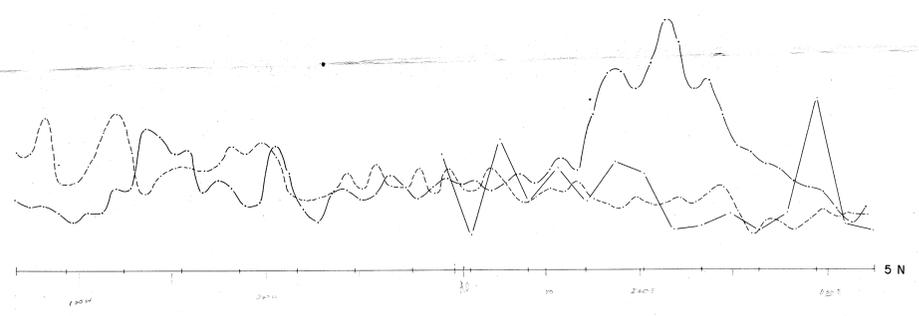
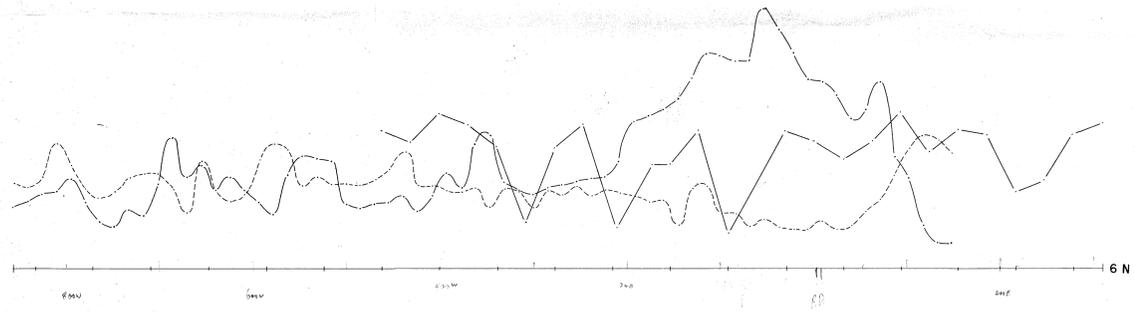
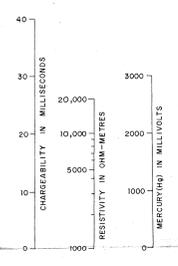
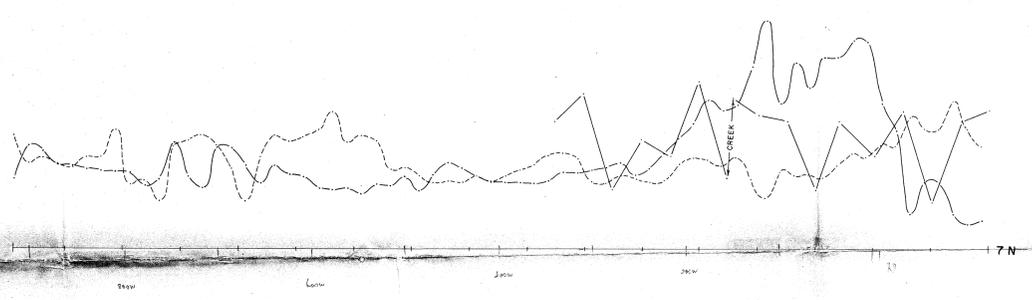
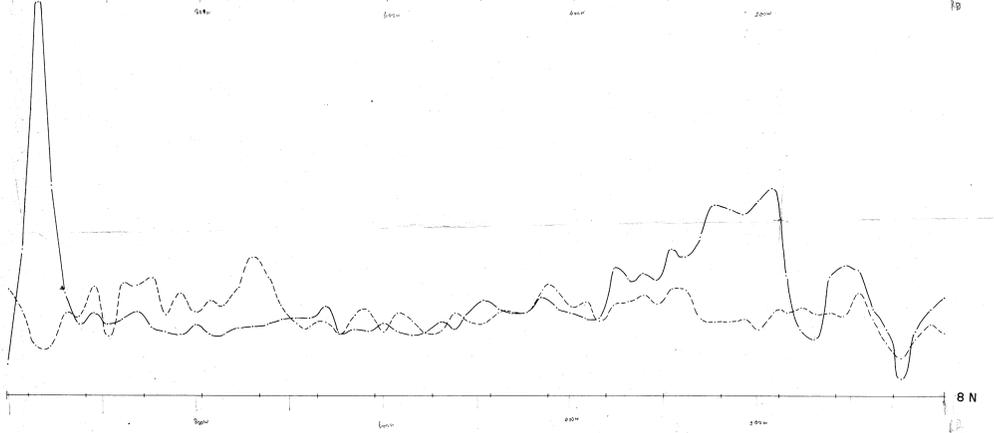
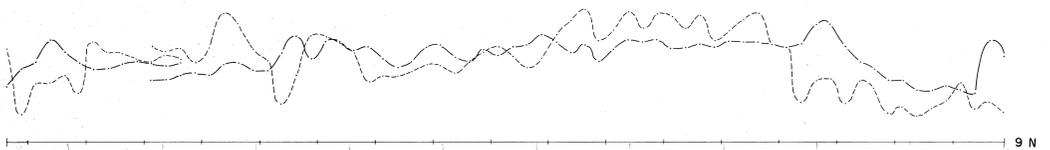
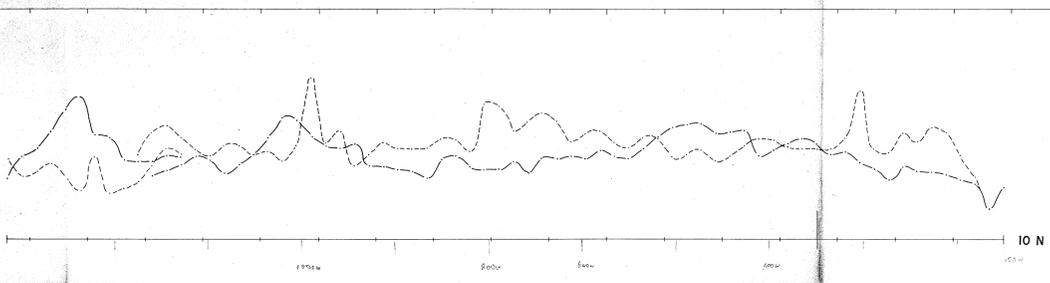


OPEN FILE

MICROFILMED

A REPORT ON
 GRADIENT ARRAY ELECTRICAL INDUCED POLARIZATION,
 SCHLUMBERGER ELECTRICAL SOUNDINGS
 AND MERCURY SPECTROMETER (SOIL) SURVEYS
 OVER THREE AREAS OF MT. TYNDALL
 ON BEHALF OF
 THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.
PLATES 1 TO 7

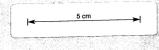
JOIN	A.O.	C.G.	E.O.	DATE
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D. DIR.	2 OCT 1984			E & H
	DEPT. OF MINES			
	FILE No. 10,076/84			



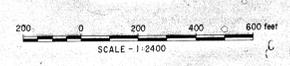
LEGEND

- Chargeability, 1^{st} = 10 milliseconds
Base level = 0
Symbol =
- Resistivity, 2^{nd} = 1 logarithmic cycle
Base level = 1000 ohm-metres
Symbol =
- Mercury (Hg), 3^{rd} = 1000 millivolts
Base level = 0
Symbol =

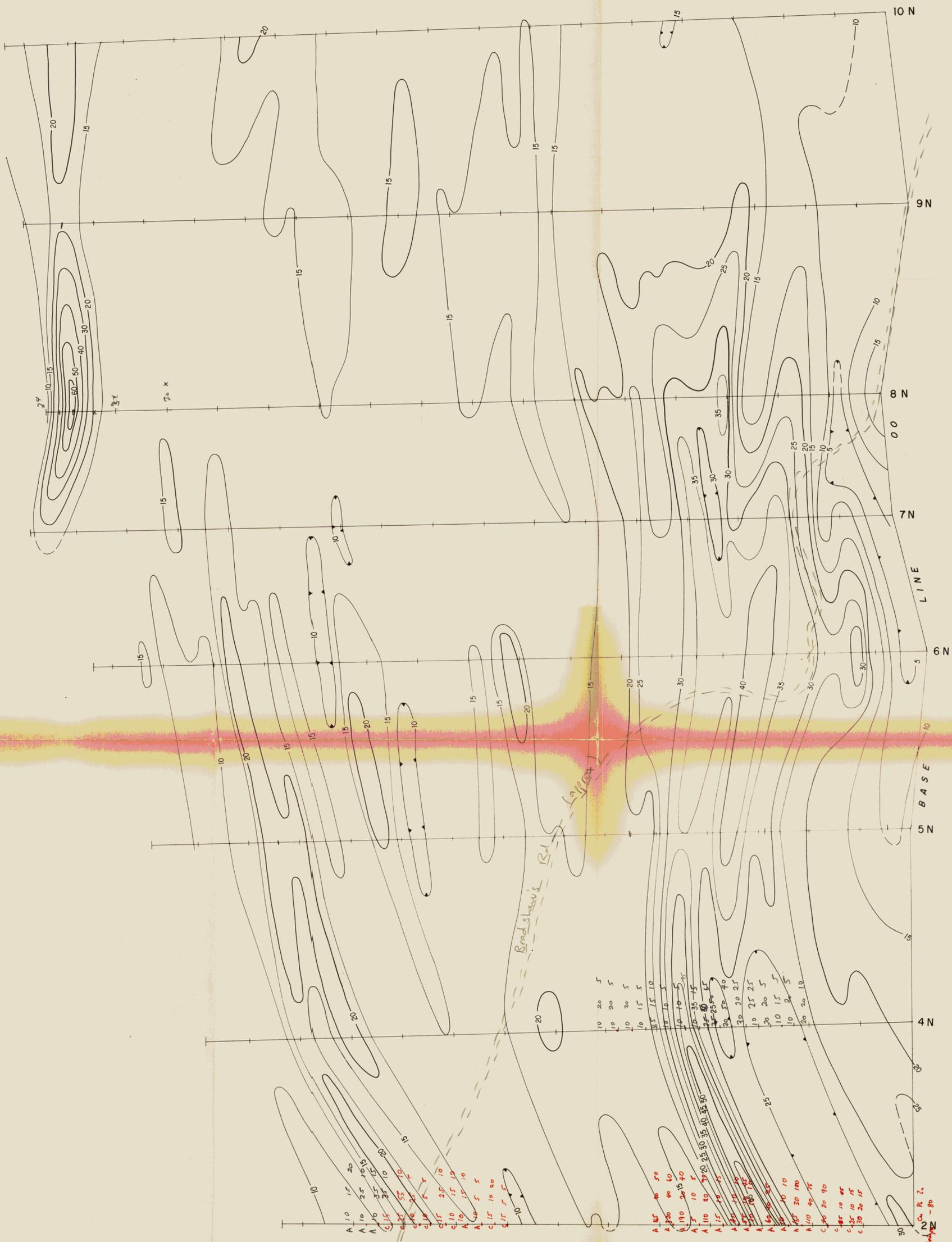
THE MOUNT LYELL
MINING AND RAILWAY COMPANY LTD.
MT. TYNDALL GRID
WEST COAST, TASMANIA
328064
AREA A
ELECTRICAL INDUCED POLARIZATION SURVEY,
(HGG-3) MERCURY SOIL SURVEY
DATA PROFILES



SURVEYED & COMPILED BY--
SCINTREX PTY. LTD.
NOVEMBER, 1974



3600 W 3400 3200 3000 2800 2600 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 00 200 400 E



LEGEND
 +-----+ 200' stations
 Chargeability low
 Contours in milliseconds

**THE MOUNT LYELL
 MINING AND RAILWAY COMPANY LTD.**
 MT. TYNDALL GRID
 WEST COAST, TASMANIA

**AREA A
 CHARGEABILITY CONTOUR MAP**

5 cm

328065

SURVEYED & COMPILED BY:-
 SCINTREX PTY. LTD.

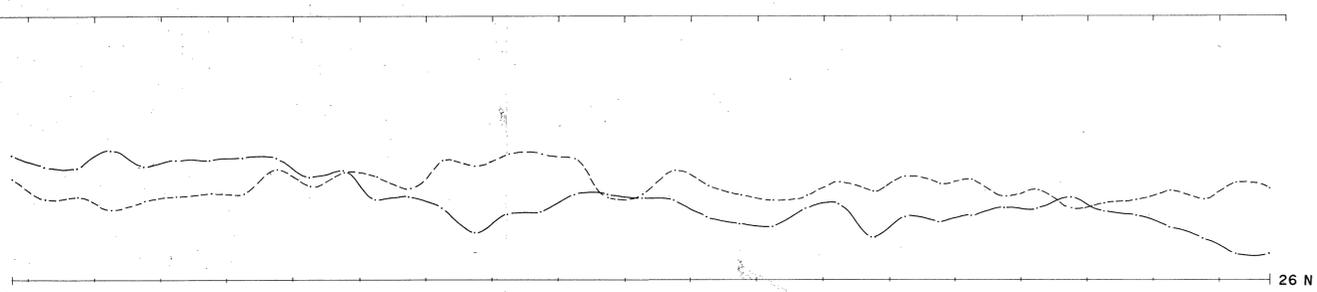
NOVEMBER, 1974



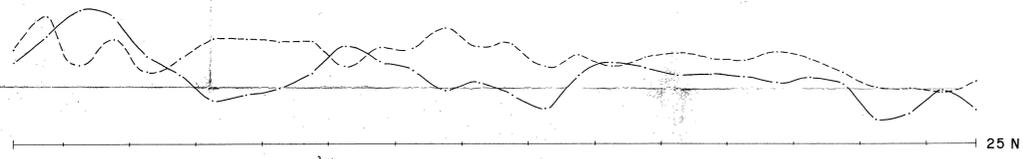
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 SCALE - 1:2400

002

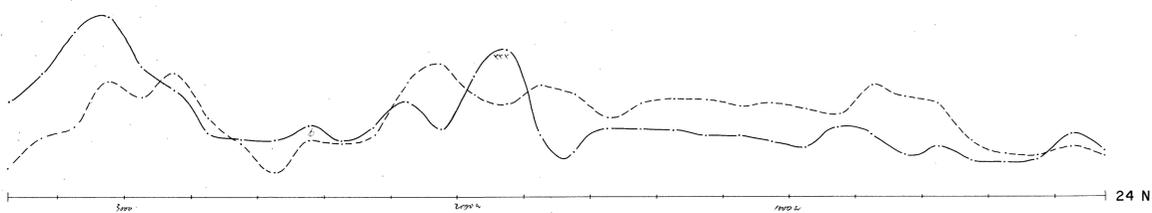
5 cm



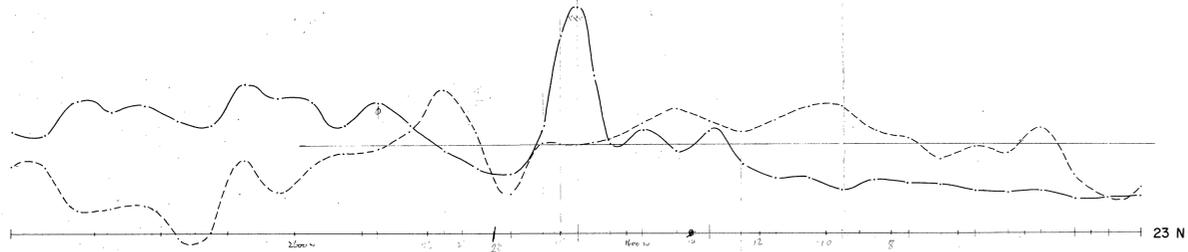
26 N



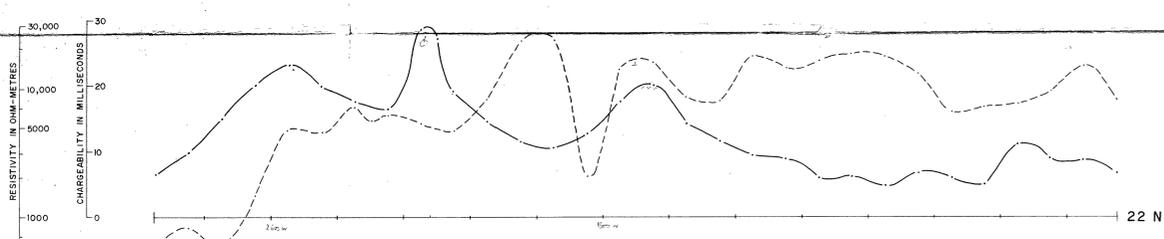
25 N



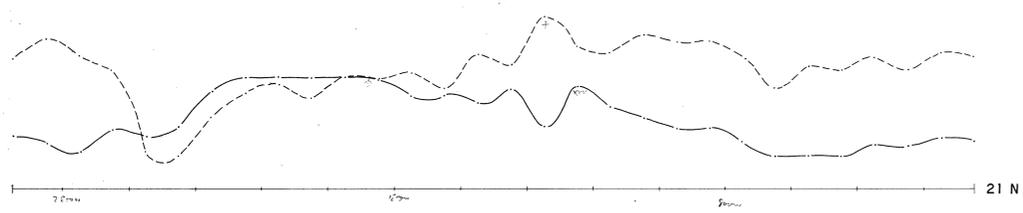
24 N



23 N

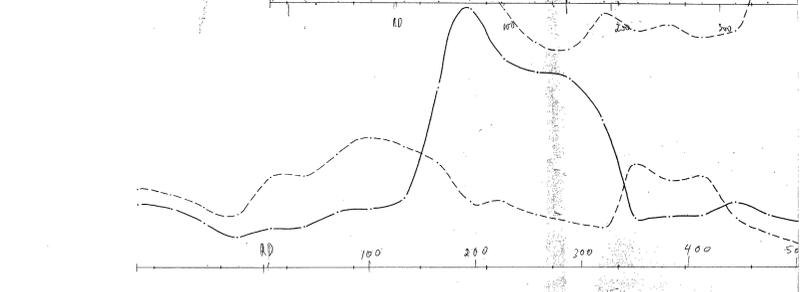
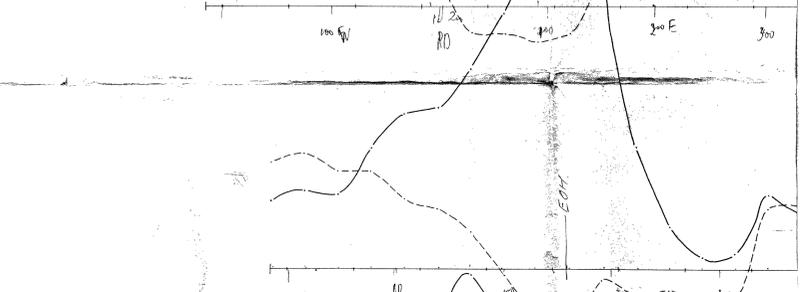
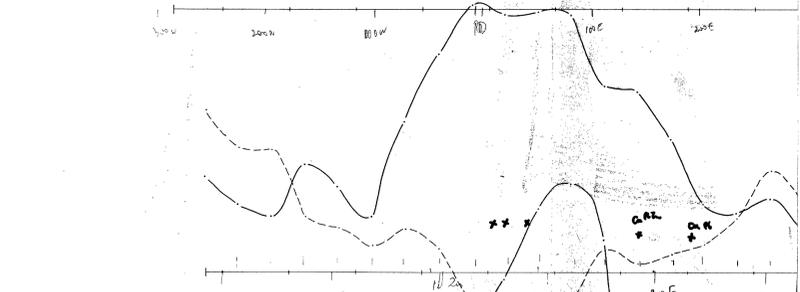
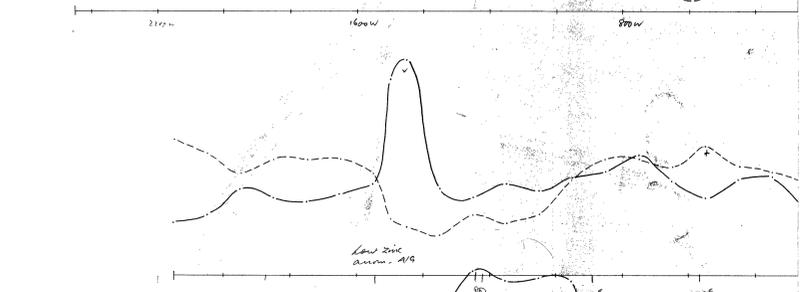
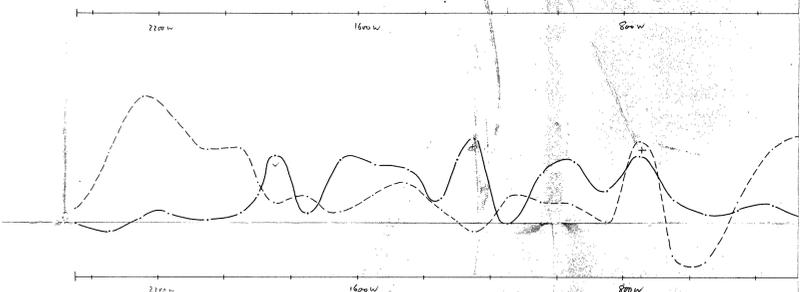
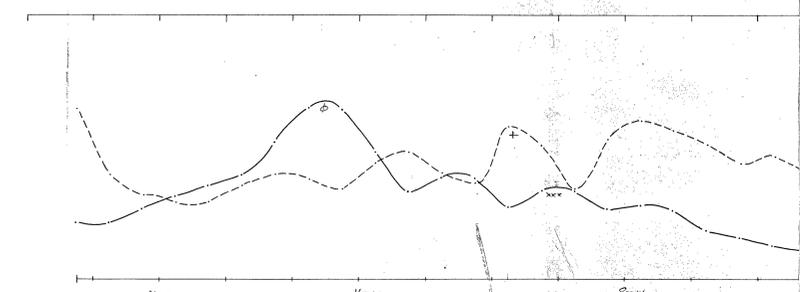


22 N



21 N

4000 W 3800 3600 3400 3200 3000 2800 2600 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 00



2600 W 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 00

LEGEND

Chargeability, 1" = 10 milliseconds
 Base level = 0
 Symbol = - - - - -

Resistivity, 2" = 1 logarithmic cycle
 Base level = 1000 ohm-metres
 Symbol = ————

THE MOUNT
 MINING AND RAILWAY
 MT. TYNDAL
 WEST COAST,

HOWARD'S ASSOCIATES
 ELECTRICAL INDUCED POLARIZATION
 DATA PROFILE

15N-26

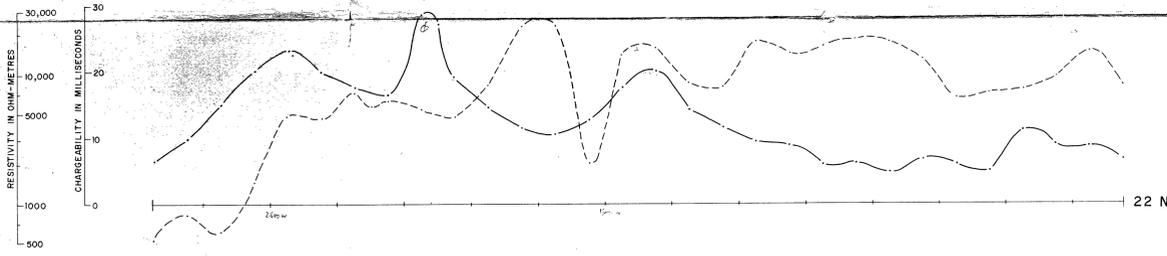
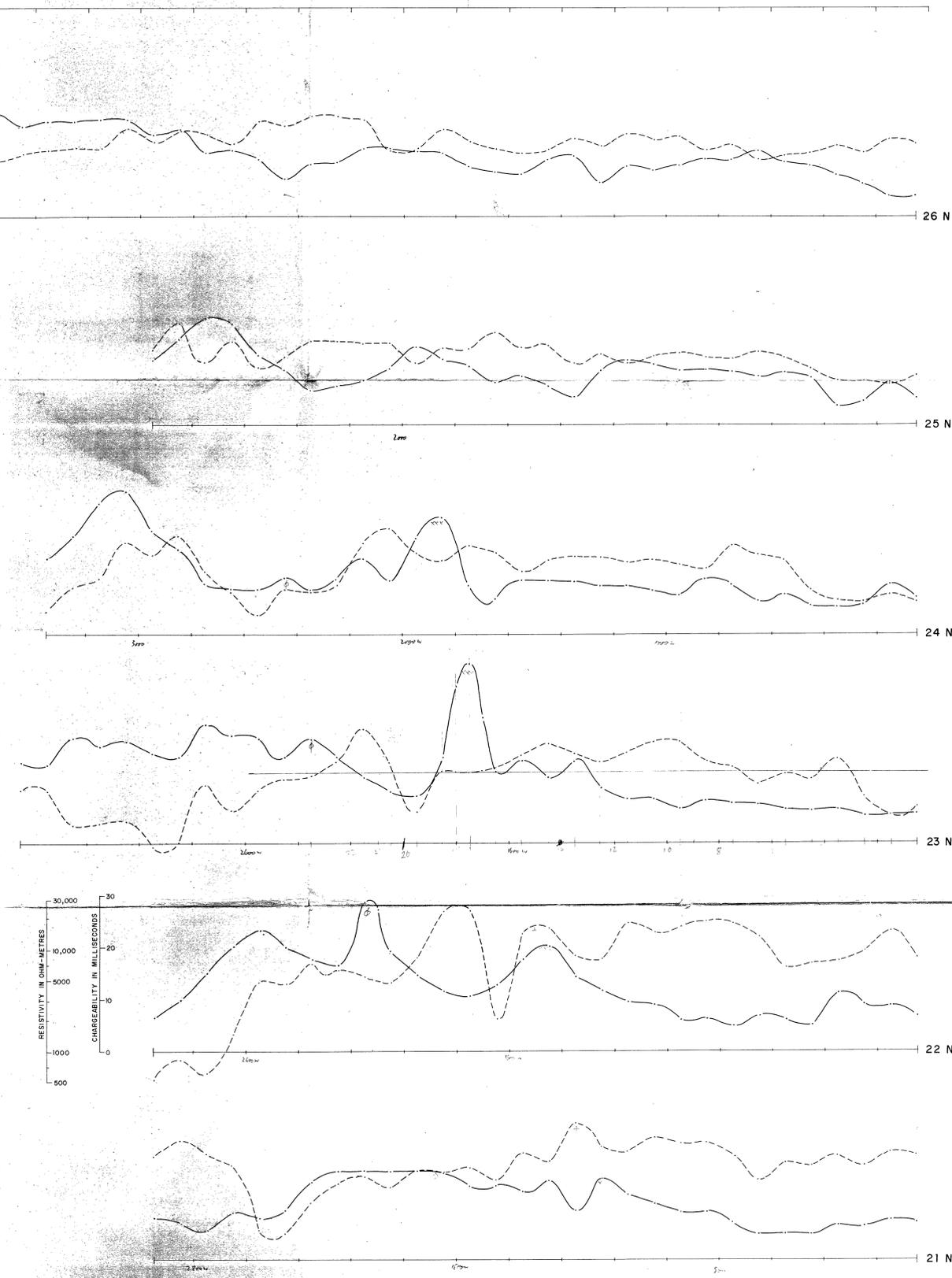
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 SCINTREX PTY. LTD.
 NOVEMBER, 1964



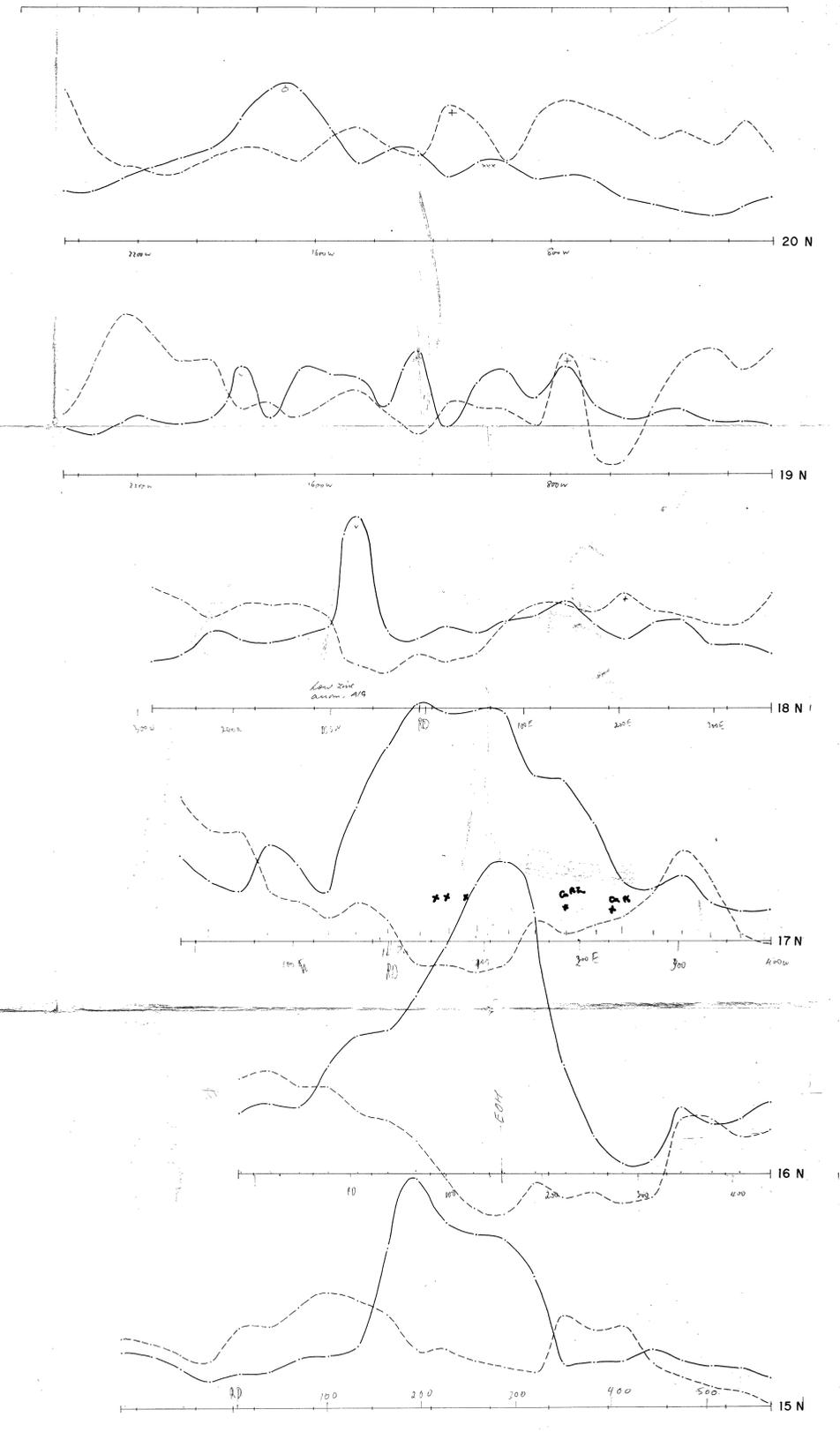
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JOB No. TAS-025 SHEET 1 of 1

5 cm



3400 3200 3000 2800 2600 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 00



2600 W 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 00

LEGEND

Chargeability, 1" = 10 milliseconds
 Base level = 0
 Symbol = - - - - -

Resistivity, 2" = 1 logarithmic cycle
 Base level = 1000 ohm-metres
 Symbol = —————

THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.

MT. TYNDALL GRID WEST COAST, TASMANIA

HOWARD'S ANOMALY
ELECTRICAL INDUCED POLARIZATION SURVEY DATA PROFILES

15N - 26N

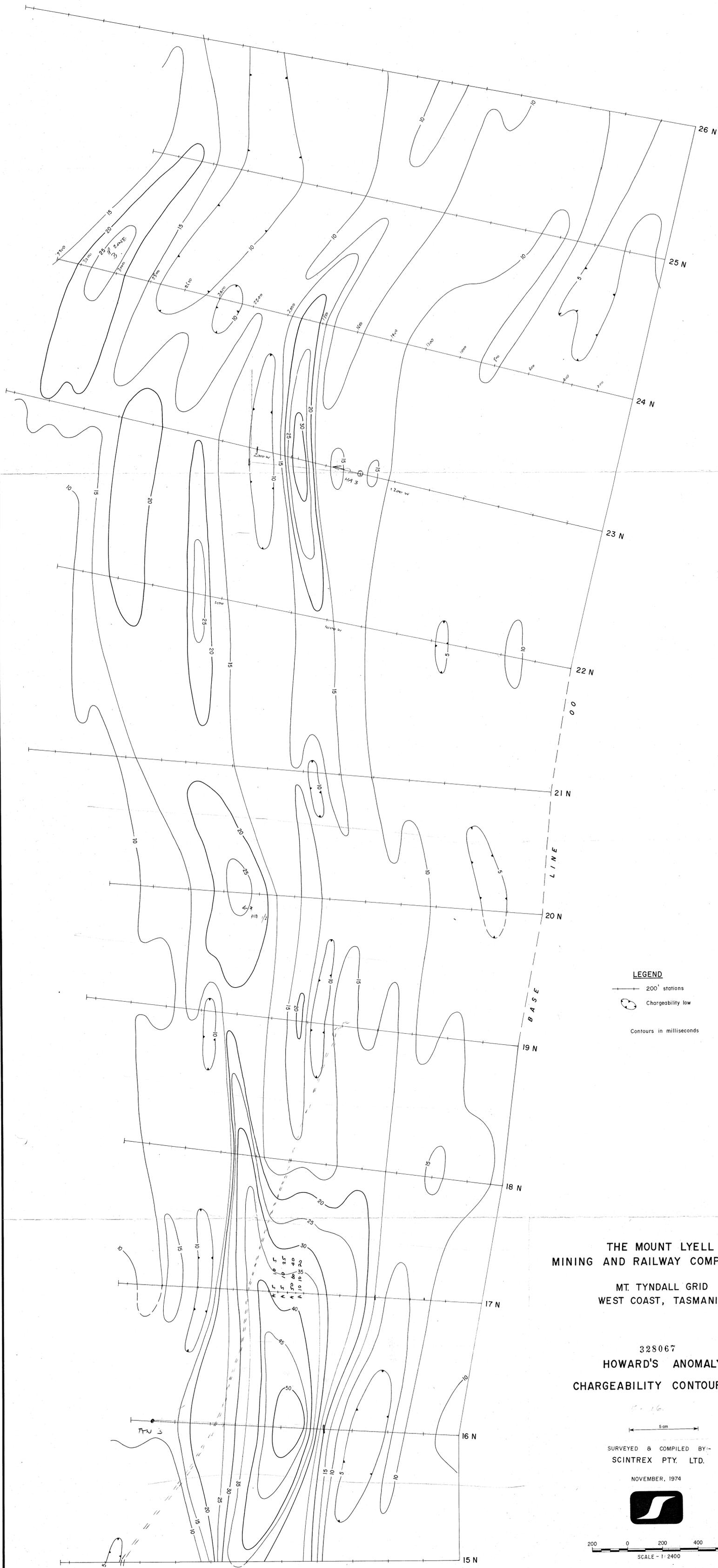
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SURVEYED & COMPILED BY:- SCINTREX PTY. LTD.

NOVEMBER, 1974 325066



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SCALE - 1:2400



LEGEND

- +— 200' stations
- Contours in milliseconds
- Chargeability low

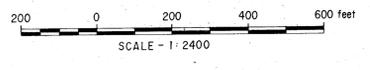
**THE MOUNT LYELL
MINING AND RAILWAY COMPANY LTD.**

MT. TYNDALL GRID
WEST COAST, TASMANIA

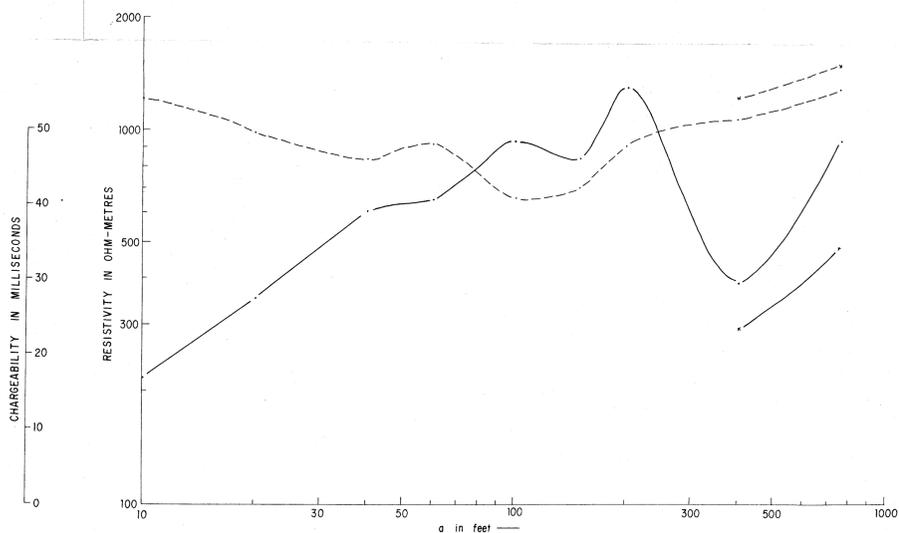
328067
**HOWARD'S ANOMALY
CHARGEABILITY CONTOUR MAP**

SURVEYED & COMPILED BY:-
SCINTREX PTY. LTD.

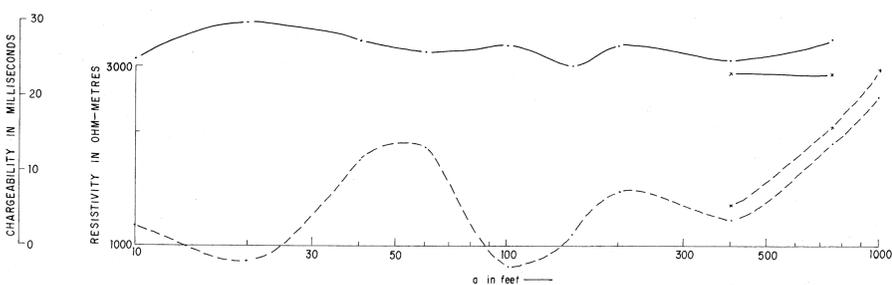
NOVEMBER, 1974



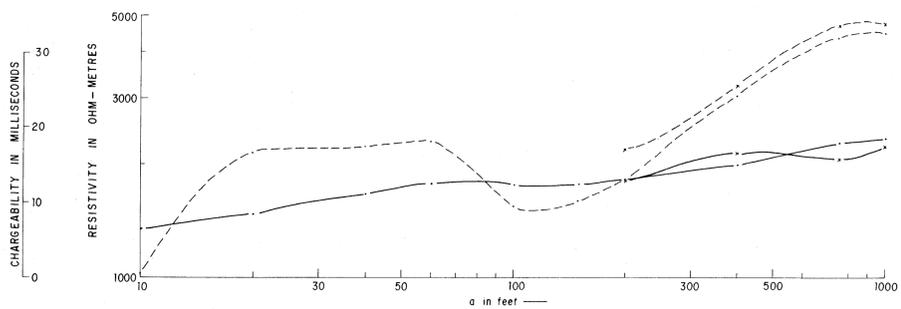
23 N/17.5 W
ALONG STRIKE



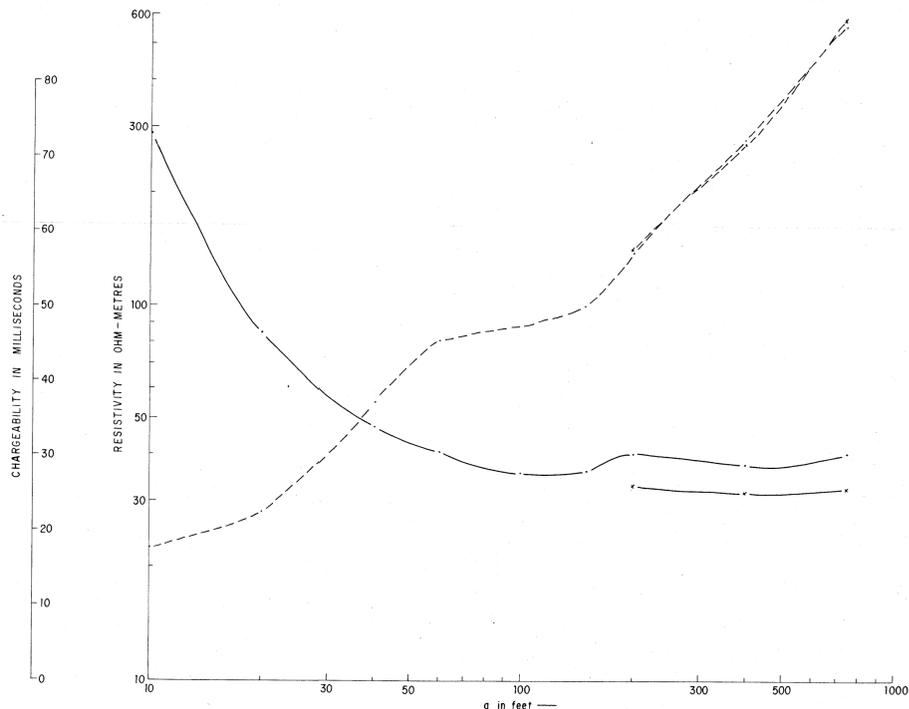
22 N/21.5 W
PERPENDICULAR TO STRIKE



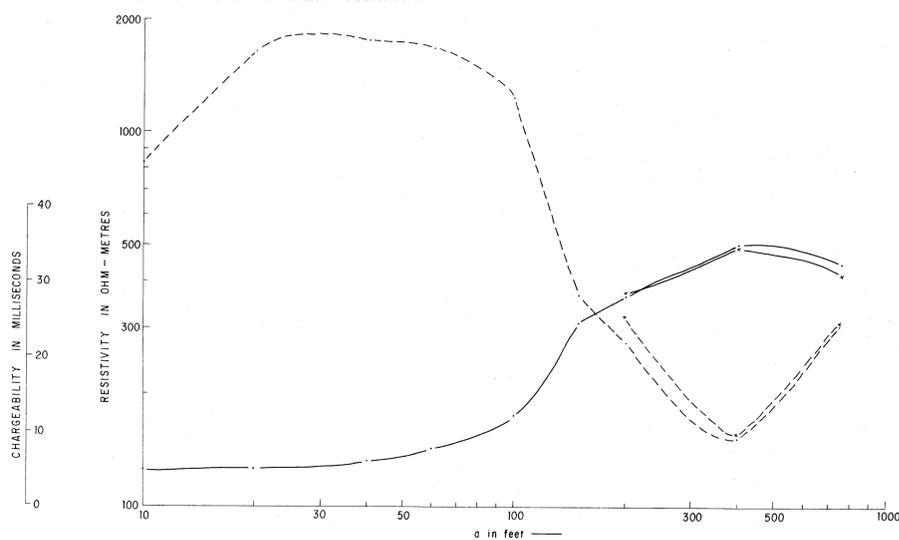
22 N/15 W
PERPENDICULAR TO STRIKE



18 N/14.75 W
PERPENDICULAR TO STRIKE



16 N/9.5 W
ALONG STRIKE



b = 3 : - - - - -
b = 5 : - - - - -

THE MOUNT LYELL
MINING AND RAILWAY COMPANY LTD.

MT TYNDALL GRID
WEST COAST, TASMANIA

HOWARD'S ANOMALY
SCHLUMBERGER ELECTRICAL SOUNDINGS
328068



SURVEYED & COMPILED BY:-
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NOVEMBER, 1974

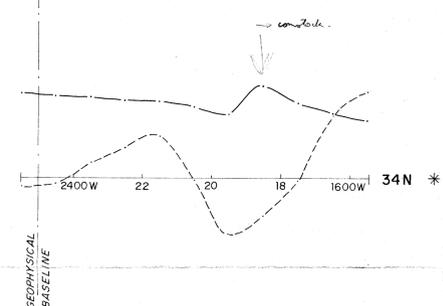
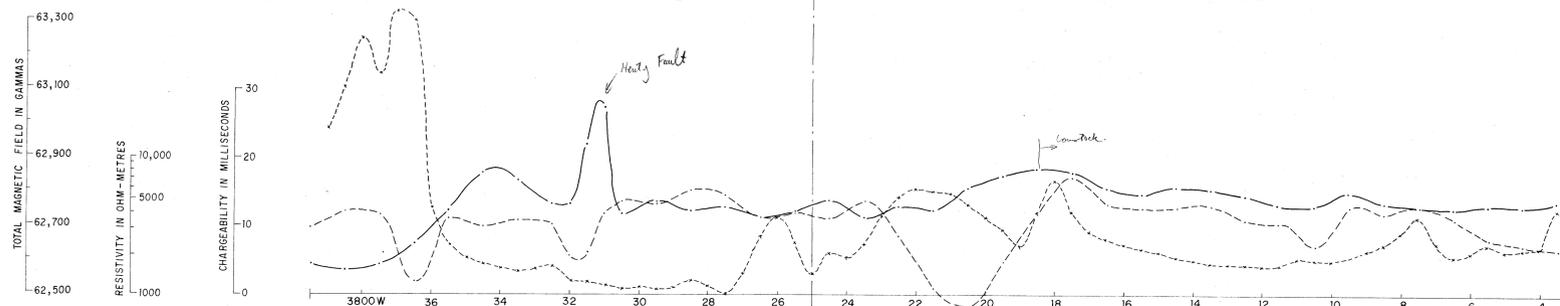
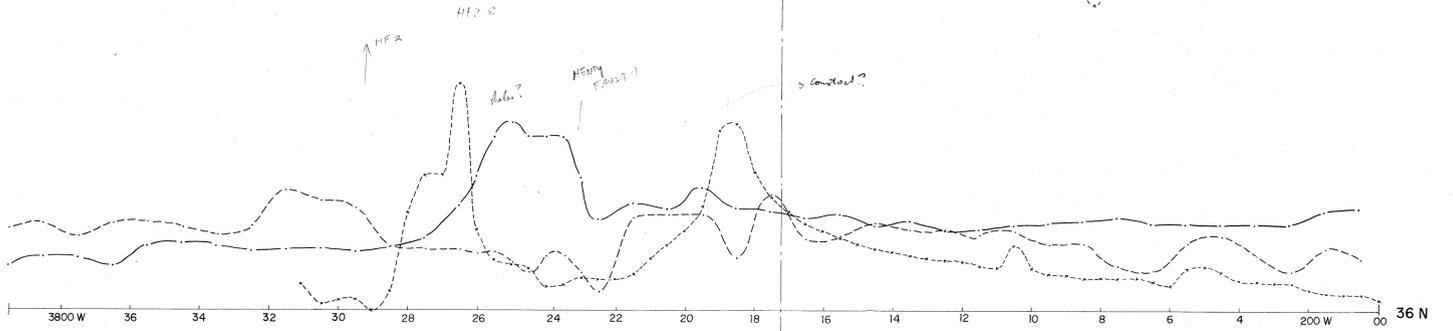
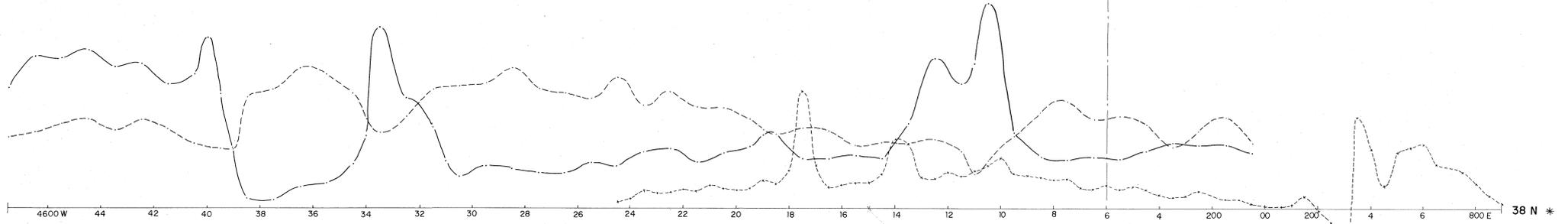
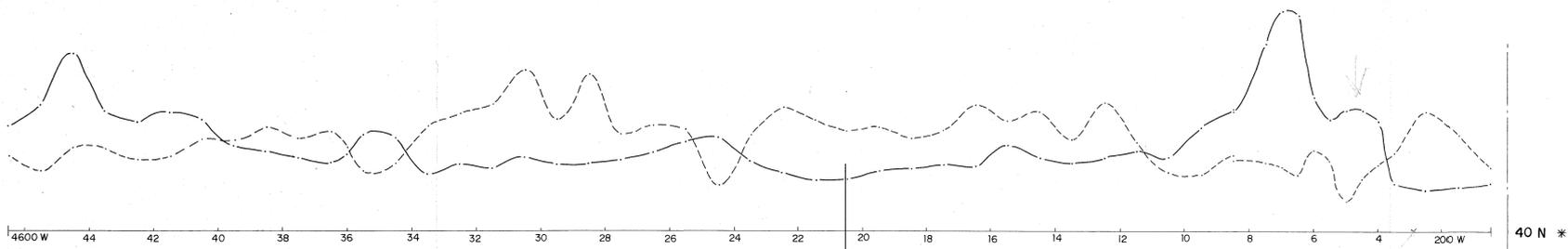


005

JOB No. : TAS-025

SHEET 1 of 1 84-2232 vol 2 PLATE 5

5 cm



LEGEND

CHARGEABILITY, $t^2 = 10$ milliseconds

Base level = 0

Symbol = ————

RESISTIVITY, $2'' = 1$ logarithmic cycle

Base level = 1000 ohm-metres

Symbol = - - - - -

TOTAL MAGNETIC FIELD, $1'' = 200$ gammas

Base level = 62,500 gammas

Symbol = ········

* = 1973 lines shown on plate 5, job TAS-018C

THE MOUNT LYELL
MINING AND RAILWAY COM

MT. TYNDALL GRID
WEST COAST, TASMAN

HF 2 South

GRADIENT ARRAY DET
DATA PROFILES

328069

5 cm

SURVEYED & COMPILED BY
SCINTREX PTY. LTD.

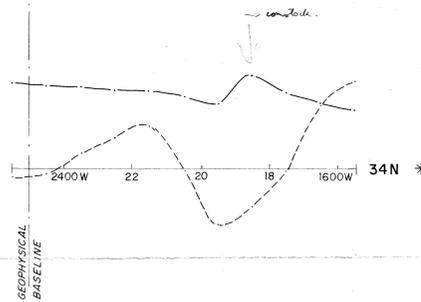
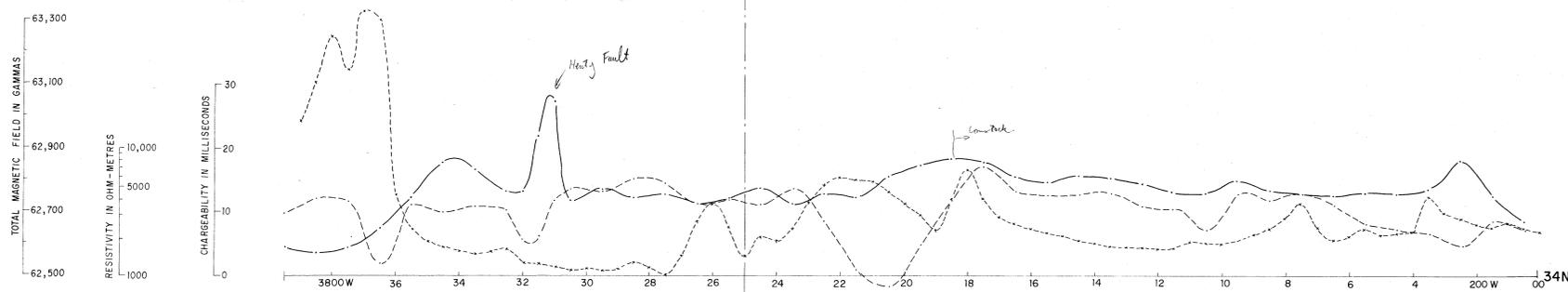
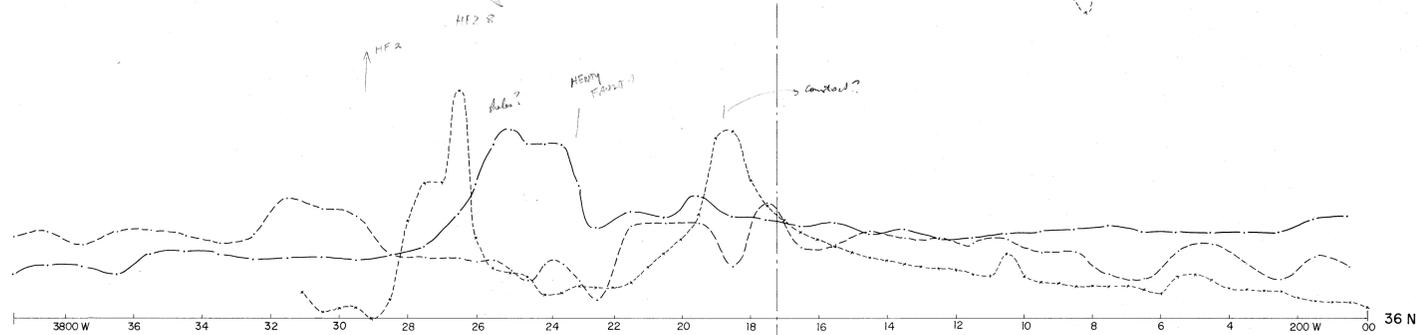
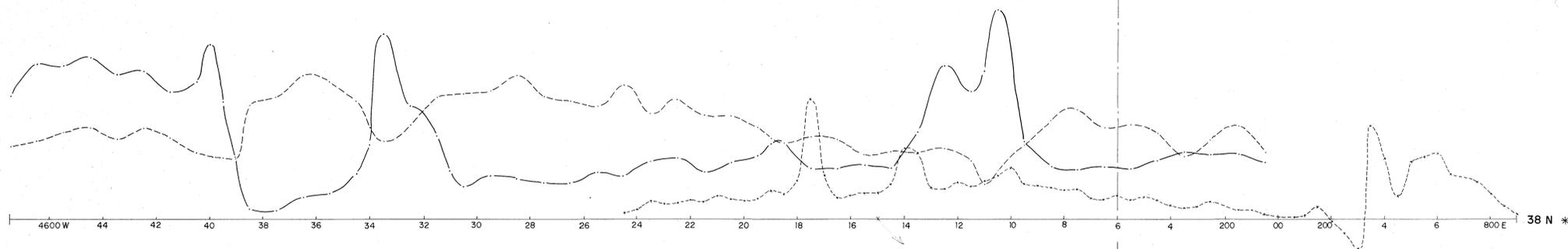
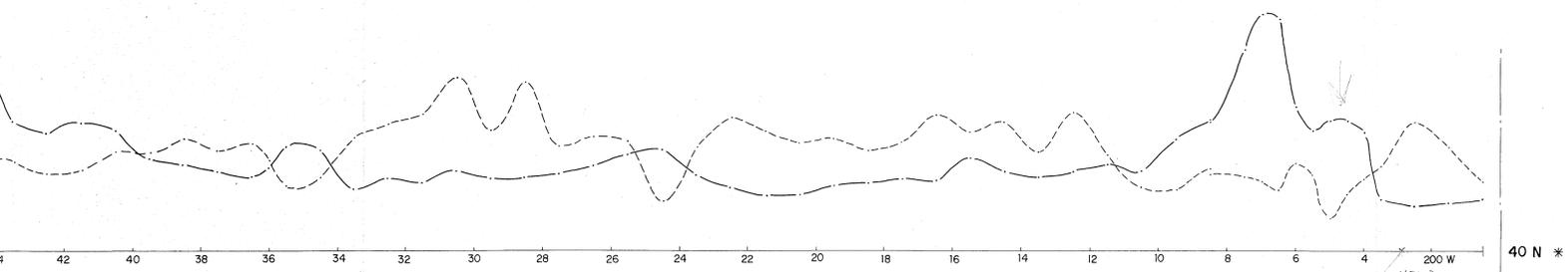
NOVEMBER, 1974



200 0 200 400
SCALE = 1:2400

JOB No. TAS-025

SHEET 1 of 1 84-2232



TOTAL MAGNETIC FIELD IN GAMMAS

RESISTIVITY IN OHM-METRES

CHARGEABILITY IN MILLISECONDS

LEGEND

CHARGEABILITY, $t^2 = 10$ milliseconds

Base level = 0

Symbol = ————

RESISTIVITY, $2^{\text{nd}} = 1$ logarithmic cycle

Base level = 1000 ohm-metres

Symbol = - - - - -

TOTAL MAGNETIC FIELD, $t^2 = 200$ gammas

Base level = 62,500 gammas

Symbol = ········

* = 1973 lines shown on plate 5, job TAS-018C

THE MOUNT LYELL
MINING AND RAILWAY COMPANY LTD.

MT. TYNDALL GRID
WEST COAST, TASMANIA

HF2 South. 34-40 N.

GRADIENT ARRAY DETAIL
DATA PROFILES

328069

5 cm

SURVEYED & COMPILED BY—
SCINTREX PTY. LTD.

NOVEMBER, 1974



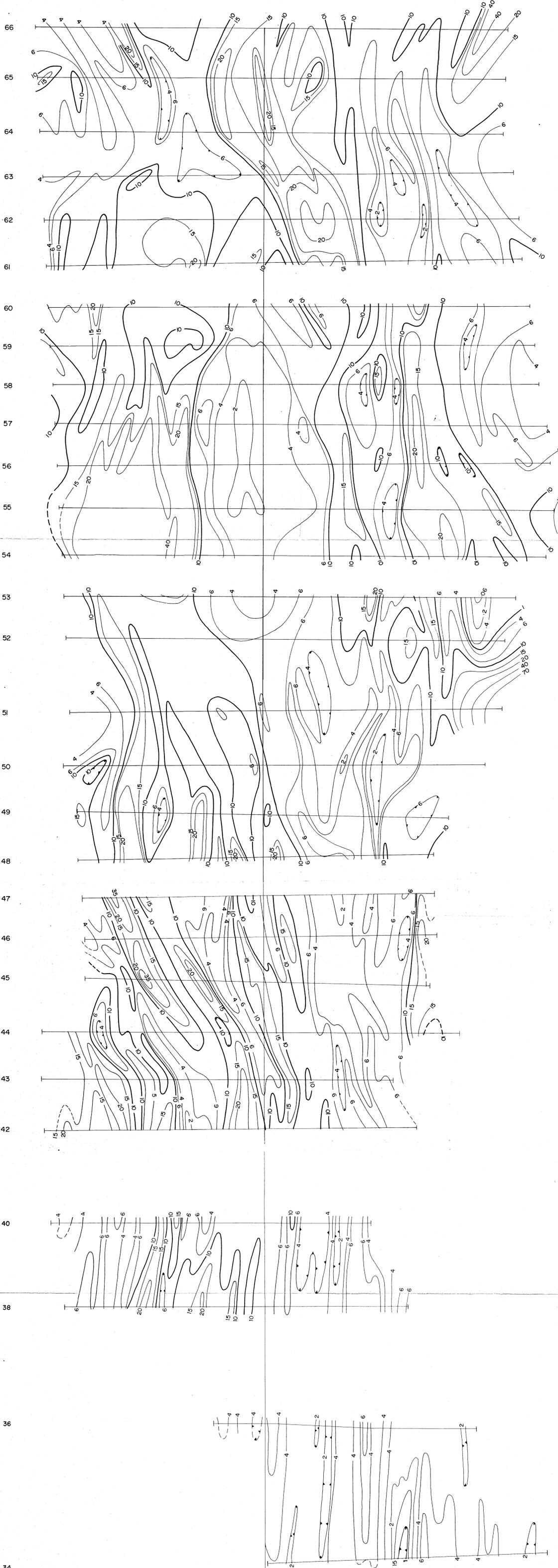
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006

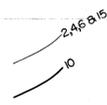
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SHEET 1 of 1 84-2232 vol 2

PLATE 6



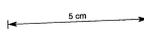
LEGEND


 CONTOUR INTERVALS IN 1,000's OF OHM-METRES
 EACH CURRENT ELECTRODE PAIR SEPARATELY CONTOURED

THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.

**MT. TYNDALL GRID
WEST COAST, TASMANIA**

**328070
GRADIENT ARRAY RESISTIVITY
CONTOUR MAP**

178 34-66N
 478

 5 cm

SURVEYED AND COMPILED BY
SCINTREX PTY. LTD.

JAN-FEB '73, DEC '73-MARCH '74, OCT-DEC '74




 Scale in feet