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MAJOR MINING LIMITED

EXPLORATION LICENCE 28/88 - ZEEHAN

SECOND ANNUAL REPORT FOR PERIOD 1ST NOVEMBER, 1989 TO 31ST OCTOBER 1990

November, 1990

420002

MAJOR MINING LIMITED

EXPLORATION LICENCE 28/88 - ZEEHAN

SECOND ANNUAL REPORT FOR PERIOD 1ST NOVEMBER, 1989 TO 31ST OCTOBER 1990

90-3204 V 1/3
COPY 1

Major Mining Limited,
P.O. Box 510,
Rockdale NSW 2216

November, 1990

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INTRODUCTION

During the first year, on 19th May, 1989, Major Mining Limited acquired the Exploration Licences EL 28/88, EL 3/89, EL 5/89, EL 13/89 (Zeehan) from His Grace, The Most Noble, the Duke of Avram. These licences were subsequently consolidated into one, namely, EL 28/88.

During the period after acquisition by Major, a preliminary investigatory geophysical survey was carried out over the exploration licence and over the Comstock lode in the adjacent exploration lease. These surveys were designed to act as pathfinder surveys for the summer exploration season which commenced at the beginning of the second year, namely mid-November to 12th December, 1989.

EXPLORATION PHILOSOPHY

The main thrust of the company's exploration efforts are directed to locating deposits of the 'Comstock Lode' type with the objective of exploiting their small to medium tonnage high grade deposits.

Geophysical methods will be employed to search for such deposits. It was intended that any significant anomalies will be further investigated by trenching and/or drilling.

The basis for the above approach is derived from the following information:

Geology

A thick sequence of Proterozoic sediments in the form of a complex anticlinorium is exposed in the Zeehan area. The sequence is predominantly Oonah quartzite. These sequences are followed by the Crimson Creek Formation and Dundas groups of sediments of Cambrian age. Sequences of Ordovician Gordon limestones followed.

Mineralisation

The Zeehan district has several distinct mineral deposit types:

Tin deposits occur within and in close proximity to the contact of the intrusive Devonian Heemskirk granite. The mineralisation consists of fissure veins and replacements of cassiterite-pyrrhotite-pyrite. these don't occur near the Heemskirk Granite

Lead-silver-zinc The bulk of lodes occur as fracture fillings having a north-north-west strike and are most often adjacent to west-north-west faults. While the actual tonnages of individual deposits were recorded as small (50,000-200,000t), the grades were extremely high, with combined lead-zinc grades well in excess of 20% being common, with high silver content (e.g. 12 oz/ton from the Spray Mine).

Zinc Carbonate hosted lead zone deposits which some workers have inferred could be similar to the Irish type deposits, are a legitimate target within the Gordon Limestone areas.

Mining History

The **Zeehan Field** was the scene of active mining during the period 1886 until the end of World War I. The chief mines were Silver Queen, Western and Oceana with many smaller deposits also being mined such as Comstock, Sylvesters, Tasmania, Swansea etc. The majority of production was silver and lead, with zinc not being able to be extracted from the ore. Production has been intermittent with the Oceana Mine within the Gordon Limestone closing in 1960.

The **Heemskirk Tin Field** has been worked from 1876 until prior to World War II. The main deposit was the Federation Mine, with numerous smaller deposits having been intermittently mined for the last 100 years.

Summary

1 The area is highly prospective for additional high grade zinc, lead, silver lode deposits of the Comstock type, and it is intended that geophysical methods will be applied to their discovery.

2 The Gordon Limestone areas will be explored for lead-zinc deposits of the "Irish"type, again using geophysical methods as the primary tool.

3 Further geological mapping of the southern margin of the Heemskirk Granite followed by geological and geophysical surveys over selected targets is programmed.

WORK CARRIED OUT DURING THE REPORTING PERIOD

During the first year (May to October, 1989), the work carried out by Major Mining Limited consisted of:

1) A study of the available data (which is continuing)
2) A geophysical survey over the Comstock Lode in the adjacent ML, and for 1000 metres east into EL 28/88.

Note: No details of work carried out to the date of transfer of leases is available to Major Mining Limited.

During the second year the geophysical grid was extended further to the south-east from line 4000N to 3200N along a baseline established at 1400E.

The work carried out consisted of self-potential, electrical induced polarization and resistivity, the latter in the gradient mode.

SURVEY DETAILS

For a detailed discussion of the geophysical results prepared by Scintrex Pty. Ltd. on behalf of Major Mining Limited see the report forwarded with the March quarterly report.

CONCLUSIONS AND RECOMMENDATIONS

These are detailed in the report referred to above, however, anomalies worthy of further investigation by trenching or shallow drilling were defined.

PROPOSED FUTURE WORK

Further work will include the investigation of the geophysical anomalies defined in the present survey, and should these so warrant, an extension of the geophysical work.

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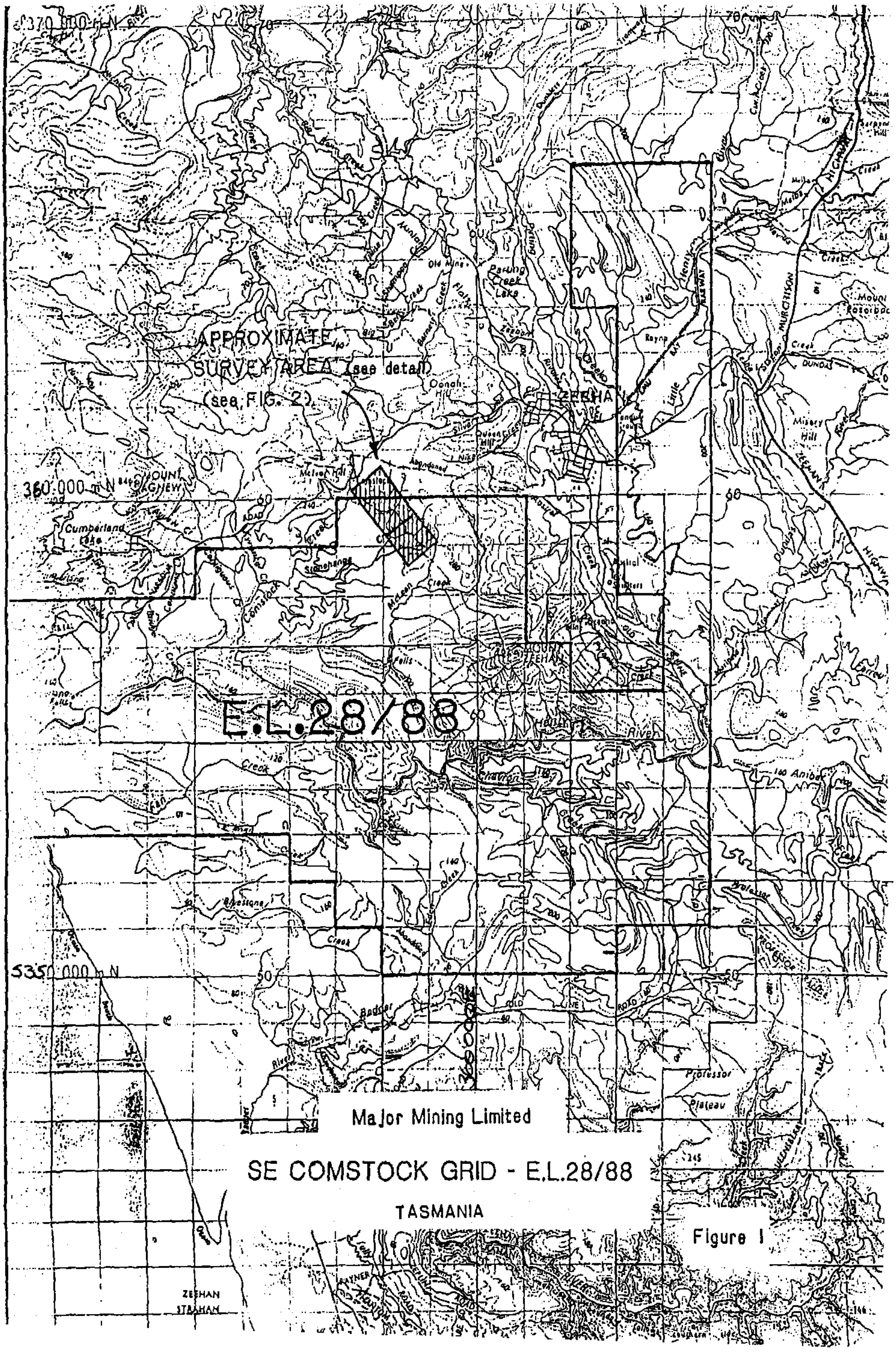
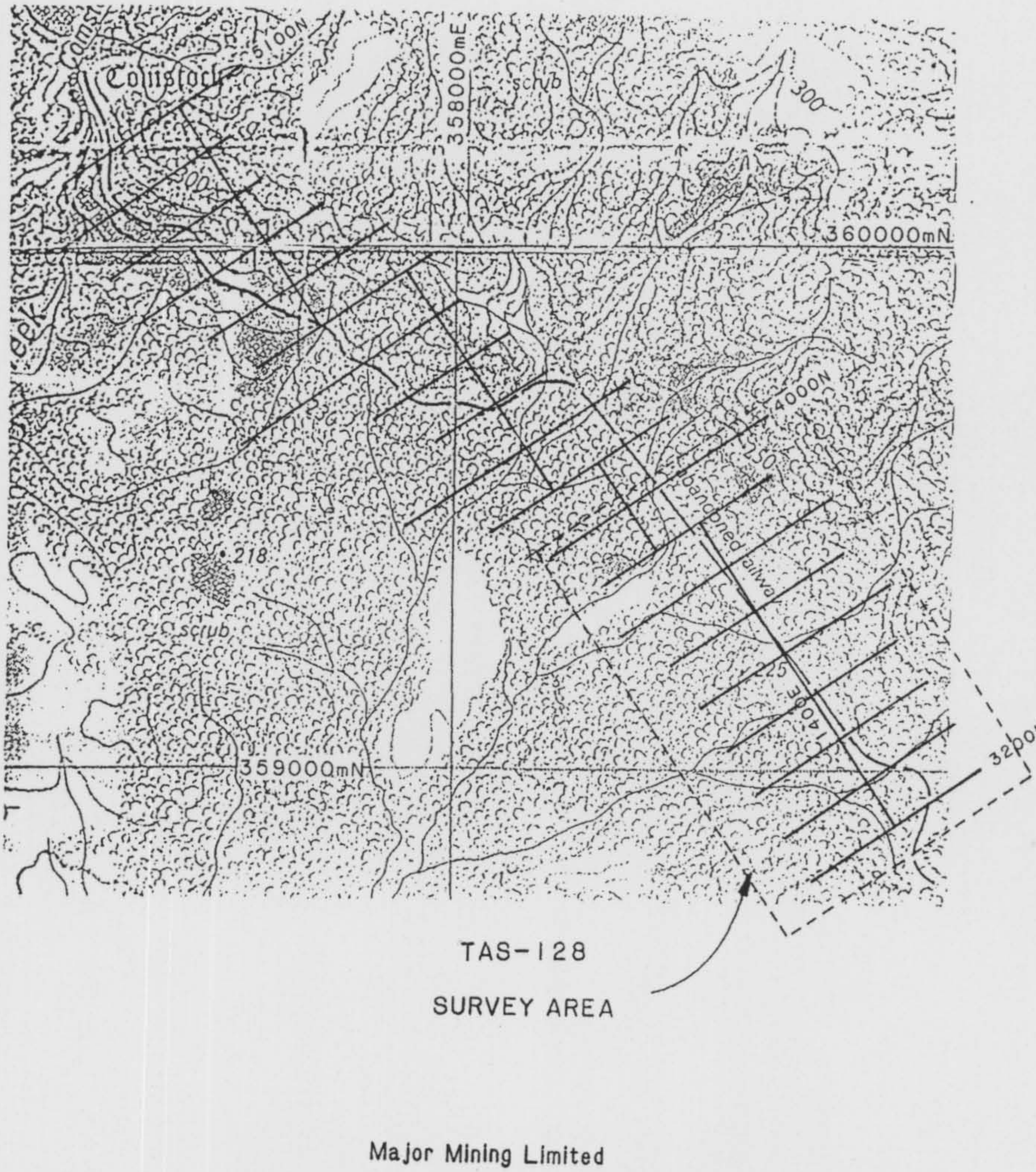


Major Mining Limited

SE COMSTOCK GRID - E.L.28/88

TASMANIA

Figure 1



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SURVEY AREA

Major Mining Limited

SE COMSTOCK AREA - E.L.28/88

TASMANIA

Figure 2

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A REPORT ON

GEOPHYSICAL TEST SURVEYS

OVER THE COMSTOCK LEAD ZINC SILVER LODE

AND AREAS TO THE EAST THEREOF

WITHIN E.L. 28/88, ZEEHAN AREA, TASMANIA

ON BEHALF OF

MAJOR MINING LIMITED

TCR 90-3204 V 2/3

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420010

PRIVATE AND CONFIDENTIAL

A REPORT ON GEOPHYSICAL TEST SURVEYS OVER THE COMSTOCK LEAD ZINC SILVER LODE AND AREAS TO THE EAST THEREOF WITHIN E.L. 28/88, ZEEHAN AREA, TASMANIA ON BEHALF OF MAJOR MINING LIMITED

BY

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SYDNEY, N.S.W.

OCTOBER, 1989

TAS-127

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CONTENTS

SUMMARY

A geophysical test survey over the Comstock Lode involving the self-potential, induced polarization, resistivity and gravity methods, has revealed a significant series of anomalies at Comstock.

A reconnaissance survey run to the grid south-east, has located two anomalies of interest. "Area A' is of greatest interest and "Area B" of lesser interest. Both warrant further investigation by trenching.

Further self-potential surveys are recommended as a reconnaissance method within the exploration licence. Anomalies should be followed up by electrical induced polarization and (perhaps) by gravity methods.

INTRODUCTION

At the request of Dr. F. Corbett, Chairman of Major Mining Limited, Scintrex Pty. Ltd. executed a series of test surveys over the Comstock lode within ML 123M/47 and along strike thereof in order to assess the use of the self-potential, resistivity, induced polarization and gravity methods in the search for lodes of the Comstock type.

The work was carried out by Scintrex Pty. Ltd. geophysicist Mr. P. Brown,BSc. and assisted by geophysicist Mr. M. Joint,BSc. over some ten production days between 20th July and 9th August, 1989. The author visited the area during the execution of the survey.

The work over the Comstock Lode was carried out with the kind permission of Mr. M. Bendall, Principal of Oceania Tas. Pty. Ltd., (the licence holder subject to transfer from Electrolytic Zinc).

THE GRID

The geophysical grid was established as a reconnaissance grid only, with the north-west south-east baselines being pegged at 100 metre intervals with 2 metres star pickets, with the traverses being marked by flagging only, except for that section of the traverses which joins the three staggered baselines.
The lines were positioned at 045° magnetic.

The approximate boundary between ML 123M/47 has been marked on all geophysical maps.

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NATURE OF MINERALISATION

The predominant minerals within the lode material consist of sphalerite, galena and pyrite with the former making up about 20%-30% of the bulk. Simple resistance measurements at the pit showed values of the order of 1000 ohm-metres. While the tests were not exhaustive, the clear inference is that the mineralisation would not be expected to be conductive or be seen as a significant conductor in any EIP, MIP or EM geophysical method.

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BRIEF NOTES ON THE METHODS

As it was understood that a distinct self-potential anomaly was associated with the Comstock Lode, this was the first method considered. As the test survey has demonstrated, there is in fact a distinct self-potential anomaly of about 500 millivolts. It is also understood that a similar anomaly exists over the Sylvester Lode.

There are two considerations arising from the above, namely,

a) The apparently high resistivity within the sphalerite rich lode material, and

b) Over the topographically low areas, there are areas of water-logged button grass plains.

The former may, in areas of high internal resistivity, preclude a self-potential anomaly being formed, while conductive near surface waters within the boggy areas will similarly preclude the formation of self-potential anomalies.

Therefore, while the self potential method can be applied quite effectively in the area as a whole, those areas which are overlain by waterlogged glacials or alluvium cannot be considered to have been exhaustively covered. In addition, those deposits which do not have sufficient electronic conduction within the body to allow the oxidation/reduction reaction to proceed, similarly will not be detected by the method.

Also, as graphitic shales exhibit self-potential, self-potential anomalies can have non-economic sources.

The other methods used in the test surveys were Electrical Induced Polarization (EIP) in the gradient geometry, and a gravity line over each of the very small areas over which EIP was carried out.

DISCUSSION OF RESULTS

The Comstock Lode Area

The **self- potential survey** was carried out over the Oceania Pty. Ltd. ground between the south-eastern flank of the Comstock pit and the boundary of the Major Mining Limited ground to the south-east. The data is shown in contour format on Plate 1, at the scale of 1:2500 and shows a distinct negative self-potential anomaly of about 500 millivolts over the zone, thus confirming the self-potential anomaly.

Within the Oceania ground, a further significant anomaly of 500 millivolts was defined at 925E on line 4900N, very close to the Majors grid. A further response of about 300 millivolts was defined at 850E on line 5000N. While both these responses have been contoured trending south-east north-west, the wide reconnaissance spacing together with the short wavelength of events along the survey lines makes this an unreliable guide to strike and extent. It would appear that lines at least 50 metres apart will be required to detail these anomalies. Bearing in mind these limitations, the areas of interest for further investigation are shown in red on the contour map. Those areas within the Oceania Pty. Ltd. area are worthy of further investigation.

A very limited **electrical induced polarization (EIP) survey** was conducted over the Comstock open pit. Time did not permit a comprehensive survey.

The electrode separation used was 200 metres, with the gradient current dipole placed at 5000N/1150E and 5100N/850E. Short sections of lines 5050N, 5100N and 5150N were surveyed at 25 metre intervals using a 20 metre potential dipole.

The observed resistivities are quite low ranging from less than 10 ohm-metres to in excess of 70 ohm-metres. While the scope of the survey was too limited to reach concise conclusions, the low resistivities appear to be associated with the mineralisation and their enclosing rocks.

The electrical induced polarization data shows a range of values between 70 millivolts/volt (at 900E/5150N and at 1060E/5050N) and 33 millivolts/volt. The contour presentation suggests that the polarization over the pit itself is slightly less (33 to 42 millivolts/volt) than the immediate surroundings, but since the detailed geology is not available, it could be that the sphalerite rich zone is less polarizable than the surrounding sulphide (graphite?) halo.

A single gravity line was run between 900E and 1020E on line 5100N. The terrain corrected data shows a sharp gravity response of about 0.3 milligals over the pit, and a further similar maximum inferred at or to the west of 900E.

Conclusions

From the limited survey carried out over the Comstock Lode it can be concluded that:-

1 There is a distinct self-potential anomaly associated with the Comstock Lode. The high resistivity of the sphalerite rich samples implies that the anomaly may be generated by the conductive sulphide sections (and/or graphite) associated with the mineralisation.

2 Anomalously low resistivities were recorded over the Comstock Lode area, with the lowest (10 to 20 ohm-metres) being to the immediate east and west of the body.

3 The induced polarization data shows the whole of the test area to have levels two to four times normal background, with the highest values lying outside the known mineralisation (but still being twice background over it). This suggests that disseminated sulphides (and/or graphite) may be responsible for the higher polarization, with the lower

polarization over the body itself being due to the higher volume of non-polarizable sphalerite.

4 A small, but quite definite 0.3 milligal gravity anomaly was discerned from the terrain corrected data.

It is thus concluded that further geophysical exploration for similar bodies could consist of:

a) Reconnaissance self potential surveys at 100 metre line intervals, locally to 50 metres for detail over areas where water-logged glacials will not render the data unreliable.

b) Localised EIP surveys in the gradient array, but over a slightly larger area to gauge background and structure, and, **perhaps**

c) localised gravity surveys.

In (a) to (c) above, the limitations of self-potential anomalies from graphite, the possibility of no self-potential anomaly over water-logged glacials, and from zinc rich sources, should be borne in mind when reviewing the data on a progressive basis.

Surveys to South-East of Comstock

A **self potential** survey was carried out extending from the north-west corner of EL28/88 for about 1000 metres to the south-east. The grid lines were put in in a south-west north-east orientation at right angles to the presumed strike. The self potential survey was carried over three sections; lines 5100N to 4600N, 4600N to 4200N and from 4200N to 3900N.

Area A

The most significant series of anomalies occurred in the south-east of the area, and the maximum trended across the lines with an east west strike. The anomaly was defined as follows:

Line 4200N	absent	
Line 4150N	1090E and 1110E	(200 millivolts)
Line 4100N	1120E and 1160E	(150 millivolts)
Line 4050N	1165E	(140 millivolts)
Line 4000N	1250E	(120 millivolts)
Line 3900N	1360E	(70 millivolts)

Old workings were recorded on the most northerly lines, 4100N and 4150N.

A very limited EIP survey was carried out over the three lines 4150N, 4100N and 4050N with the energising current electrode placed on line 4100N at 1000E and 1300E. Each of the two self potential maxima have an associated electrical induced polarization anomaly. In the west, the self potential anomaly centred from 1100E/4150N to 1120E on 4100N has a 45 millivolts/volt response situated parallel to, and 40 metres to the west. The second discrete self-potential response recorded on line 4100N at 1160E to 1165E on 4050N is almost coincident with a 35 to 37 millivolts/volt EIP response. While the self-potential data **implies** an extension to the east of 300 metres, no EIP was carried out to check this.

Unlike the Comstock area, the resistivities recorded were much higher being from 200 ohm-metres to 300 ohm-metres.

The gravity survey located an anomalous response of 0.4 milligals, about the same order as at Comstock, centred at 1110E with a lesser peak of 0.3 milligals at 1140E.

The anomaly in Area A would appear to warrant further investigation by trenching as it has a self-potential response, induced polarization anomaly and a gravity signature similar to that observed at Comstock.

Area B

A self potential anomaly centred at 1220E on line 4600N and extending across lines 4550N, 4500N to line 4400N at 1300E was recorded which was up to 200 millivolts negative with respect to local background. This significant anomaly is inferred to have a parallel source trending east from 1250E/4600N.

The first zone noted above, showed up as an abnormally low **resistivity** of 15 ohm-metres (on line 4550N) on the small gradient array set up for the purpose of checking the self-potential anomaly. The **electrical induced polarization** response over the self-potential negative was highly variable. A 54 millivolts/volt reading was obtained on line 4550N coincident with the self potential zone, with very variable readings from 50 millivolts/volt to 26 millivolts/volt being recorded to the west of the self-potential anomaly.

A short **gravity** line run from 1150E to 1270E on line 4550N showed a local increase of 0.15 milligals, about half that seen over Comstock. This is centred at 1230E coincident with the highest self-potential maximum.

While worthy of ground follow-up by trenching, the anomaly in Area B is of secondary interest to that defined in Area A.

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CONCLUSIONS AND RECOMMENDATIONS

1 The Comstock Lode is seen as giving a moderate self potential field of 500 millivolts, a gravity high of 0.3 milligals, low resistivities of 20 ohm-metres ±, and is surrounded by an induced polarization high.

2 In the reconnaissance survey of EL 28/8, two areas having similar characteristics are designated Area A, while a zone of lesser interest has been designated Area B. Both are recommended for investigation by trenching as, to a greater and lesser extent respectively, they have the characteristics of the Comstock Lode.

3 On the present evidence it would appear that self-potential at 100 metre/50 metre line intervals, followed up by limited electrical induced polarization (and perhaps gravity) would be a reasonable geophysical approach to locate "Comstock Type" bodies, always bearing in mind the limitation imposed by the method, the body characteristics, and environment.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.

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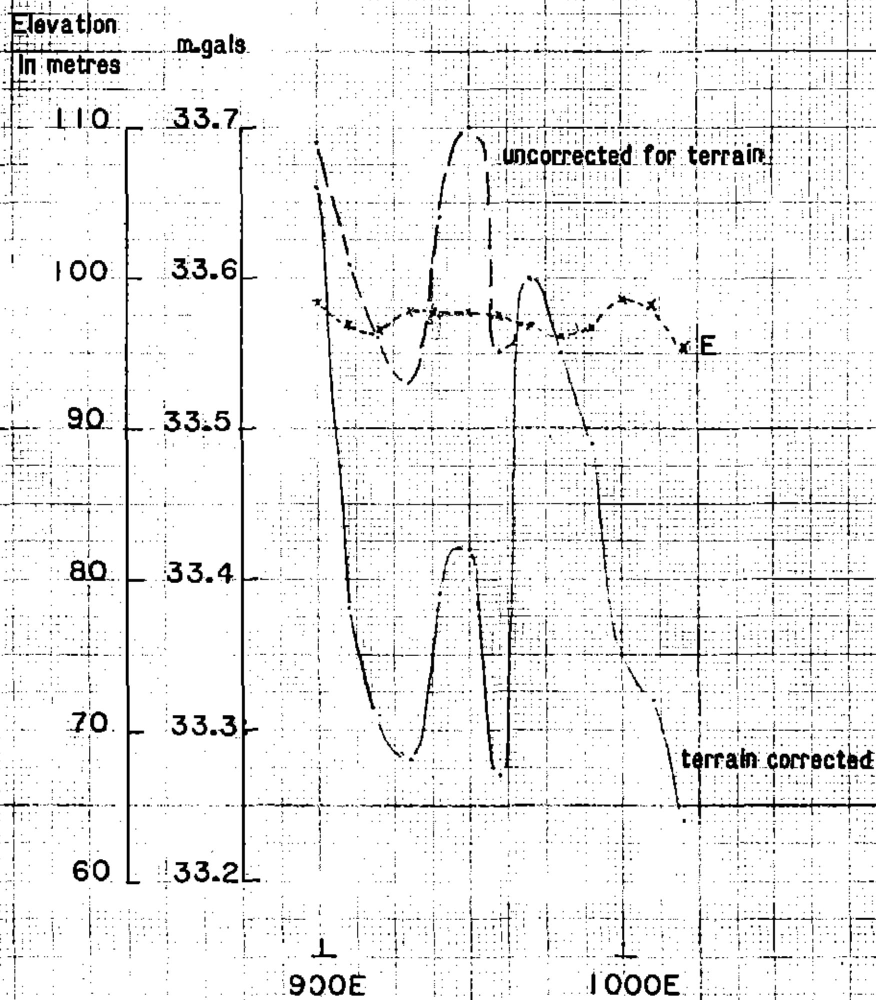
Geophysicist

SE Comstock
GRAVITY DATA
TAS-127

Line 5100N



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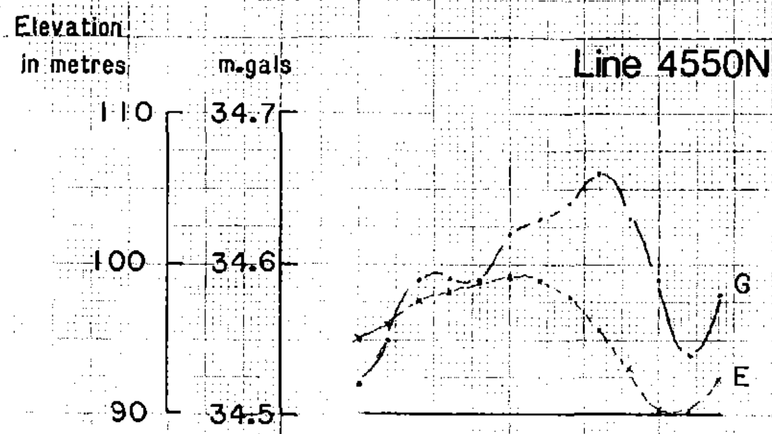
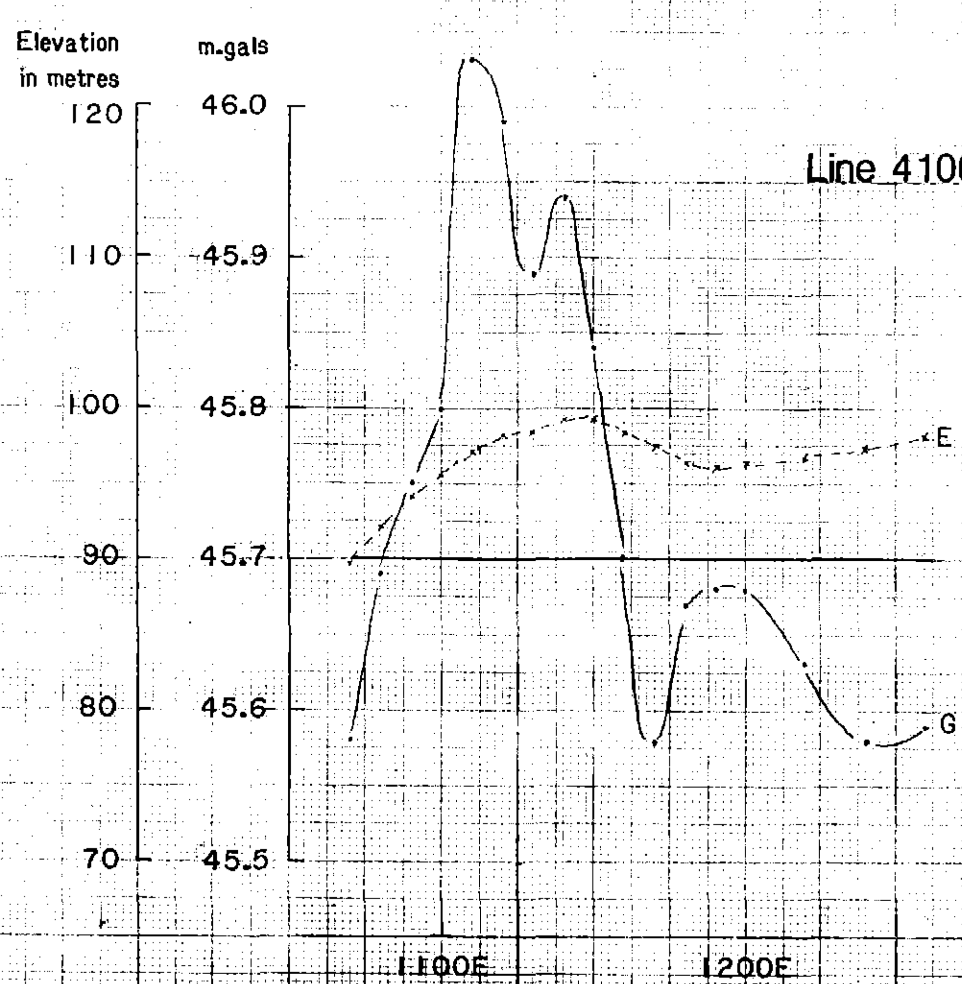
SE Comstock

GRAVITY DATA

TAS-127





NOTE: Baselines and connecting traverses pegged with 2m star pickets at 100m intervals.

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MAJOR MINING LIMITED

SE COMSTOCK

NR. ZEEHAN – TASMANIA

SELF POTENTIAL SURVEY CONTOURS

SURVEYED AND COMPILED BY
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420025

AUGUST 1989

5 cm

SCALE 1:2500m

Job No. TAS-127

PLATE 1

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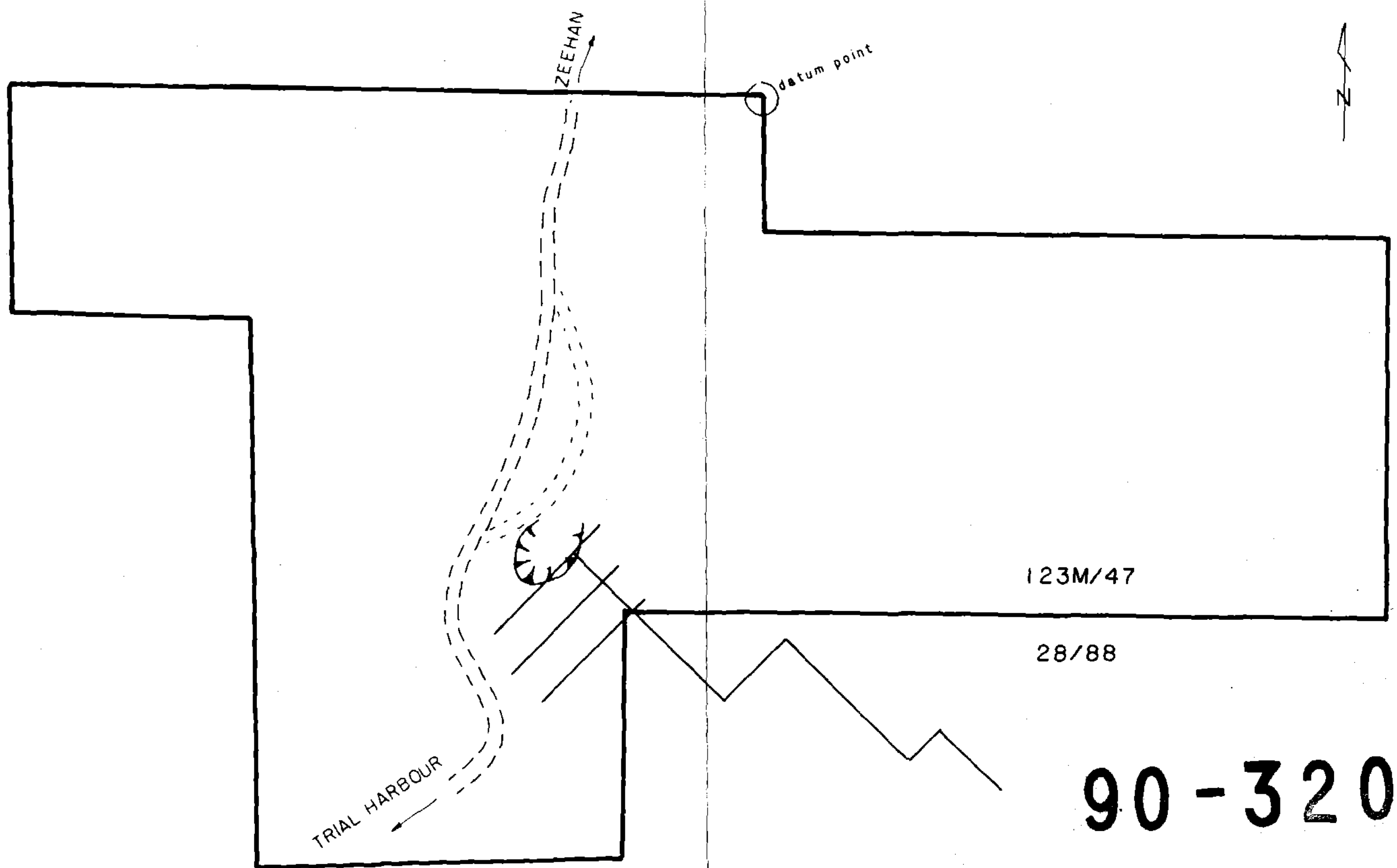

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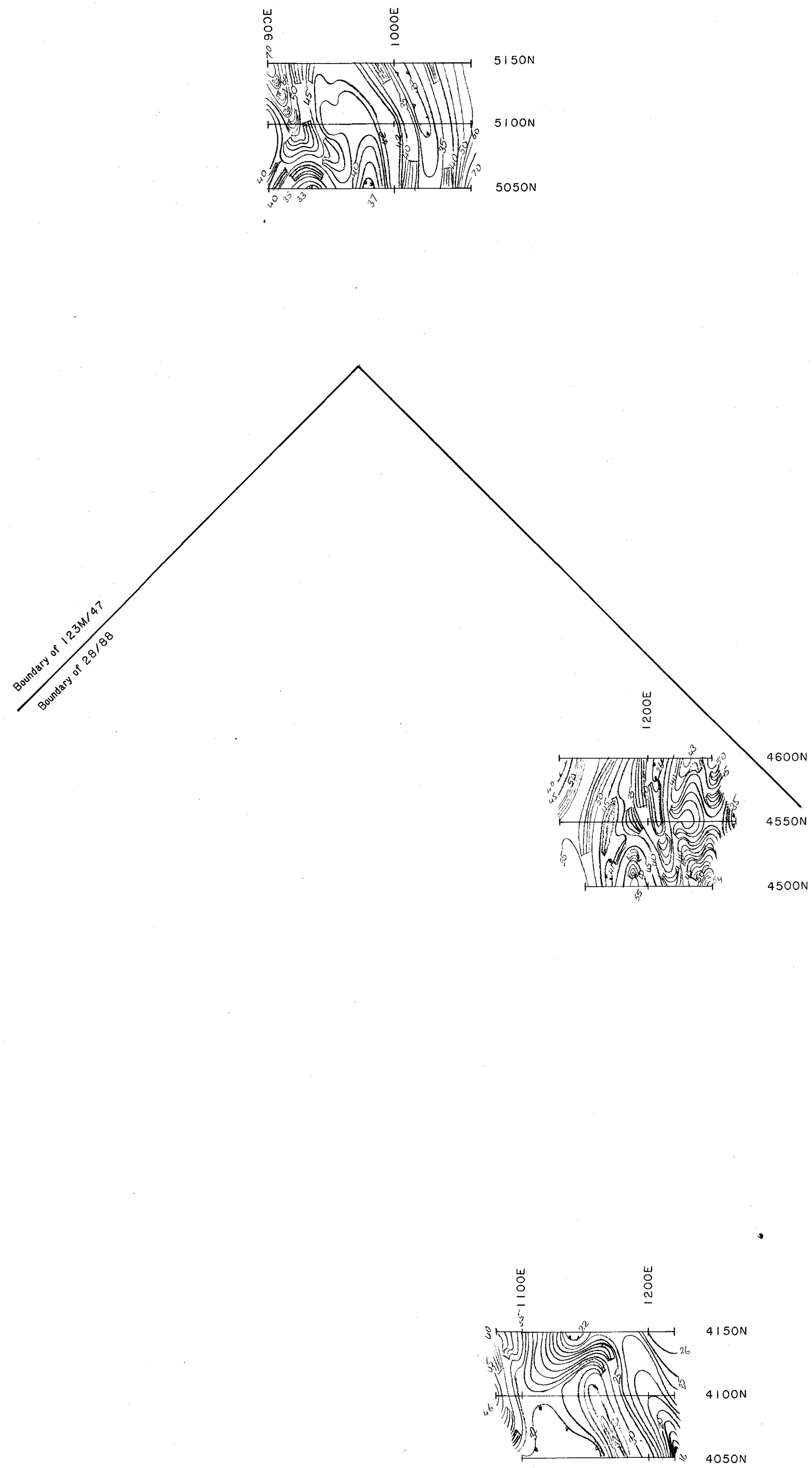
APPROXIMATE GRID LOCATION

SE COMSTOCK

TAS-127 420026



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MAJOR MINING LIMITED

SE COMSTOCK

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GRADIENT ARRAY EIP SURVEY
CHARGEABILITY CONTOURS

420027

SURVEYED AND COMPILED BY
SCINTREX

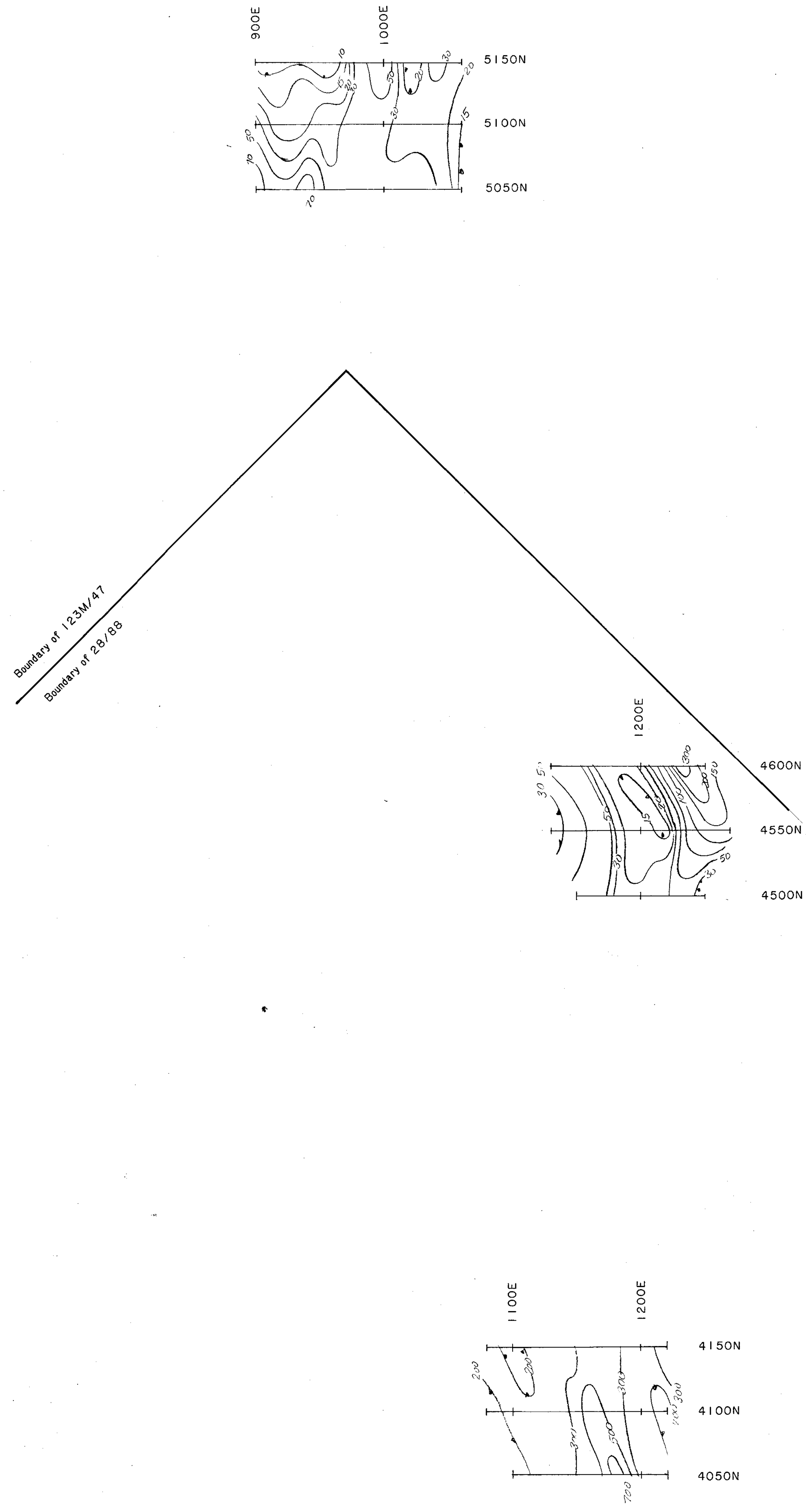
5 cm

AUGUST 1989

SCALE 1:2500m

Job No.TAS-127

PLATE 2



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MAJOR MINING LIMITED

SE COMSTOCK

NR. ZEEHAN – TASMANIA

GRADIENT ARRAY EIP SURVEY
RESISTIVITY CONTOURS

SURVEYED AND COMPILED BY
SCINTREX

AUGUST 1989

SCALE 1:2500m

5 cm

Job No.TAS-127

PLATE 3

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420029

A REPORT ON

FURTHER GEOPHYSICAL TEST SURVEYS

SOUTH EAST OF THE COMSTOCK LODE (EL 28/88)

NEAR ZEEHAN, TASMANIA

ON BEHALF OF

MAJOR MINING LIMITED

SCINTREX

420030

PRIVATE AND CONFIDENTIAL

A REPORT ON
FURTHER GEOPHYSICAL TEST SURVEYS
SOUTH EAST OF THE COMSTOCK LODE (EL 28/88)
NEAR ZEEHAN, TASMANIA
ON BEHALF OF
MAJOR MINING LIMITED

BY

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FEBRUARY, 1990
TAS-128A

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SCINTREX

420031

CONTENTS

SCINTREX PTY. LTD.

GEOPHYSICAL CONSULTANTS AND CONTRACTORS

SUMMARY

A self-potential and gradient array electrical induced polarization survey was carried out to the south-east of the Comstock Lode within EL 28/88. A number of low amplitude self-potential anomalies and moderate induced polarization anomalies are considered worthy of further investigation by trenching (if possible) or by shallow drilling if not.

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INCORPORATED IN W.A.

INTRODUCTION

Following a request from Dr. F.J. Corbett, Chairman of Major Mining Limited, Scintrex Pty. Ltd. carried out a further series of geophysical surveys south-east of the Comstock Lode, and to the south-east of the initial reconnaissance surveys carried out in late July and early August, 1989, and discussed in a report by the author dated October, 1989.

The methods used consisted of self-potential, electrical induced polarization and resistivity, the latter two in the gradient mode. Two gravity test lines were also run.

The gridding and geophysical survey work was carried out over 16.5 production days between 13th November and 12th December, 1989, by Scintrex geophysicist Mr. P. Brown BSc. assisted by Mr. M. Joint BSc.

THE GRID

The geophysical grid was established in reconnaissance mode only, **but** the 1300E-1400E baseline was pegged with steel pickets every 100 metres. The grid system was the same as that used on the first survey, with the grid extending from 1200E to 1600E and from 3200N to 4000N.

THE MINERALISATION

The predominant minerals within the lode material consist of sphalerite, galena and pyrite with the former making up about 20%-30% of the bulk. Simple resistance measurements in the Comstock pit showed values of the order of 1000 ohm-metres. While the tests were not exhaustive, the clear inference is that the mineralisation would not be expected to be conductive or be seen as a significant conductor in any EIP, MIP or EM geophysical method.

DATA PRESENTATION

The self-potential, resistivity and induced polarization data are presented in contour format at the scale of 1:2500. The two test gravity lines are presented in profile format at the same horizontal scale.

BRIEF NOTES ON THE METHODS

While these were discussed in the initial October report, the comments are repeated here for completeness.

The first surveys commenced with the self-potential method, as it was understood that a distinct self-potential anomaly had been recorded over the Comstock Lode (and other like zones) in the area.

This was the first method considered. As the test survey has demonstrated, there is in fact a distinct self-potential anomaly of about 500 millivolts. It is also understood that a similar anomaly exists over the Sylvester Lode.

There are two considerations arising from the above, namely,

a) The apparently high resistivity within the sphalerite rich lode material, and

b) Over the topographically low areas, there are areas of water-logged button grass plains.

The former may, in areas of high internal resistivity, preclude a self-potential anomaly being formed, while conductive near surface waters within the boggy areas will similarly preclude the formation of self-potential anomalies.

Therefore, while the self potential method can be applied quite effectively in the area as a whole, those areas which are overlain by waterlogged glacials or alluvium cannot be considered to have been exhaustively covered. In addition, those deposits which do not have sufficient electronic conduction within the body to allow the oxidation/reduction reaction to proceed, similarly will not be detected by the method.

Also, as graphitic shales exhibit self-potential, self-potential anomalies can have non-economic sources.

In the case of the present survey, self-potential and gradient electrical induced polarization/resistivity were run over the entire grid.

DISCUSSION OF RESULTS

The reconnaissance grid was surveyed at standard 100 metre intervals between lines. Interline detail was carried out over any zone considered significant subsequent to reading the grid at 100 metre line intervals. This was necessary as a response from shorter strike length zones can be expected on the 100 metre spaced lines, but the **strike direction** will be difficult to define. In practice, the self-potential data tends to demonstrate this ambiguity.

Each of the methods undertaken is separately discussed below.

Self-Potential Data

This shows a range in amplitudes to 120 millivolts with a regional trend being noticed. The more negative values are seen in the eastern third of the area, While the main trend **overall** appears to be approximately grid north south, there is clearly an ambiguity for individual events, which may be contoured either trending grid north south (±) **or** with a grid north-north-west bias. As discussed elsewhere, intermediate detail would be mandatory to define strike.

Spot self-potential negative lows worthy of consideration for further investigation are listed below by coordinate. The anomaly is listed relative to background.

Eastern Section

S1	3900N/1380E	-40 millivolts
S2	3800N/1540E	-90 millivolts
S3	3800N/1580E	-110 millivolts
S4	3500N/1500E	-70 millivolts
S5	3500N/1600E	-90 millivolts

The annotated contour map shows the location of old diggings and, as can be seen, evidence of workings are generally associated with the self-potential axes although not often directly.

Western Section

S6 An extremely weak self-potential anomaly of -40 millivolts (±) was defined approximately along grid coordinate 1300E (±) between 3200N and 3900N. The low amplitude would normally not be significant, however, diggings around 3700N and the "old camp" between lines 3200N and 3300N may enhance the interest of this feature.

While it should be noted that the self-potential anomalies are small, the amplitude thereof will depend inter alia on:

- the degree of conductivity within the source.
- the size and mass of the conductor
- the nature of the material between the source and surface.

Thus, size of anomaly in the present circumstances is not necessarily a guide to the possible economic interest of the source. Also, the source may be due to either sulphides and/or graphite.

Induced Polarization Survey

The induced polarization/resistivity data was read in the gradient array from current electrodes set up at 1000E and 1700E on line 3800N for lines 3600N to 4000N and on line 3400N at 1000E and 1800E for lines 3200N to 3600N. Both set-ups utilised a 25 metre potential dipole moved at 25 metre intervals. The data is presented in contour format at the scale of 1:2500.

The **induced polarization data** shows a range in values from 13 millivolts/volt to in excess of 60 millivolts/volt. The background can be considered to be about 20 millivolts/volt, with values of 30 millivolts/volt or above being considered anomalous.

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While not all areas of the grid can be uniquely contoured, two distinct trends are in evidence, namely, grid 320° and grid 340°-360°. Due to the complex nature of these data, a relatively large number of the lines were run at 50 metre intervals, but in spite of this, the local maxima at 1400E/3450N, 1460E/3350N and 1550E/3300N for instance are capable of being drawn either with a 320° or 340°-360° trend. Thus, any investigation of their sources would best be carried out on the actual survey line.

The **apparent resistivity** data shows a range in values from 15 ohm-metres to over 1000 ohm-metres, which can be considered generally quite low. The background is assessed to be in the range 350 ohm-metres to 500 ohm-metres. While the polarization data show **two distinct trends** namely, just north-west of grid north south and grid north-west the resistivity data shows only the former. The main trends are summarised on the interpretation plan.

There are no clear overall relationships between the higher polarization values and any particular resistivity feature, although the central broad resistivity high running from 1350E on line 4000N to 1500E/3200N appears to be associated with higher values.

Brief Discussion of Individual Polarization Maxima

Zones A, B and C

The anomaly of largest areal extent is seen traversing from 1400E/3600N to 1380E on 3800N (A) then on lines 3850N and 3900N at 1350E (B) and finally on lines 3950N and 4000N at 1300E and 1250E respectively (C). Generally, this feature is associated with higher than average resistivities of 700 ohm-metres ±.

It is recommended that **subject to ground follow-up**, any investigation of this anomaly should take place either on line 3850N **or** 3900N centred at 1350E. The **maximum** depth to source is about 50 metres. The source is disseminated, or if massive, electrically discontinuous in nature.

This anomaly could be related to the anomalies located on the first survey in the vicinity of old mines and self-potential anomalies 1125E/4100N (±50 metres).

Zone D

A sharp well defined anomaly was recorded on lines 3700N and 3750N at 1475E of just under twice local background. While the source lies within rocks of average resistivities it does not have any particular influence on the resistivity. Thus the source is interpreted as being wholly disseminated and/or electrically discontinuous. The maximum depth to source is estimated to be 25 to 30 metres.

Zones E, F and G

Three local highs, designated **E**, **F** and **G**, have been located centred at 1525E/3650N, 1550E/3550N and 1525E/3500N respectively. While the most likely strike direction is as contoured, namely, grid north-west south-east (i.e. about true east west), a grid north south dip is a lesser possibility. In all cases the **maximum** depth to source looks to be of the order of 30 metres (±).

The resistivity data shows zone **E** to lie parallel to a sharp change in resistivity from 300 ohm-metres (±) (seen on all three anomalies) to lower resistivities of 20 ohm-metres to the immediate east. The sources themselves are either disseminated or if "massive" must be electrically discontinuous.

Of particular interest, as far as a comparison with resistivity data is concerned, is that the resistivity data shows a grid north south trend, while the polarization anomalies show a north-west south-east trend on the preferred interpretation of the data. Thus, they may be due to mineralisation rather than be formational in origin.

Zone H

Two subparallel maxima of about 50% above background were noted on line 3900N at 1525E and 1575E trending into line 3800N at 1550E and 1625E respectively. Unlike the anomalies described to date (i.e. A to G), these responses are associated with and lie parallel to a depression in resistivity to 100 ohm-metres - about half of background. While these anomalies may be of formational graphitic or pyritic origin, an adit at 1525E/3910N and diggings at 1625E/3800N must enhance their interest. Any investigation by drilling or trenching should be carried out to test the anomaly at their sides. The maximum depth to source on line 3800N at 1625E was 25 metres.

Zones I, J and K

Three approximately grid north south trending zones centred at 1400E, 1475E and 1550E on lines 3450N, 3350N and 3300N respectively, all lie within the high resistivity (500 to 700 ohm-metres) section which itself has a grid north south trend. The maximum depths to source of each response at the coordinates specified above are 40 metres, 30 metres and 35 metres respectively. Again, the source of each is considered to be disseminated or electrically discontinuous in nature.

Zone Ln and Ls

Two small elongate and perhaps related anomalies of 5 millivolts/volt above background were defined at 1325E/3350N and 1350E/3200N. The southern section lies within some of the most resistive rocks (1000 ohm-metres) while the northern section lies within rocks having resistivities of half this level. The maximum depth to source is 20 metres, and neither are accorded a high importance due to their low amplitudes.

Zones N and M

Two zones of about 50% above background were located on line 3900N at 1200E and 1250E respectively. Both are associated with high resistivities of 300 to 800 ohm-metres, and have an apparent north south strike. Maximum depth to source in each case is 25 metres and 35 metres respectively. As for most sources, a disseminated and/or electrically discontinuous nature is interpreted. As zone M can be traced southwards to 1250E/3700N where diggings have been observed, this anomaly is considered worthy of further investigation.

Gravity Survey

Two short gravity traverses were run over zones **B** and **G**. In both cases, very small responses of 0.2 milligals above background were observed. While these of themselves are not considered significant, they could indicate the presence of sulphides.

CONCLUSIONS

1 Some dozen or so polarization responses having strike lengths of greater than 100 metres have been detected on the present survey. They can be broadly classified into three categories.

a) Those anomalies which lie in resistive rocks and trend grid north south i.e. zones **B***, **C**, **D***, **I**, **J**, **K**, **L**, **M** and **N***.

b) Those anomalies which appear to have a grid north-west south-east strike and lie within resistive rocks, namely, **A**, **E**, **F** and **G***.

and

c) those which have an approximate 340° trend associated with less resistive rocks, i.e zones **He*** and **Hw**.

(Anomalies marked "*", are recommended for follow-up - see below.)

2 It is recommended that subject to ground inspection, the following anomalies should be investigated by trenching (or perhaps drilling). The target site and the **maximum** depth to source are listed below. However, the surface "trace" could be very significantly above the maximum depth to source indicated

Zone		Coordinates	Maximum Depth
Zone B		3850N/1350E	50 metres
	(or	3900N/1350E)	50 metres
Zone D		3750N/1475E	25-30 metres
Zone G		3500N/1525E	30 metres
Zone He		3800N/1625E	25 metres
Zone M		3900N/1250E	35 metres

3 In addition to the trenching targets generated by the induced polarization survey, a number of the self-potential targets should be tested by trenching. Subject to access and overburden thickness not being too great, those recommended for attention are:

Zone S4 3500N/1500E This anomaly may be related to the EIP zone G recommended for detail. The line should extend to cover both responses.

Zone S2 3800N/1525E This may be related to induced polarization axis He **and** the adit recorded at about 1525E/3900N. Again, both anomalies should be traversed by a single trench.

4 The extent of gravity work (due to time constraints), was not sufficient to assist in target delineation.

Respectfully submitted on behalf of:
SCINTREX PTY. LTD.

A.W. Howland-Rose,MSc,DIC<FIMM,FAusIMM,FAIG,FGS,CEng.
Geophysicist

APPENDIX

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

INTRODUCTION

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

DISCUSSION

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

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

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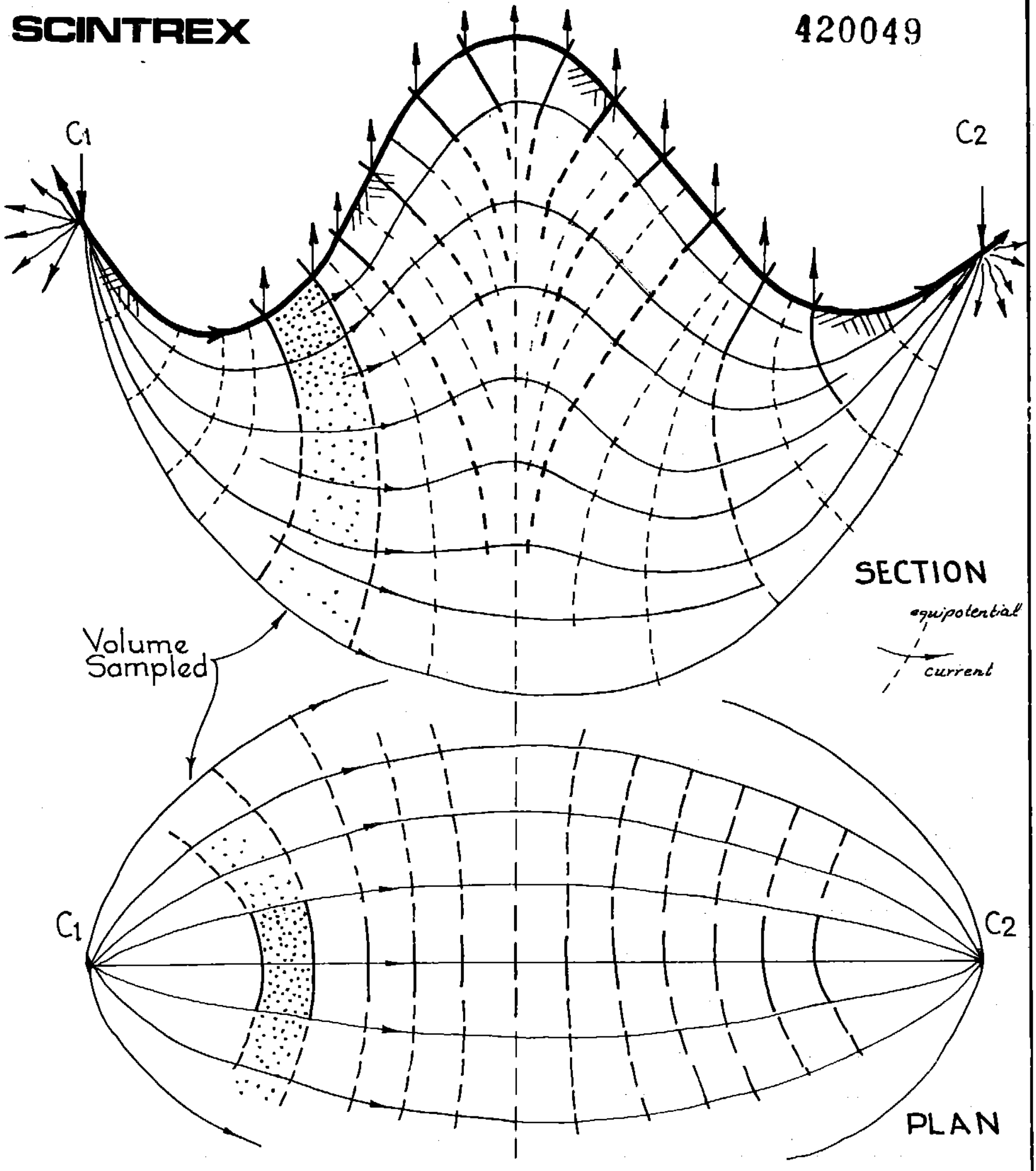

Diagrammatic Representation of Primary Current and Potential Field in Steep Topography.

FIGURE 1.

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

Note also that the volume of material **closest to** the potential electrode 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) is not necessarily the same volume as is the secondary potential field (apparent chargeability). 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 and 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

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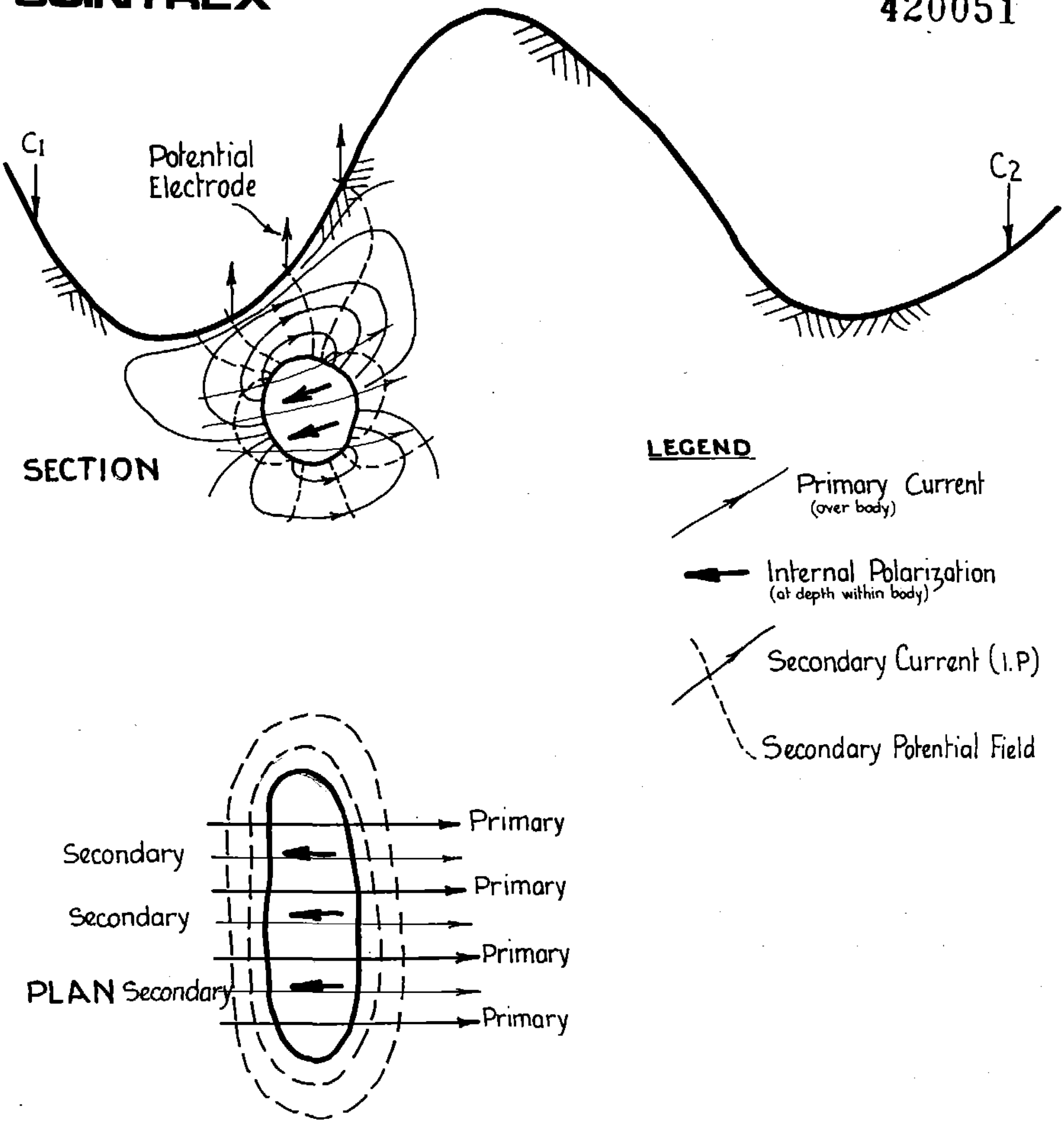

Diagrammatic representation of secondary current (I.P. effect) and secondary potential field in steep terrain.

FIGURE 2.

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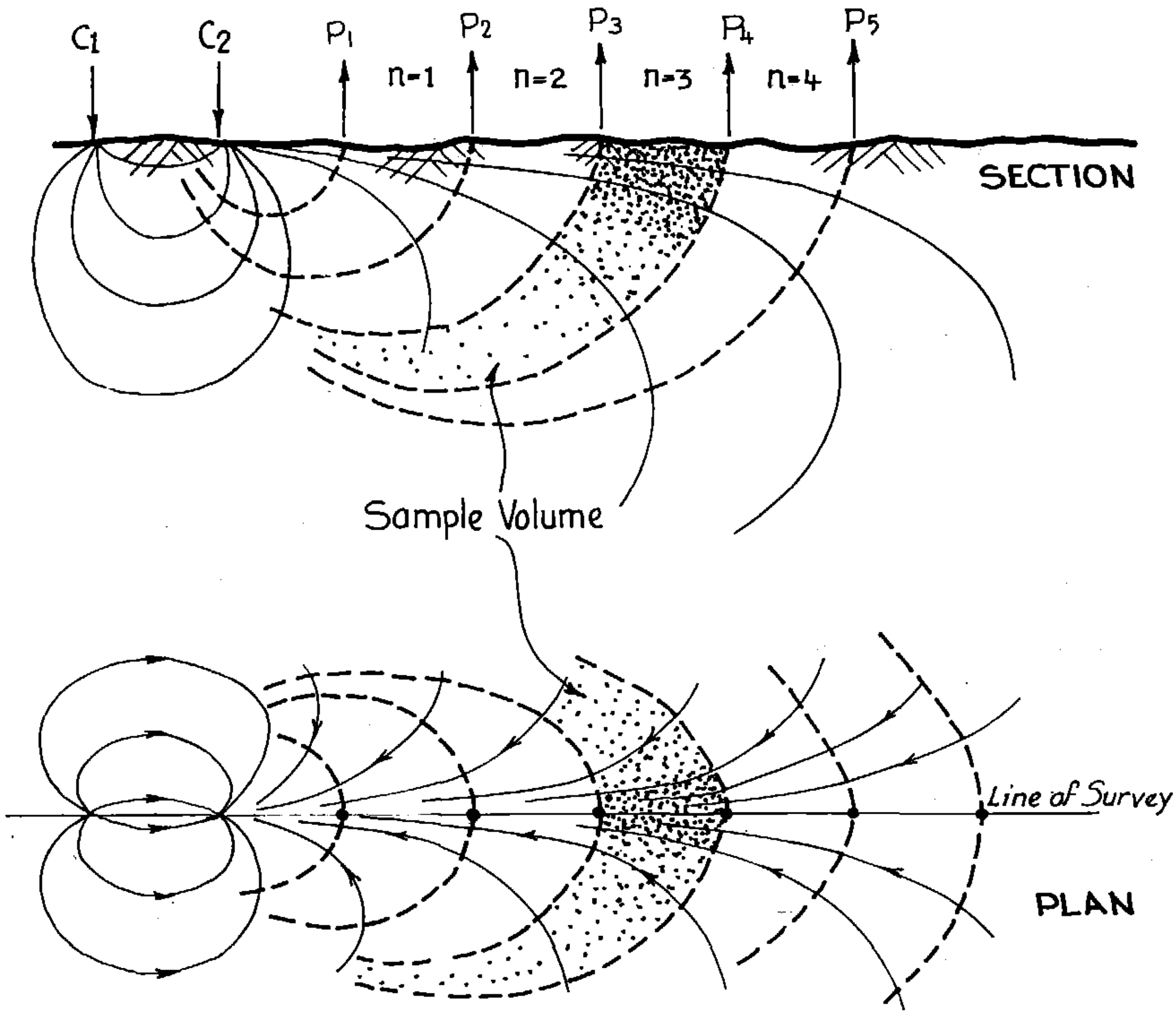
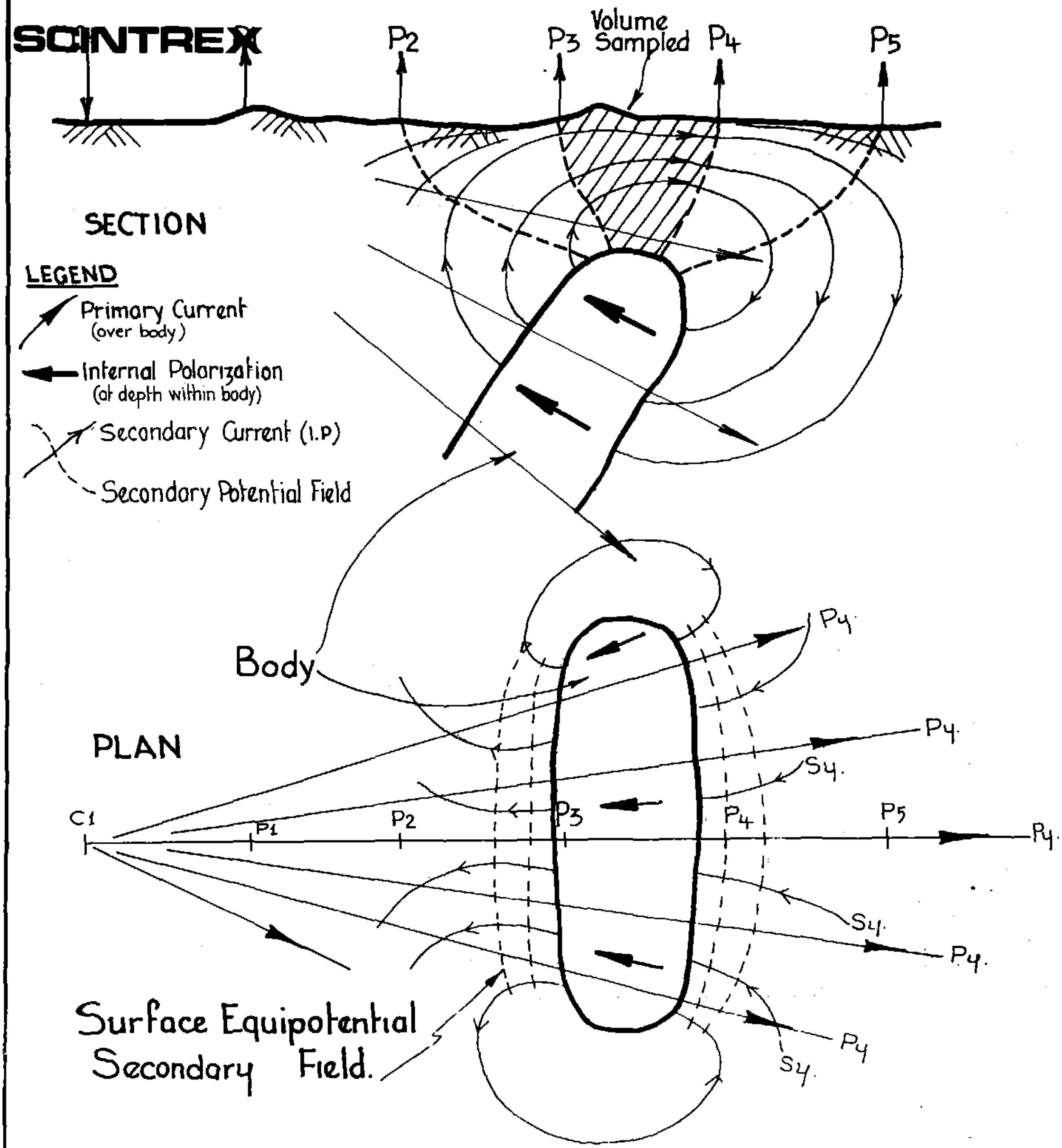


Dipole - Dipole Array
Primary current paths and equipotential field
Showing volumes sampled

FIGURE 3



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.

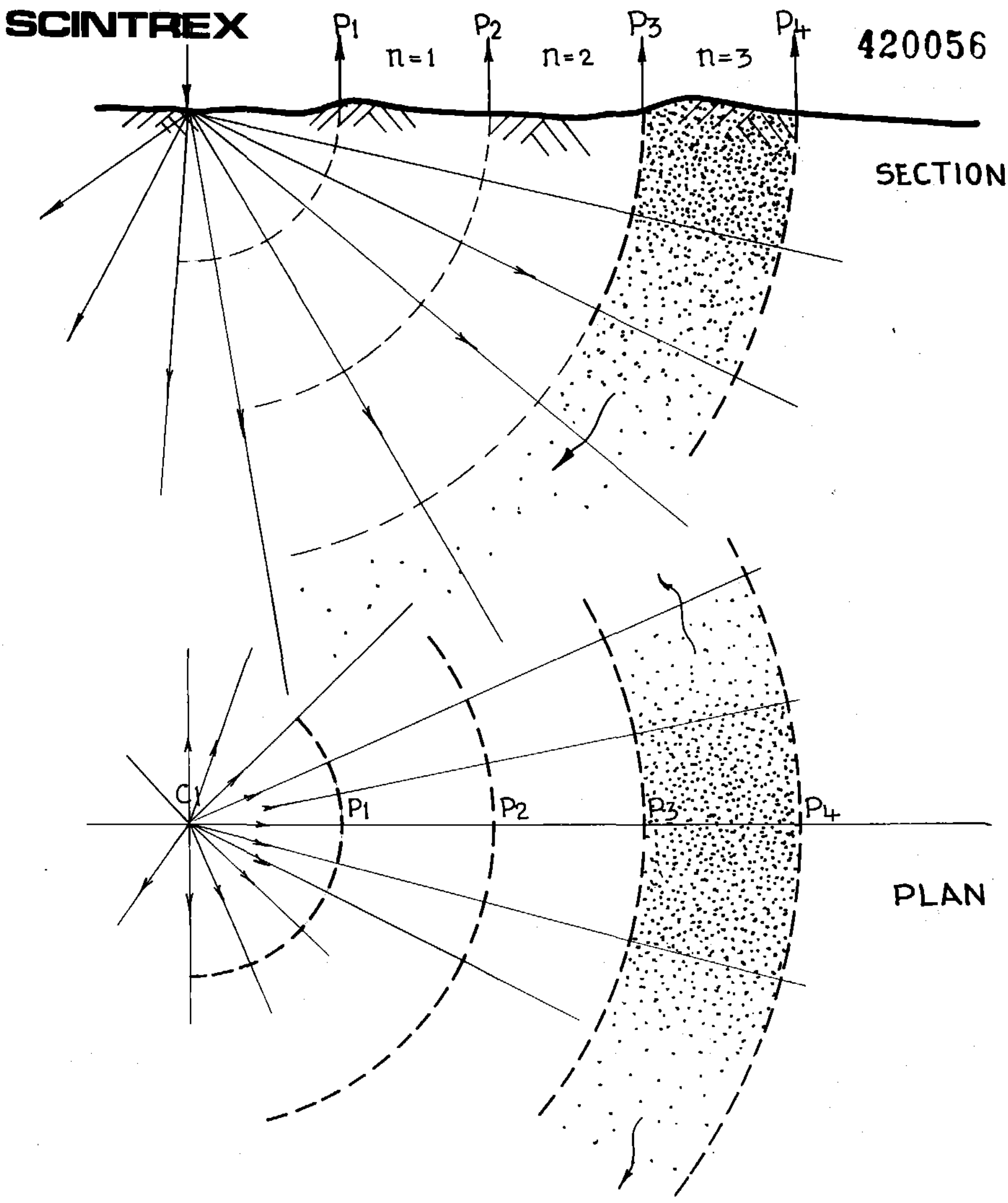
dipole, and at a deeper level in the pseudo-section presentation used in this report. It is **vital** to realise that this data point does not represent the characteristics of the ground at the point plotted, but that of the **total volume** sampled.

A further characteristic of the array is that where the effective spacing (**n** x **a**) is greater than the depth to the source, a 'high' (or 'low', depending on characteristics) **will** occur as each of the dipoles (i.e. transmitting C_1 and C_2 and potential P_1 and P_2) pass over the source of that anomaly. The resultant 45° patterns on the pseudo-section **DO NOT** represent dip, or even depth extent, but merely represent a complex interference pattern over the source due to the potential and current dipoles. For a single source, this **double peak effect** can be recognised as it tends to have two maxima displaced by (**n** x **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** x **a** is greater than the depth to source. Where **n** x **a** is less than the depth to source, a single maximum will be produced midway between the energising and measuring dipoles C_1/C_2 and P_1/P_2.

Pole-Dipole:- This array is similar in principle to the dipole-dipole array, except that a single electrode is placed 'close' to the potential dipole, with an 'infinite' electrode placed 10 x **n** x **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 dipoles, which in the pseudo-section format is 45° towards the pole source. The chargeability reading is generated in a similar fashion to that described for dipole-dipole (Figure 4).

As with the dipole-dipole array, a double peak will result when **n** x **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.)



Current Path and Primary Equipotential Field from Pole-Dipole Array

FIGURE 5

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SPHERE RESPONSE THREE ELECTRODE ARRAY

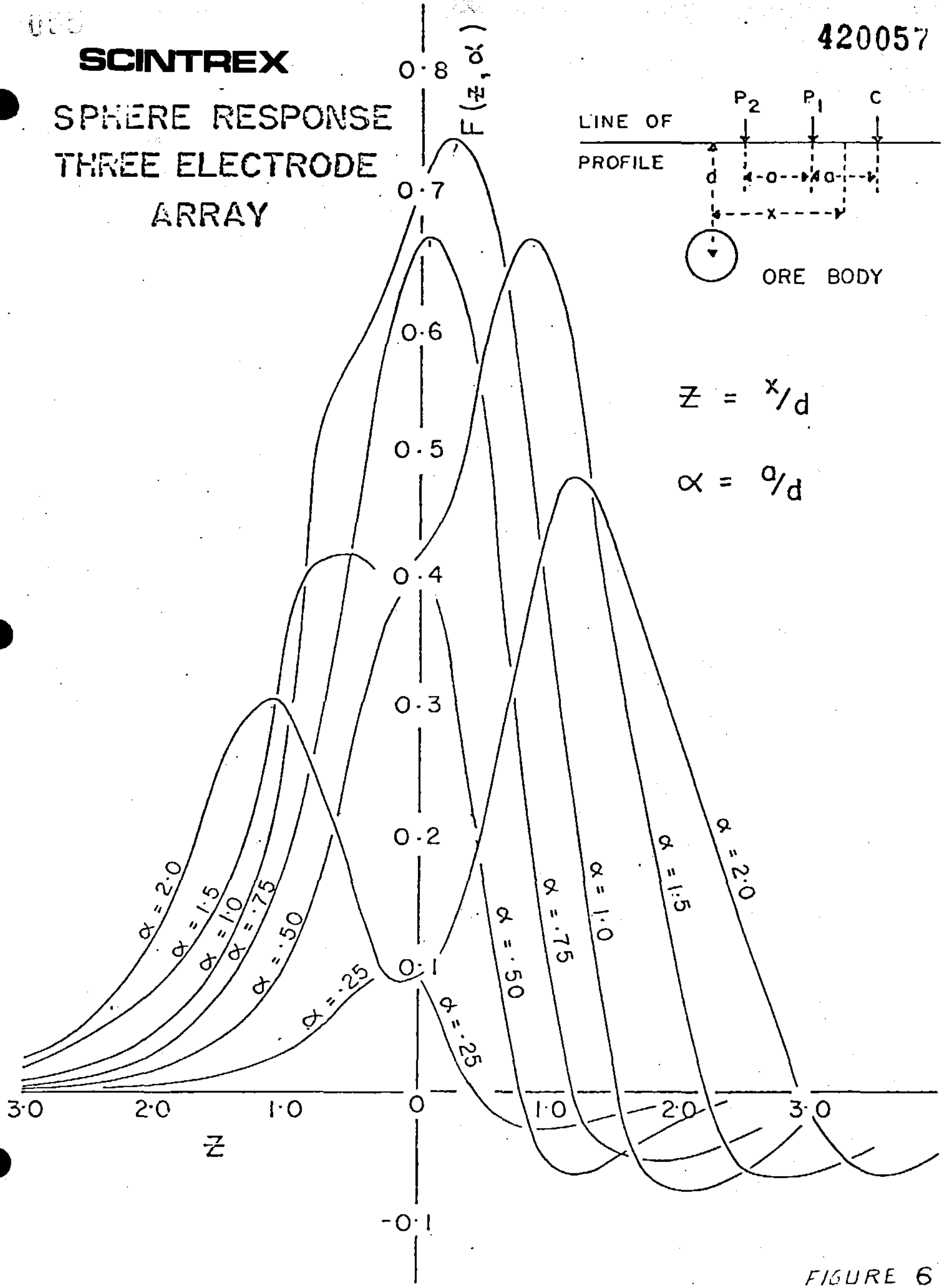

FIGURE 6

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 Canadian Geological Survey publication. In resistive mountainous terrain the author prefers the gradient array as the prime reconnaissance method due to the high productivity (two to five times that for 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-dipole 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 required 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

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TABLE 1

(Table 3. 1)

SCINTREX Comparison of IP Survey Electrode Arrays

(after Sumner, 1972)

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

Extract from: Geological Survey of Canada - Paper 75-31 "Borehole Geophysics Applied to Metallic Mineral Prospecting: A Review" the source can influence the decay form. Coarse grained efficient sources such as sulphides show **slow** decay forms, magnetic and fine grained sulphides often show **fast** decay forms. This can be shown as $\Delta M = M_5 - M_1$, where positive ΔM infers **slow** decay form and negative ΔM **fast** decay form. A superior parameter is ΔMn where

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

which is essentially ΔM normalised for the amplitude of the decay. ΔM and ΔMn are merely shorthand 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 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.

A.W. HOWLAND-ROSE, MSc, DIC, FIMM, MAusIMM, FAIG, FGS, CEng.

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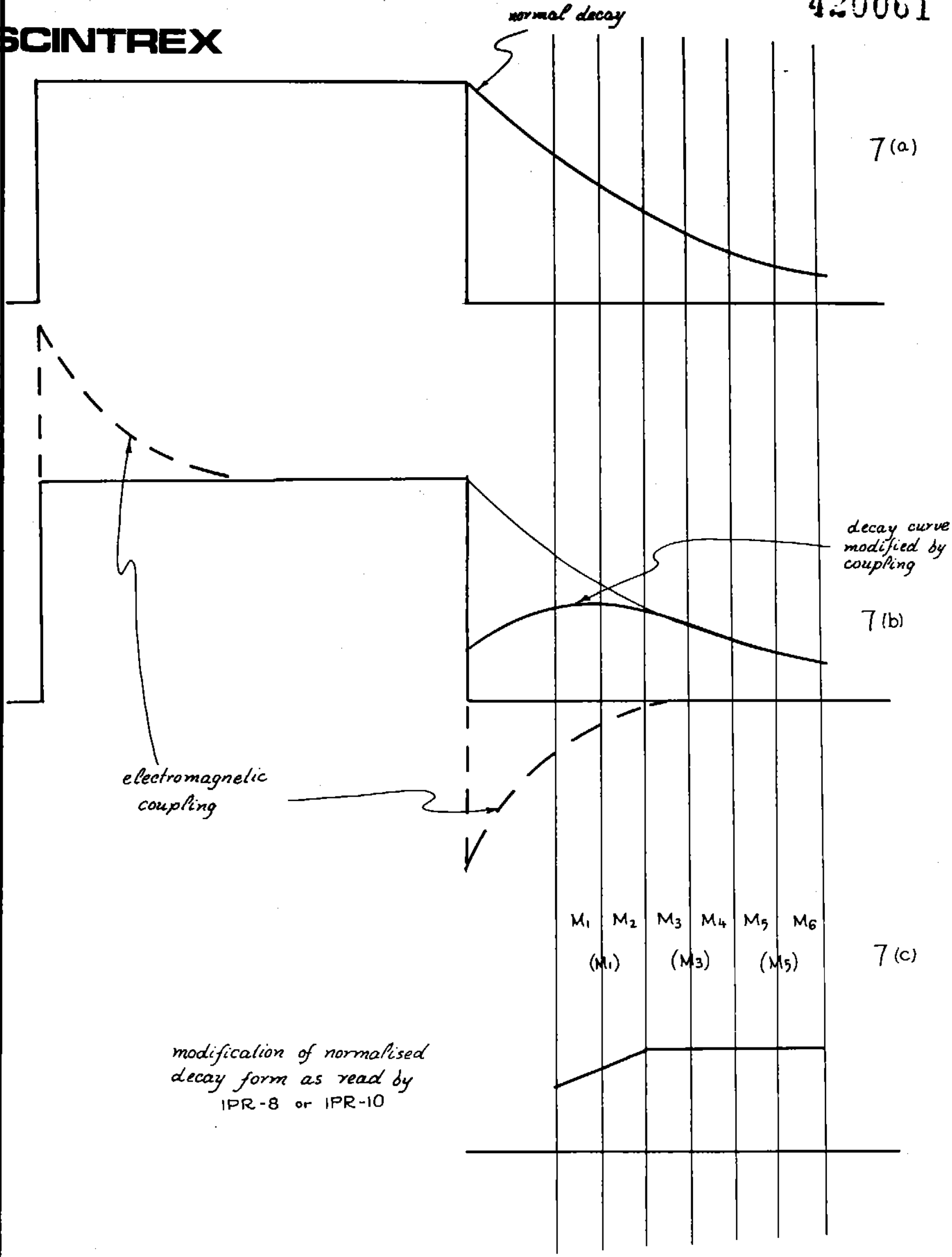

EFFECTS OF ELECTROMAGNETIC COUPLING ON IPR-8/10

Fig. 7

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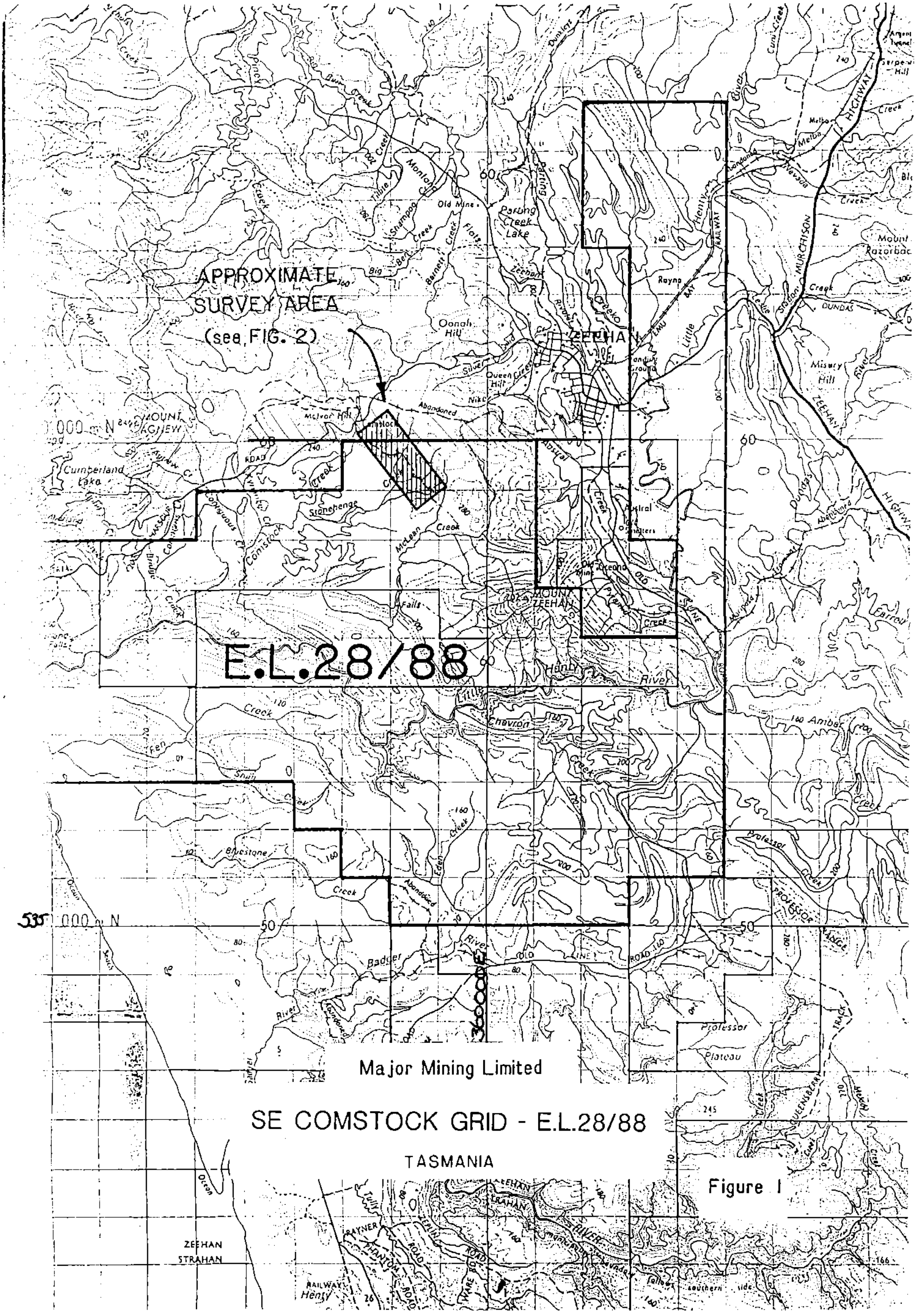

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Figure 1

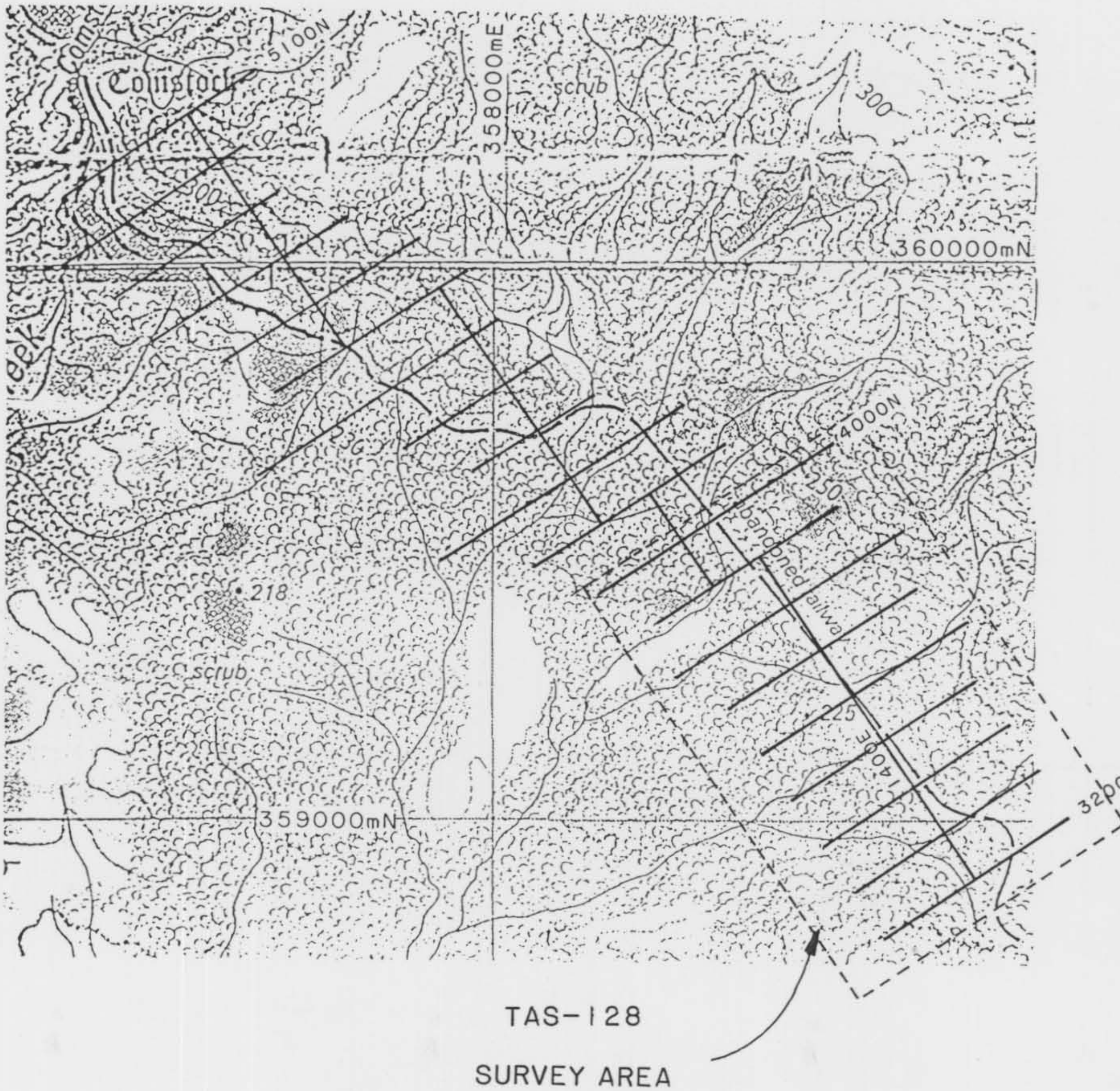

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Figure 2

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Line 3900N

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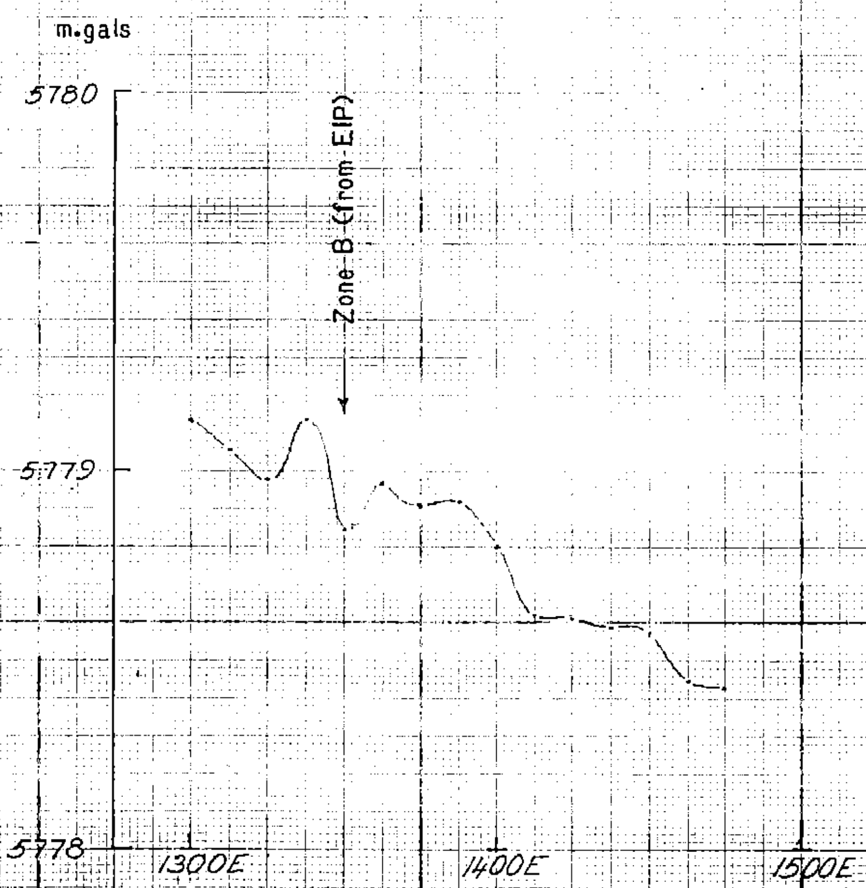
Gravity

TAS-128



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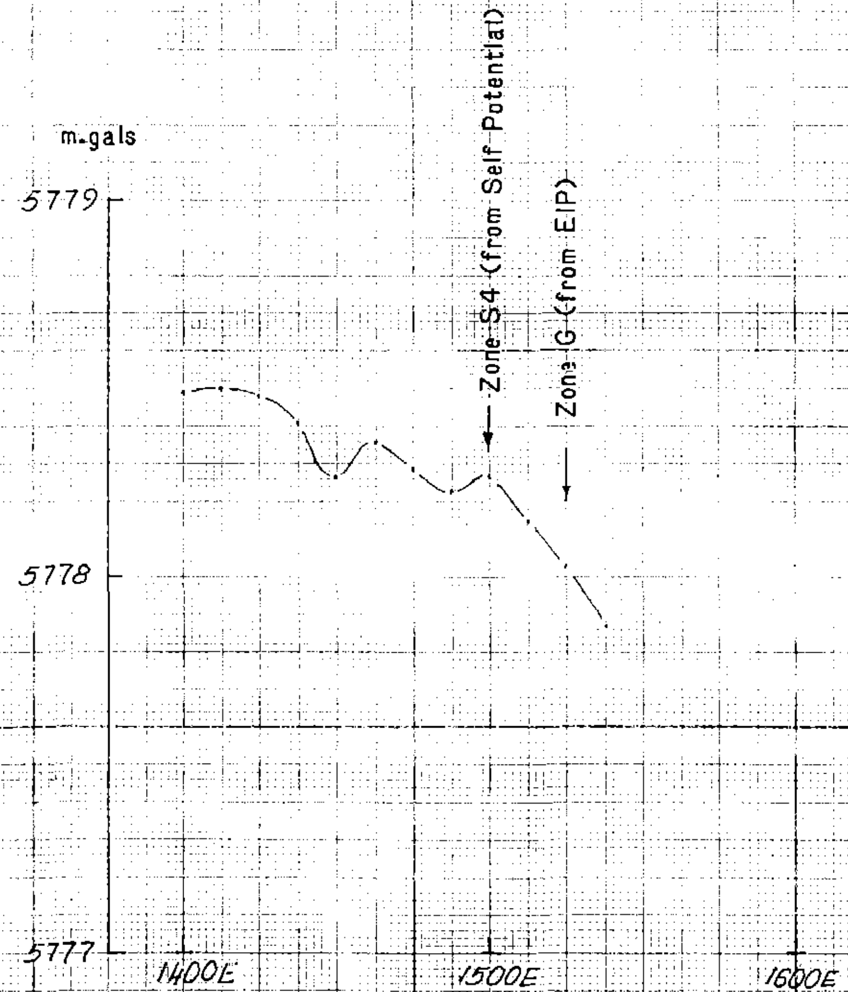
GORMACK GRAPH PAPERS CHRISTCHURCH N.Z. C102X 40 cm x 28 cm x 1 mm

Line 3500N
SE COMSTOCK
Gravity
TAS-128



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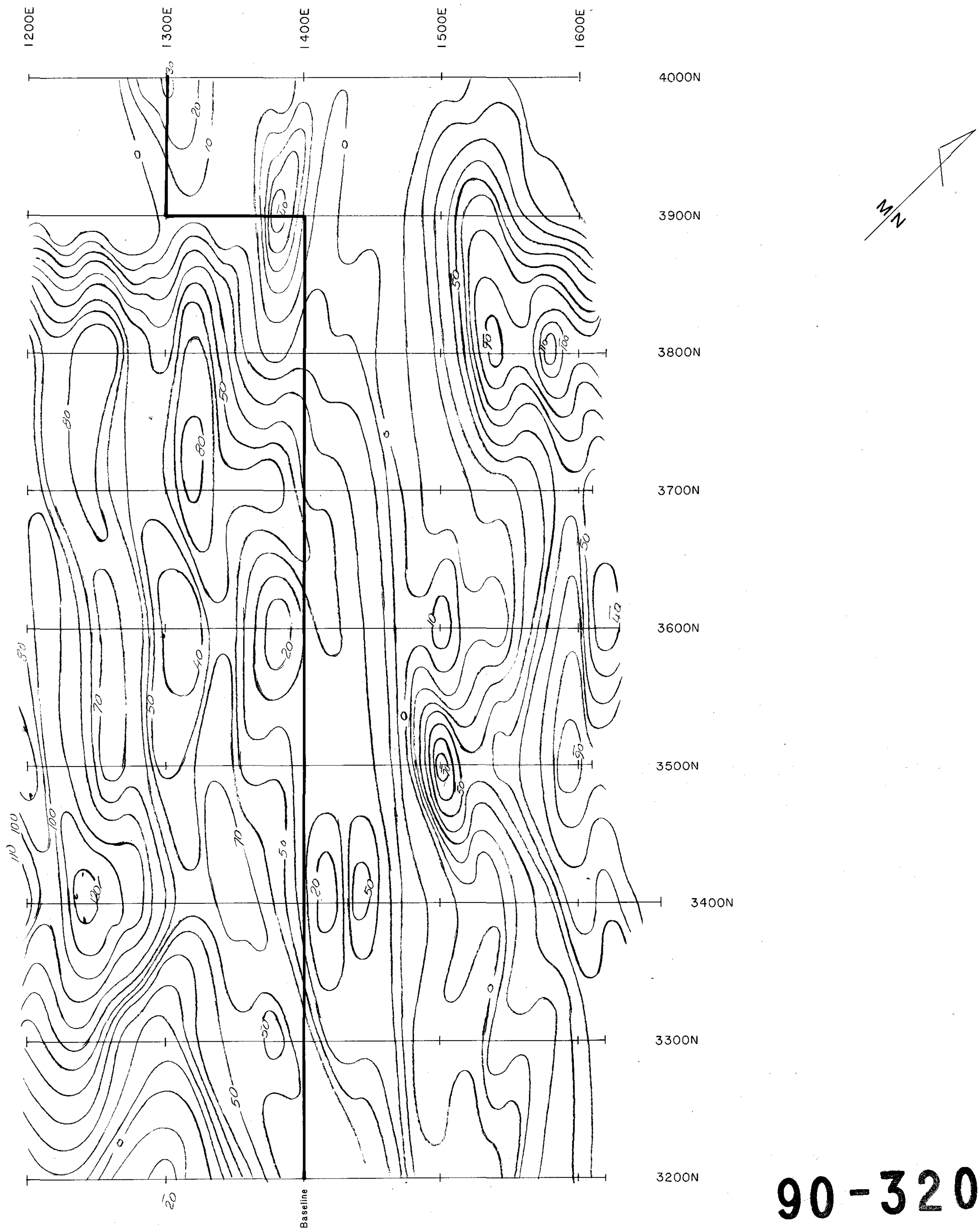

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NR. ZEEHAN – TASMANIA

SELF POTENTIAL SURVEY

CONTOUR PLAN

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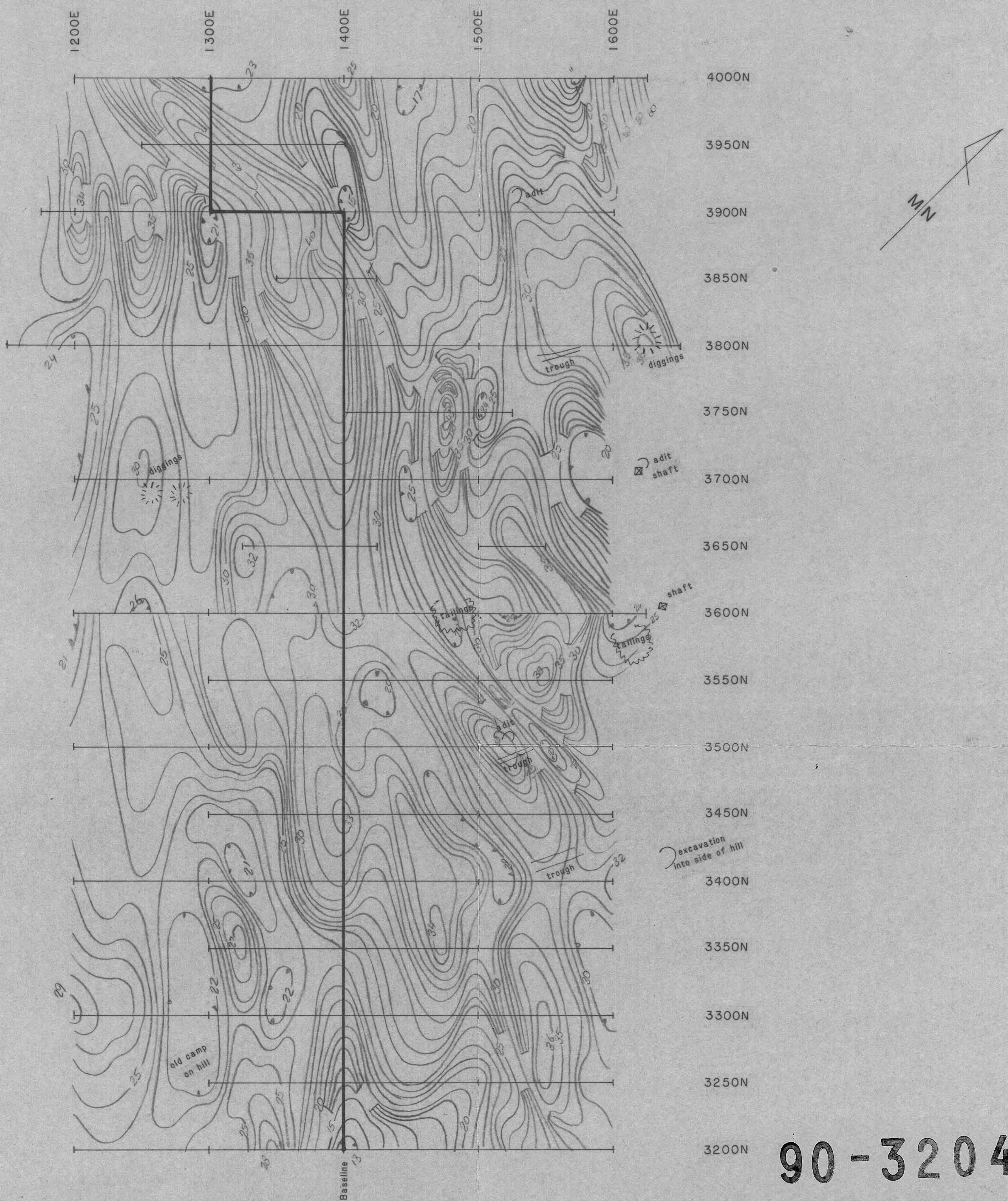
NOV–DEC 1989
SCALE 1:2500m
Job No. TAS-128 A

5 cm

PLATE 1A

9871



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GRADIENT ARRAY EIP SURVEY

CHARGEABILITY CONTOURS

SURVEYED AND COMPILED BY
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420067

5 cm

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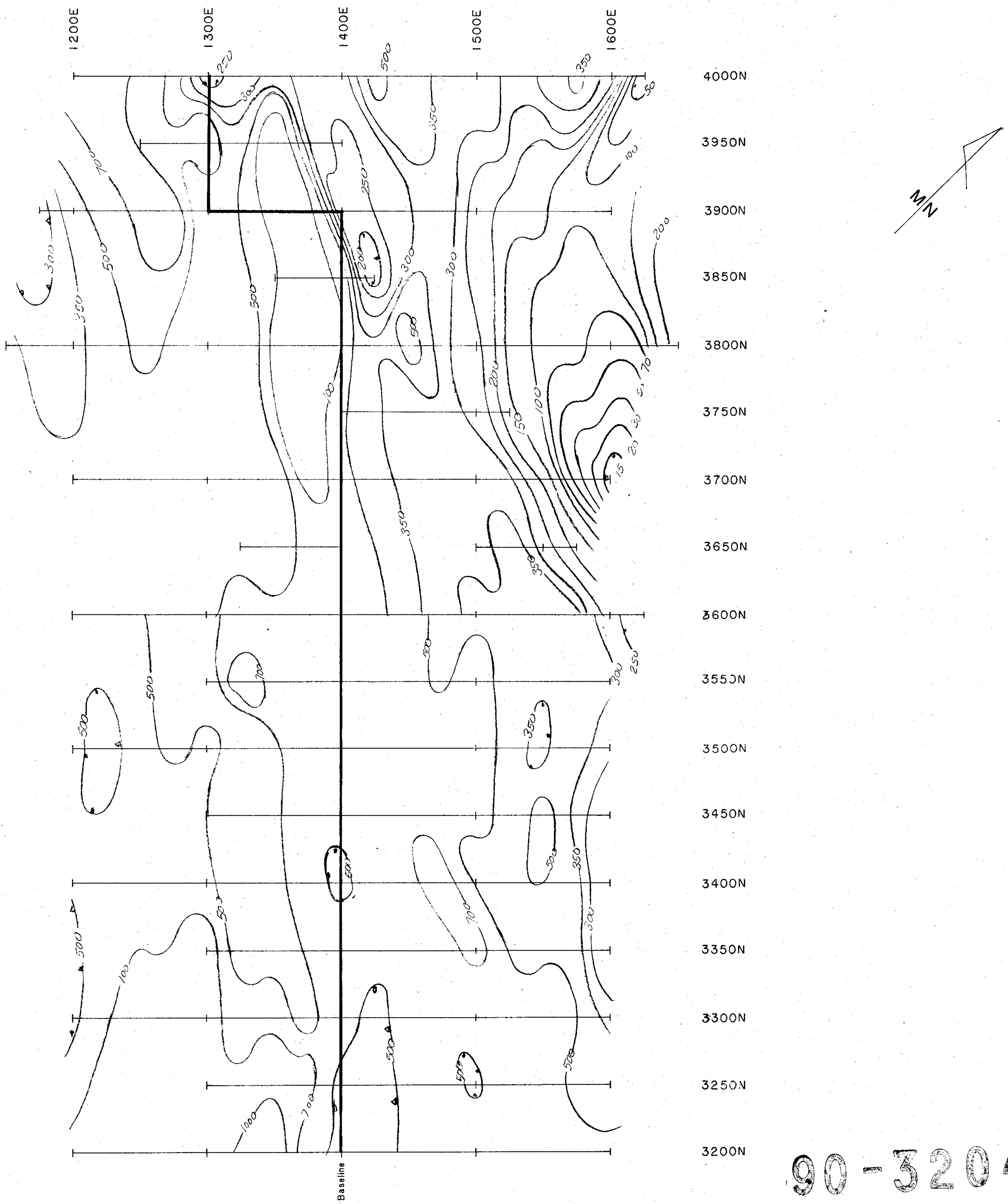
SCALE 1:2500m
Job No. TAS-128 A

PLATE 2A

9872



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GRADIENT ARRAY EIP SURVEY

RESISTIVITY CONTOURS

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SCALE 1:2500m
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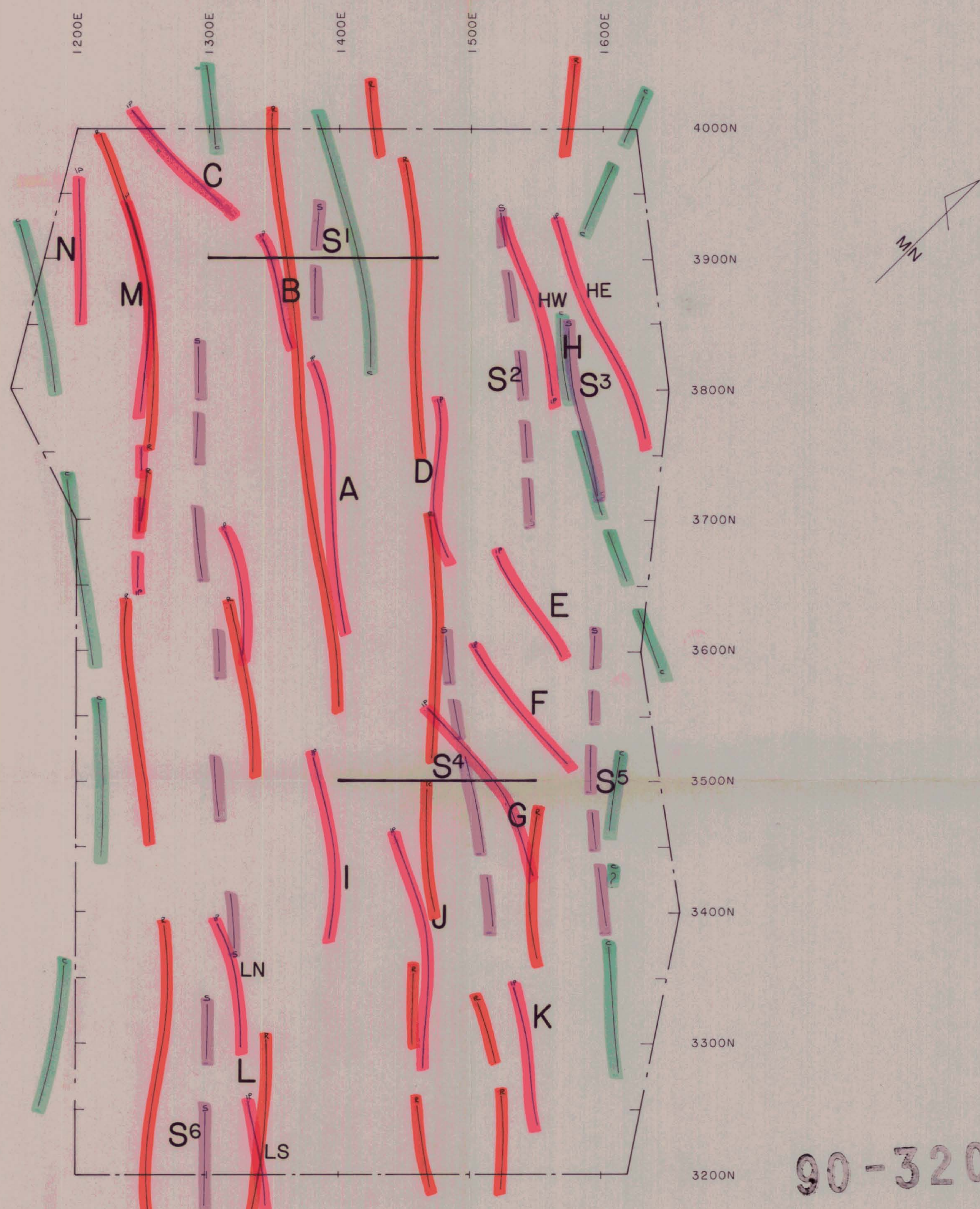
5 cm

PLATE 3A

9873



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LEGEND

- Chargeability axis
- Resistivity axis (high)
- Resistivity axis (low)
- B — Zones of interest (EIP)
- Self Potential axis
- S2 — Zones of interest (Self Potential)
- Extent of Gravity readings

420069

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GRADIENT ARRAY & SELF POTENTIAL SURVEY

INTERPRETATION PLAN

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5 cm

NOV-DEC 1989
SCALE 1:2500m
Job No. TAS-128A

PLATE 4A