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COMMENTS ON
AN APPLIED POTENTIAL SURVEY
HENTY FAULT ZONE, NEAR QUEENSTOWN, TASMANIA
ON BEHALF OF
THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.

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COMMENTS ON
AN APPLIED POTENTIAL SURVEY
HENTY FAULT ZONE , NEAR QUEENSTOWN, TASMANIA
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THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.

BY

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APRIL, 1980
TAS - 073B

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GEOPHYSICAL CONSULTANTS AND CONTRACTORS

SUMMARY

An applied potential survey was carried out over the Henty Fault zone mineralisation by placing an electrode within a massive sulphide body centred at 1500E on line 49N.

Subject to distortion in form due to misplacement of the relative position of the survey lines, the body was seen at least extending over 500 to 600 feet crossing lines 49.1N and 48.3N with a possible extension from line 49.3N to 48N or even 47.5N should the body itself have internal resistance. The inferred dip of the source is to the west.

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INTRODUCTION

At the request of Mr. K. Reid, Chief Geologist for Mt. Lyell Mining & Railway Company Ltd., Scintrex Pty. Ltd. executed an applied potential survey over mineralisation located as a result of trenching carried out over gradient array anomalies on the Tyndall grid (Report TAS-016 dated January-February, 1973) Unfortunately as no drill hole was open, the work was carried out by placing one current electrode in the *surface* outcrop, with two matched distant electrodes placed across strike.

The work was undertaken over 9½ operator days between 27th October and 6th November, 1979 by Mr. B. Ekstrom assisted by Mr. P. Duncan. The work was supervised by Mr. R. Meares, while the author visited the site on 30th October, 1979.

EQUIPMENT

The equipment consisted of a Scintrex IPC7-25W transmitter using a two second standard square wave, together with an IPR-8 to investigate the primary (Vp) and secondary (Vs) field.

APPLIED POTENTIAL METHOD

Comments prepared for the applied potential surveys carried out at Red Hills

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(TAS-054F, dated August, 1978) are repeated below for completeness.

For a single electrode emplaced within resistive rock, the current moves to infinity as shown in Figure 1A. In section, the equipotentials will form a series of equipotential surfaces, essentially spheres, concentric with the emplaced electrode *providing the resistivity of the medium is homogeneous*. Figure 1B shows a plan of the equipotential in the same situation. On the surface they will form a series of equipotentials concentric about the surface projection of the emplaced electrode.

In the applied potential method the body is made to act as an electrode by an energising current electrode emplaced within the body. For this method to work the body must be significantly less resistive than the enclosing medium. When current is introduced into the body it will give the *whole body an equal potential*, and the current will then flow to infinity as shown in Figure 2. It will be noted that the equipotential surfaces will *wrap themselves around the body* as the current will leave the body at right angles. Providing there is a significant contrast between the body and the enclosing rocks, the equipotential gradient will be steeper on the up-dip side of the body. The steepness of the potential field will show the depth. Therefore it should be possible to ascertain the following information from an applied potential survey (providing always that the current is at infinity):-

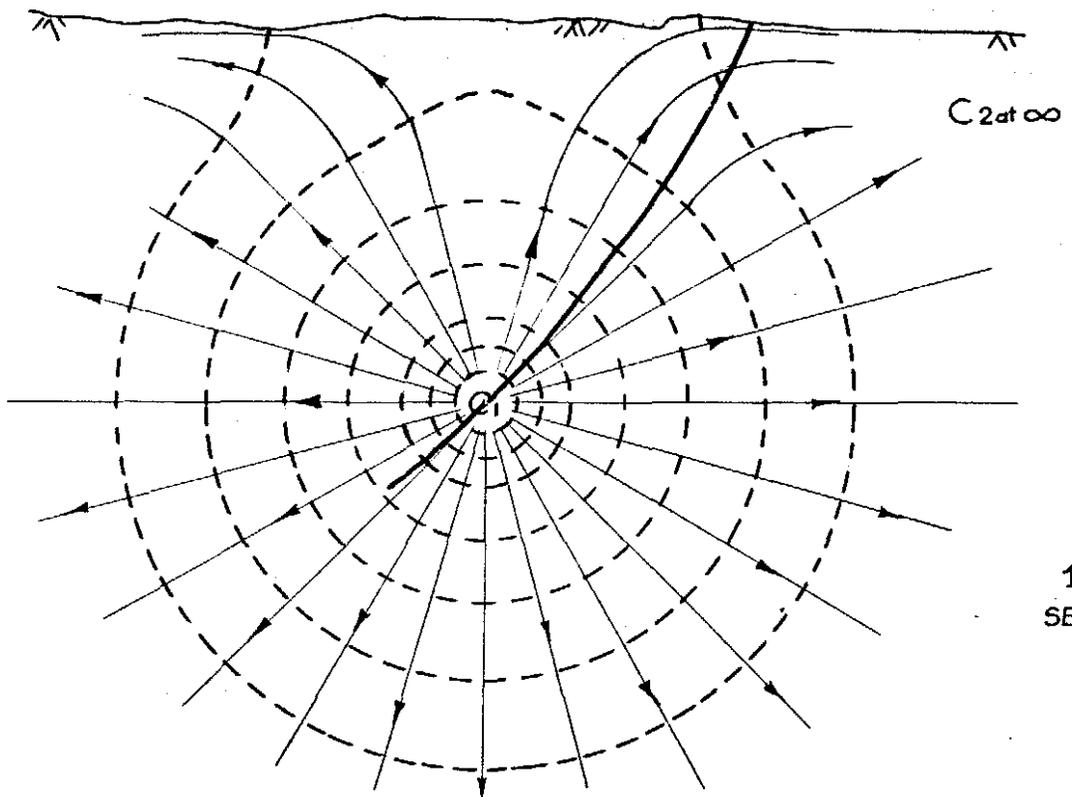
- depth to the top of the source
- strike length
- dip of the source
- the pitch of the source

005

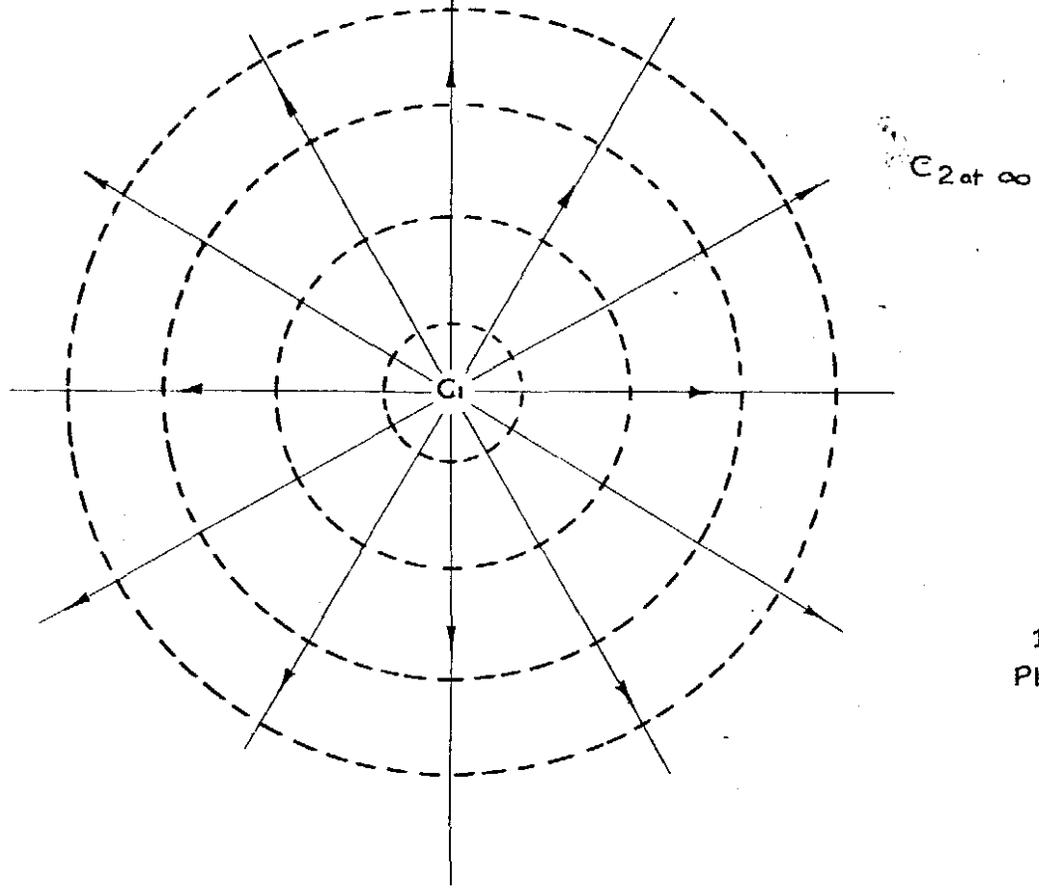
Current Electrodes Emplaced in a Drill Hole

SCINTREX homogeneous medium-

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1a.
SECTION



1b.
PLAN

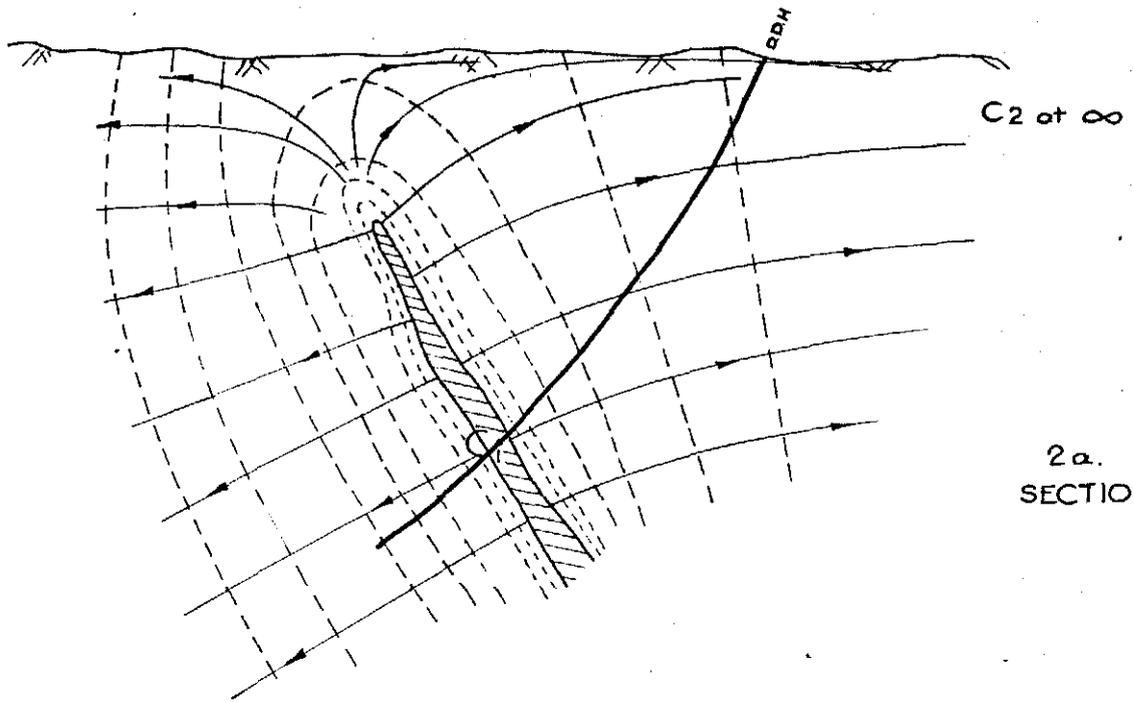
Fig 1

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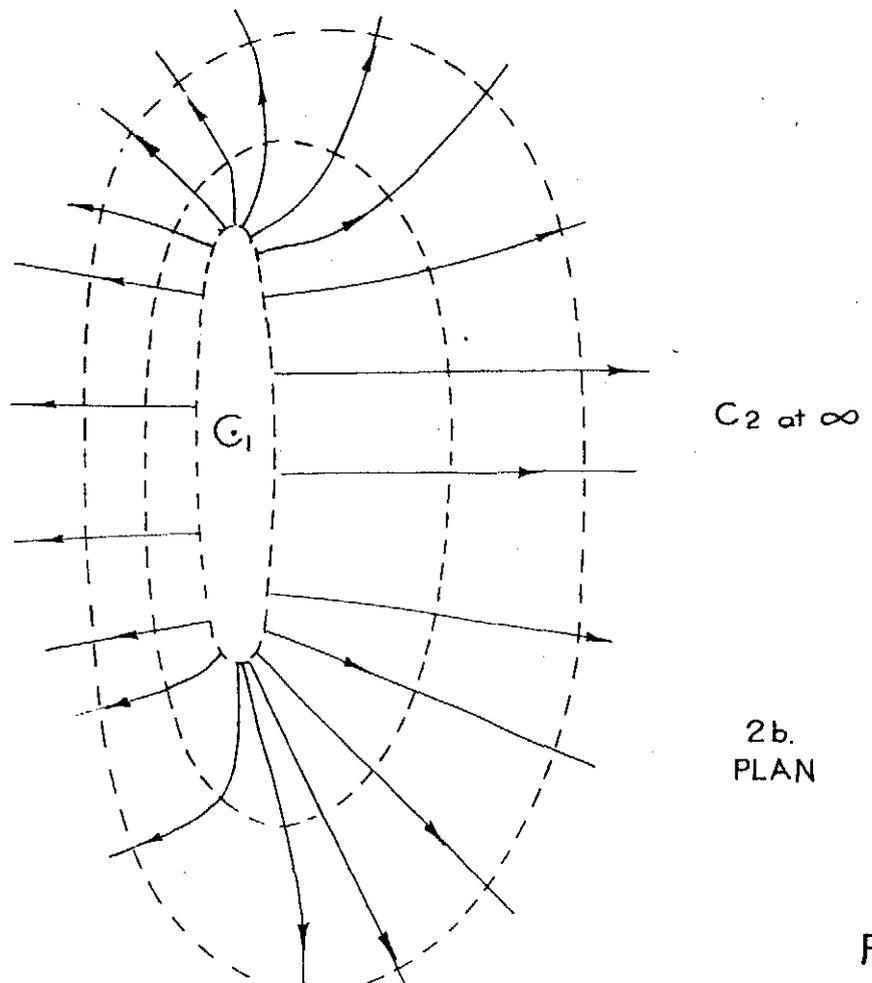
Current Electrode Emplaced in a Drill Hole

SCINTREX - within a conductor -

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2a.
SECTION



2b.
PLAN

Fig 2.

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One of the procedural problems is that for a conductor of significant strike length (and depth extent) a single electrode cannot be put at infinity because it cannot be positioned far enough away from the body. One method of overcoming this problem is to emplace *one* electrode (C_1) *within* the body and *two* electrodes (C_2 and C_2') of *opposite pole* across strike as shown in Figure 3. The current flowing through each is equalised, so that the nett effect is to "pull out" the current from the body as if the two "distant" electrodes are in fact at infinity. In this way the steepness of the equipotential gradients can be meaningfully interpreted to yield dip information.

In Figure 3 the salient points to note are (a) the body energised via C_1 emplaced in DDH-A will produce a severe potential gradient when logged down hole 'B' drilled down dip, which should unambiguously show that this hole intersected the same conductor in holes 'A' and 'B'. (This would also be true *along strike* as well as down dip). In DDH-C a change in gradient at 'Y' would indicate the close proximity of the conductor, but the absolute equipotential level indicated would show that the body has been missed. In practice a three-array log at 2 or 3 spacings would then be run to ascertain the distance of the source from the hole.

Down hole 'C', a potential log would show that the sulphide body 'X' was not in electrical continuity with the energised body, and therefore not part of it. In practice this body would be energised and the resultant surface and down-hole (hole 'C') equipotential contour plans would show the extent of the body 'X'.

The shape of the potential field on the surface is ascertained by holding a

EQUIPOTENTIAL DIAGRAM

APPLIED POTENTIAL ARRAY

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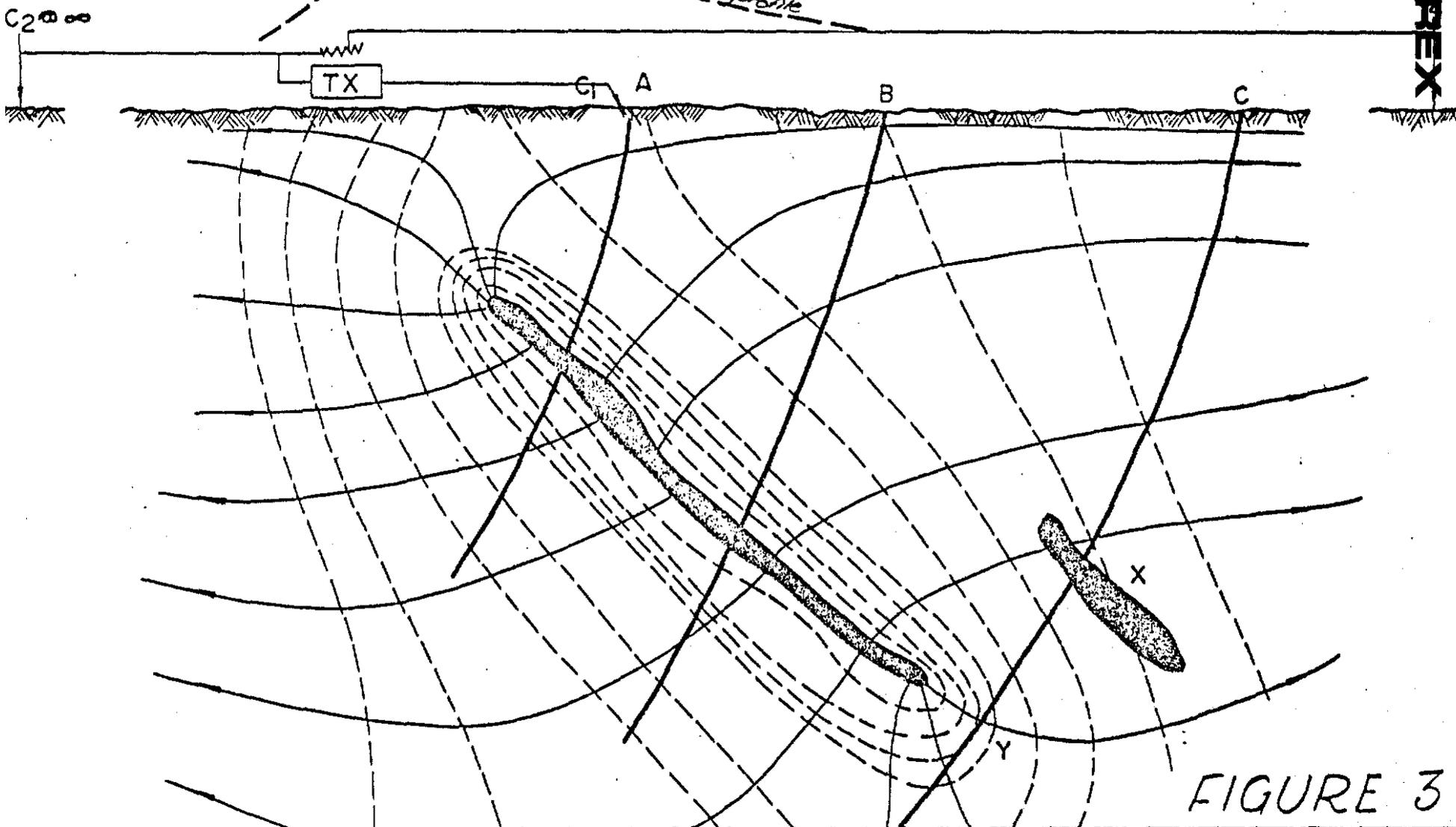


FIGURE 3

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single potential stationary and moving a second over the surface (or down hole) to map the potential field. The resultant potential readings are then contoured. The shape of the contour plan will reflect the shape of the *conductive* source, the position of the distant electrodes C_2 and C_2' if close to the emplaced current electrode C_1 , and also the position of the stationary potential pot P_1 . Diagram 4 will illustrate this last point:-

- a) shows the geological section, while
- b) shows the Vp readings observed, which show a high over the body and also as the electrodes C_1 and $C_2 - C_2'$ are approached.

It is important to realise that the reference pot will be the zero equipotential contour *wherever* it is placed in the field, and the resultant 'low' will not represent a physical property. This is because when the moving potential electrode passes to the one side of the zero contour, the current will move in one sense, and when on the other, it will be in the opposite sense. Diagram 4C is a reconstruction of a profile form when the *sense* of the current flow with respect to the reference pot is taken into account.

For a pipe-like body, multiple balanced infinities can be used which can again allow the dips and plunge of the pipe to be traced.

Figure 5 diagrammatically shows some typical equipotential pattern over bodies energised in the manner outlined above.

DATA PRESENTATION

The data is presented in contour format only using a horizontal scale of 1 inch = 200 feet (1:2400). The data is presented in the following plates:-

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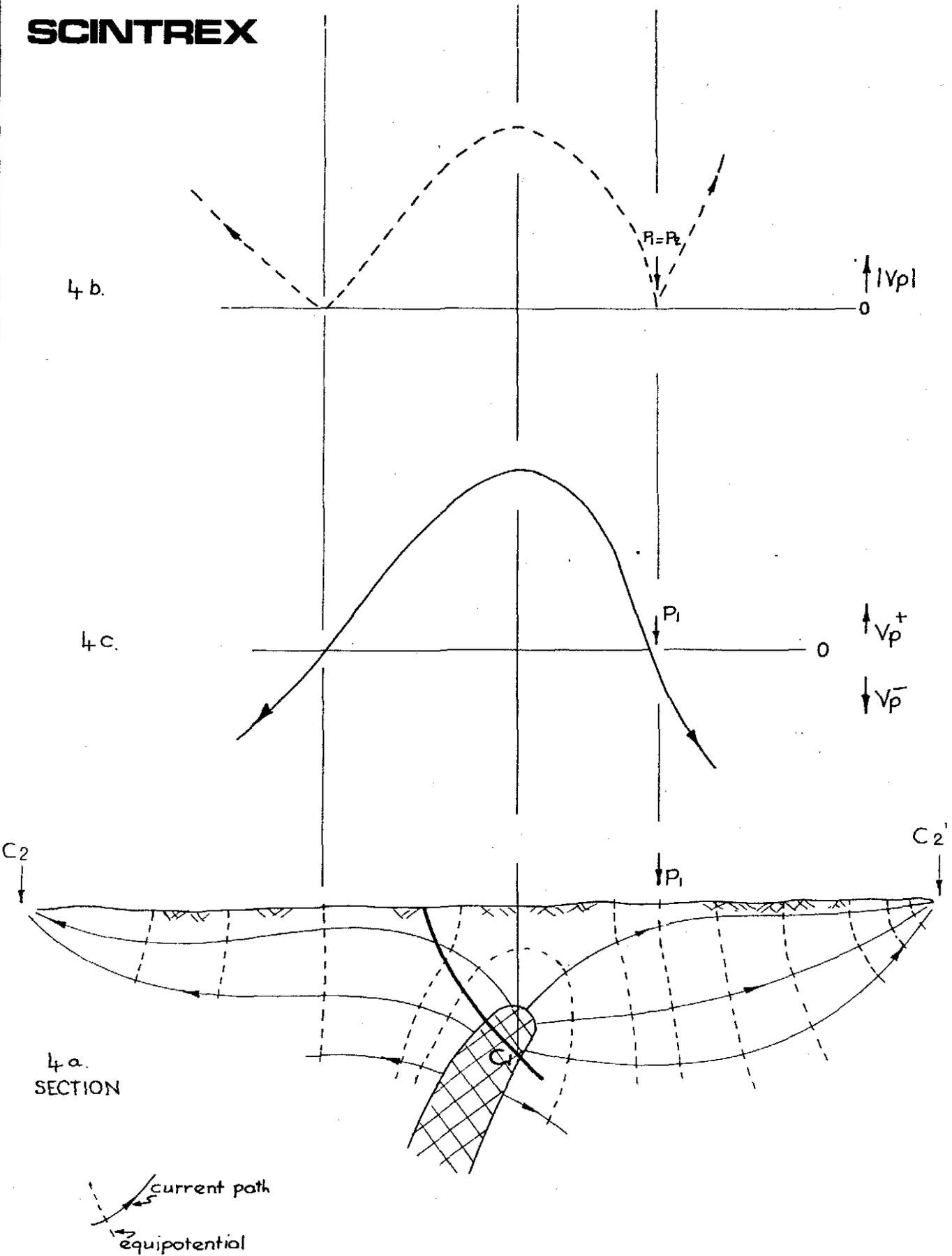
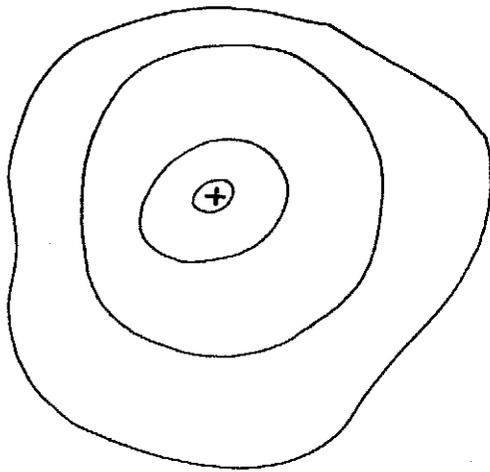


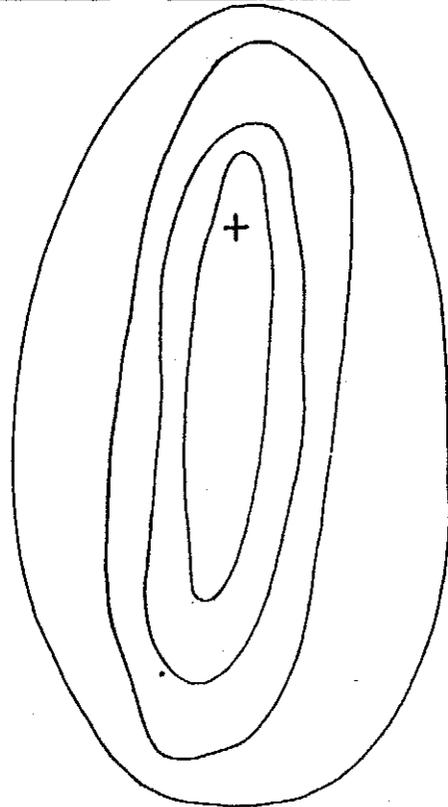
Fig 4

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Typical Applied Potential Patterns

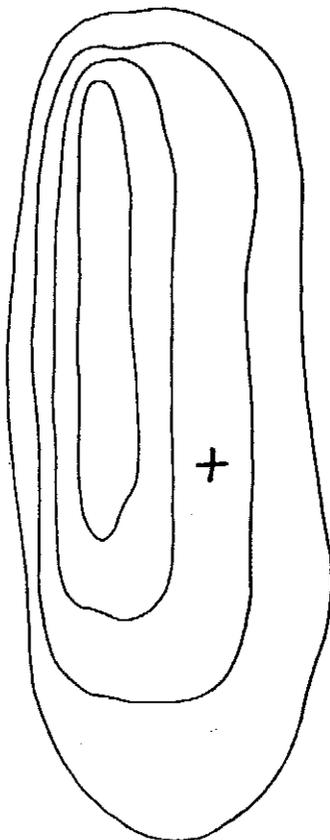


INTERSECTION
OF LIMITED EXTENT

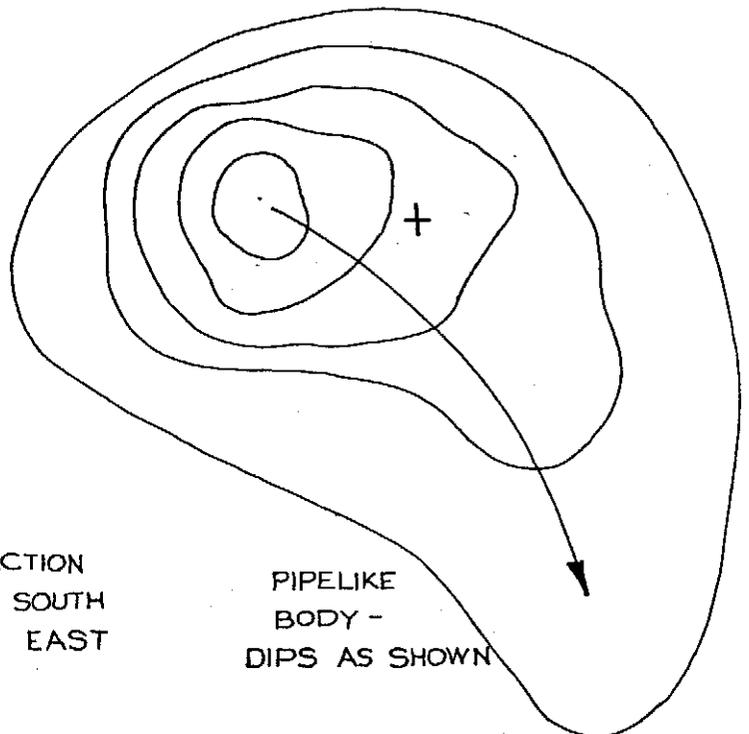


INTERSECTION ELONGATE
STEEPLY DIPPING

+ Vertical projection
of C_1



INTERSECTION
PITCHES SOUTH
STRIKES EAST



PIPELIKE
BODY -
DIPS AS SHOWN

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Plate 1 - primary potential (V_p), Plate 2 - Chargeability (M_3), Plate 3 - secondary potential (V_s) (calculated from $V_s = V_p \times M_3$)

DISCUSSION OF RESULTS

As mentioned in the introduction, the energising electrode was emplaced within the *surface* outcrop of 'massive' mineralisation at 1500E on line 49N. "Distant" balanced electrodes were emplaced at 600E and 2400E on the same line to approximate a single infinite electrode. The stationary (standard) potential electrode P_1 (i.e. the zero potential) was placed at 1200E on line 49N.

The applied potential, V_p , data is displayed on Plate 1. From the sharp variations in the V_p contours, it appears that a number of the survey lines are displaced. Firstly the whole of line 48.3N is displaced to the west. Secondly, the western section of line 49.1N appears to be displaced to the west, west of 1400E. Other minor distortions are not material.

The V_p shows a strong elongation along strike, which to some degree is influenced by the limited lateral (across strike) extent of the 'distant' electrodes with respect to the distance surveyed *along* strike. Nevertheless the V_p shows only a 50% fall in amplitude from about 2000 millivolts over the subcrops on lines 48.9N and 49N to 1000 millivolts on line 49.1N (at 1450E - 1412E) in the north, and line 48.3N in the south (at 1390E - 1312E). This is the probable extent of the mineralisation. However, a distinct elongation observed which crosses line 48N between 1525E and 1400E, centred at 1488E, implies an extension in that direction, but with a source which has some internal resistance. During the author's visit to the site, it was observed that although the sulphides are massive, some silicification may be present. Thus, there may

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be some resistance along the strike of the body. The effect of this on the applied potential data would be to still elongate the equipotential lines along strike, but cause a crop off in the amplitude of the anomaly. This could well be what occurs on line 48N at 1488E and perhaps on line 47.5N at 1600E (+25 metres).

The primary potential field data has been examined and the current path from the point of energisation within the body to the distant electrodes reconstructed. (The current path will be perpendicular to the equipotential lines). This is shown in Figure 6. Also, assuming homogeneity, a current path and equipotential for the same set-up has been constructed. It is the divergencies between the forms of the measured and theoretical current paths which are significant. As can be seen, one of the factors complicating the picture is the uncertainty in the precise relative position of each station and line.

A comparison of Figures 6 and 7 infers that:-

1. the body terminates between lines 49.1N and 49.2N
2. the strike of the body swings grid north-west to north-north-west immediately north of the energisation.
3. to the south of the point of energisation the body swings slightly west of south to line 48.3N, then east of south from lines 48.3N to 48N.
4. An elongation of the Vp high occurs to the south of the body allied with a fall-off in potential. This would be due to a somewhat resistive body (but still *less* resistive than enclosing material) extending south, or be due to the rock unit in which the sulphides occur.
5. On lines 49N and 48.9N the contour gradients strongly suggest a west dip to the source - *with respect to local topography.*

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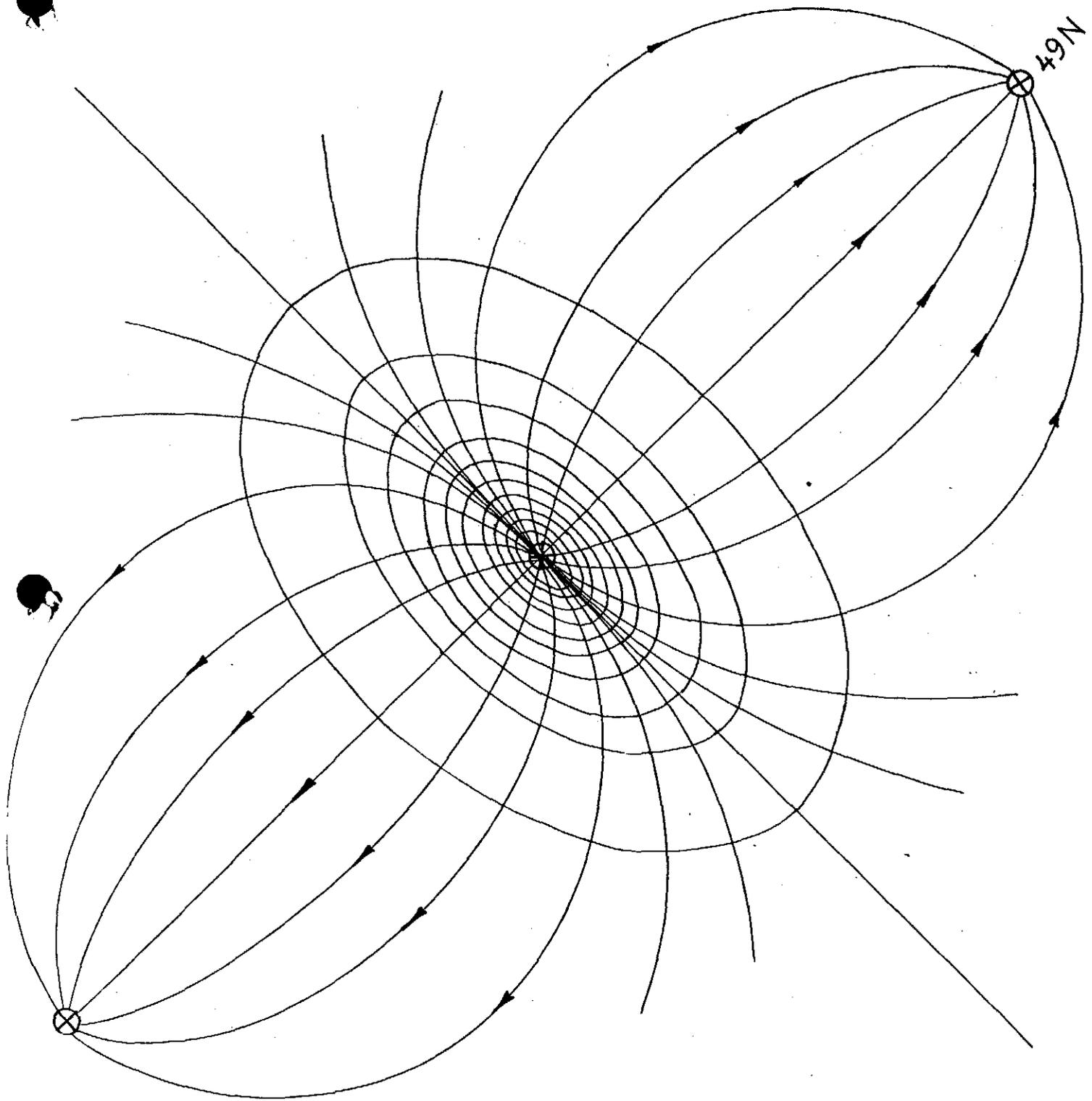


Figure 6.

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▬ Interpreted extent of main body
▬ Interpreted possible extremities of more resistive sections of same body

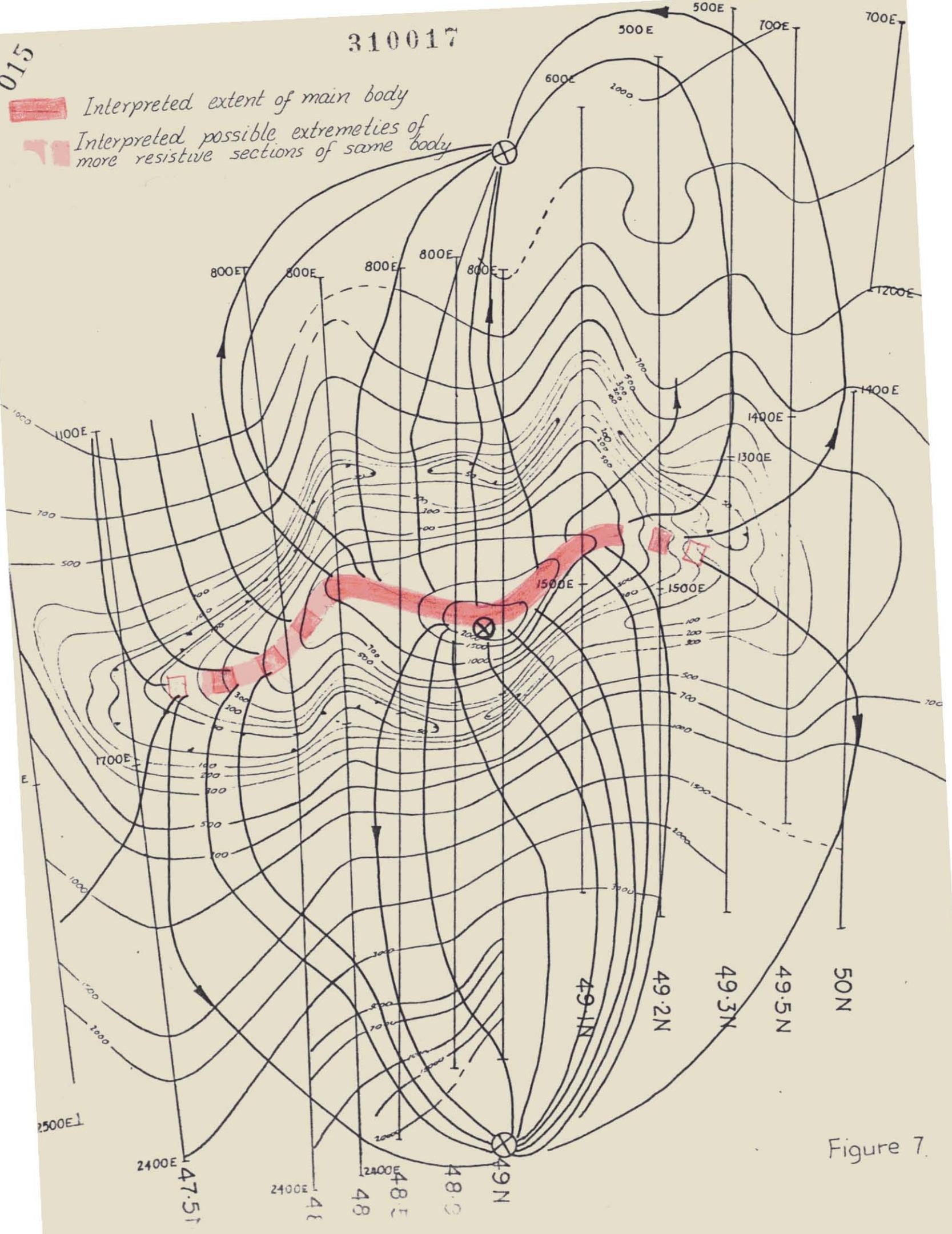


Figure 7.

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As can be seen the *form* of the contour map is much influenced by the surveyed lines. If these are incorrectly placed, the course of the current path, and the extent, and perhaps also the gradient may be incorrect. Therefore *in detail* interpretation is contingent on an accurate line survey, at least in the area contained by the zero potential.

The chargeability data is contoured on plate 2, and the Vs (constructed from $V_p \times M_3$) is displayed in millivolts on plate 3. The form of the latter is broadly similar to V_p , save that the contours are markedly less elongate along strike and infer a lesser strike extension at least as seen via the Vs.

The feature of the data suggests that:-

1. the body dips to the grid west
2. the body extends to the grid south to cross line 48.3N at 1350E, probably terminating between lines 48.3N and 48N.
3. The body extends grid north-north-east from the point of energisation on line 49N at 1500E to cross line 49.1N and 49.2N (However, any distortion in the survey on this line may well change this conclusion).

CONCLUSIONS

1. The V_p indicates a longer possible extension along strike than does Vs. This is perhaps because the former relies wholly on the contrast in resistivity between sulphide body *and host rocks along strike?*, while the latter will be influenced by the polarization. There is a requirement for certainty in the location of the relative positions of lines, certainly in the area enclosed by the standard zero potential, as the implementation of strike extension depends to a certain degree on the form of the contours, and this is much influenced by line position.

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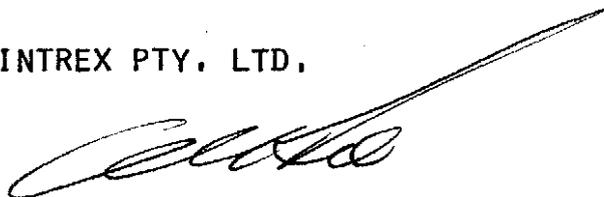
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2. The maximum certain strike extent is 500 to 600 feet as seen for both Vp and Vs. However, if some resistance is assumed within the body itself, which is likely, then the strike length may be as great as 1000 feet (for details see text).

3. The dip appears to be to the west, with the possibility of a plunge to both the north-north-east and the south, however, a precise positioning of the lines would be required to infer this.

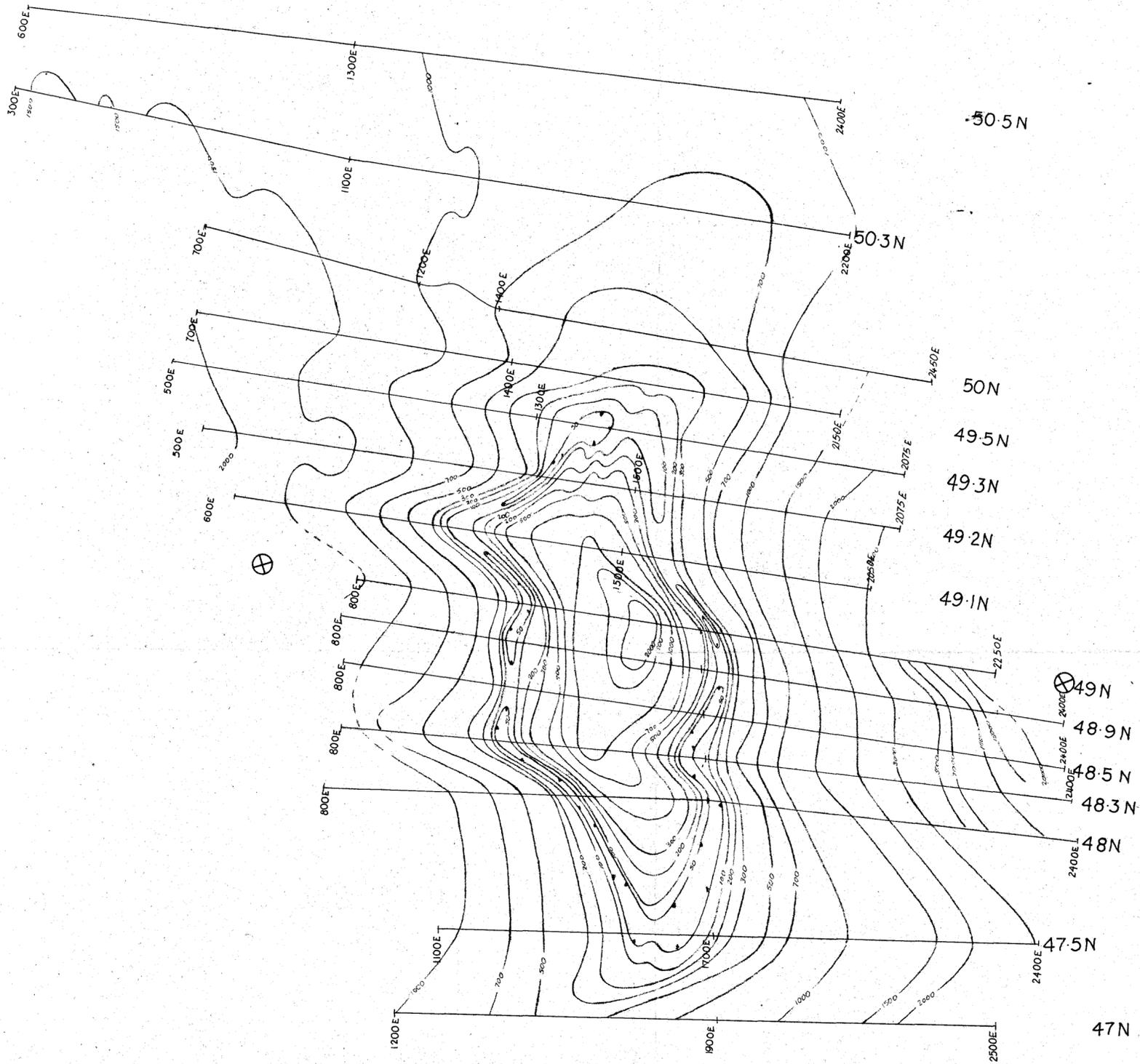
Respectfully submitted on behalf of:

SCINTREX PTY. LTD.



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

GEOPHYSICIST



⊗ electrode positions

MT LYELL MINING & RAILWAY COMPANY LTD.

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NR. QUEENSTOWN - TAS

APPLIED POTENTIAL SURVEY

Vp
CONTOUR PLAN 310020

SURVEYED & COMPILED BY
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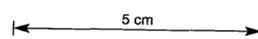


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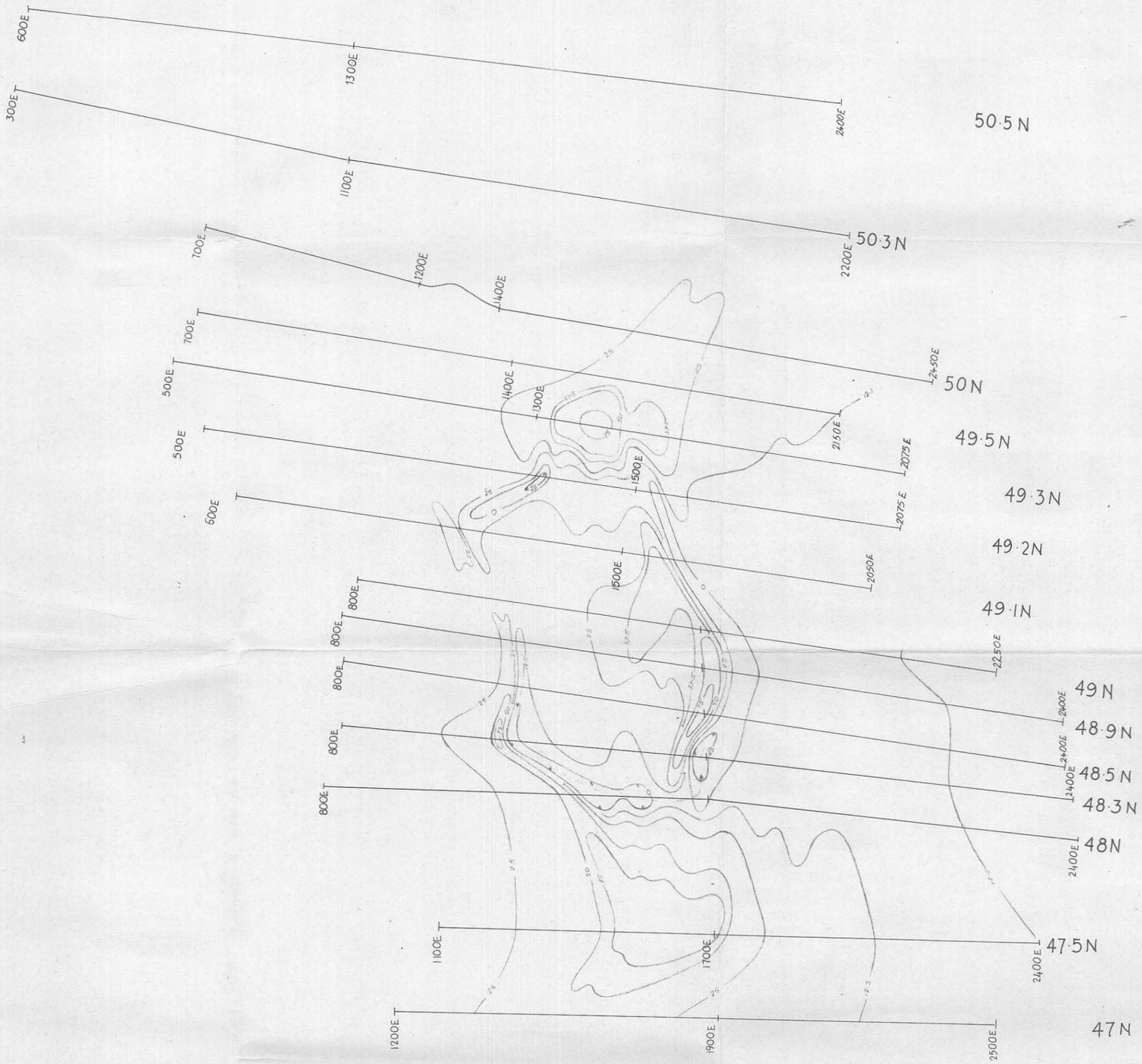
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Job N° TAS-073-B

PLATE 1.



84-2250
84-2256



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HENTY FAULT
NR. QUEENSTOWN - TAS

APPLIED POTENTIAL SURVEY

**CHARGEABILITY
CONTOUR PLAN** 510021

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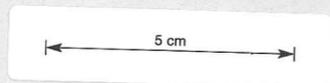


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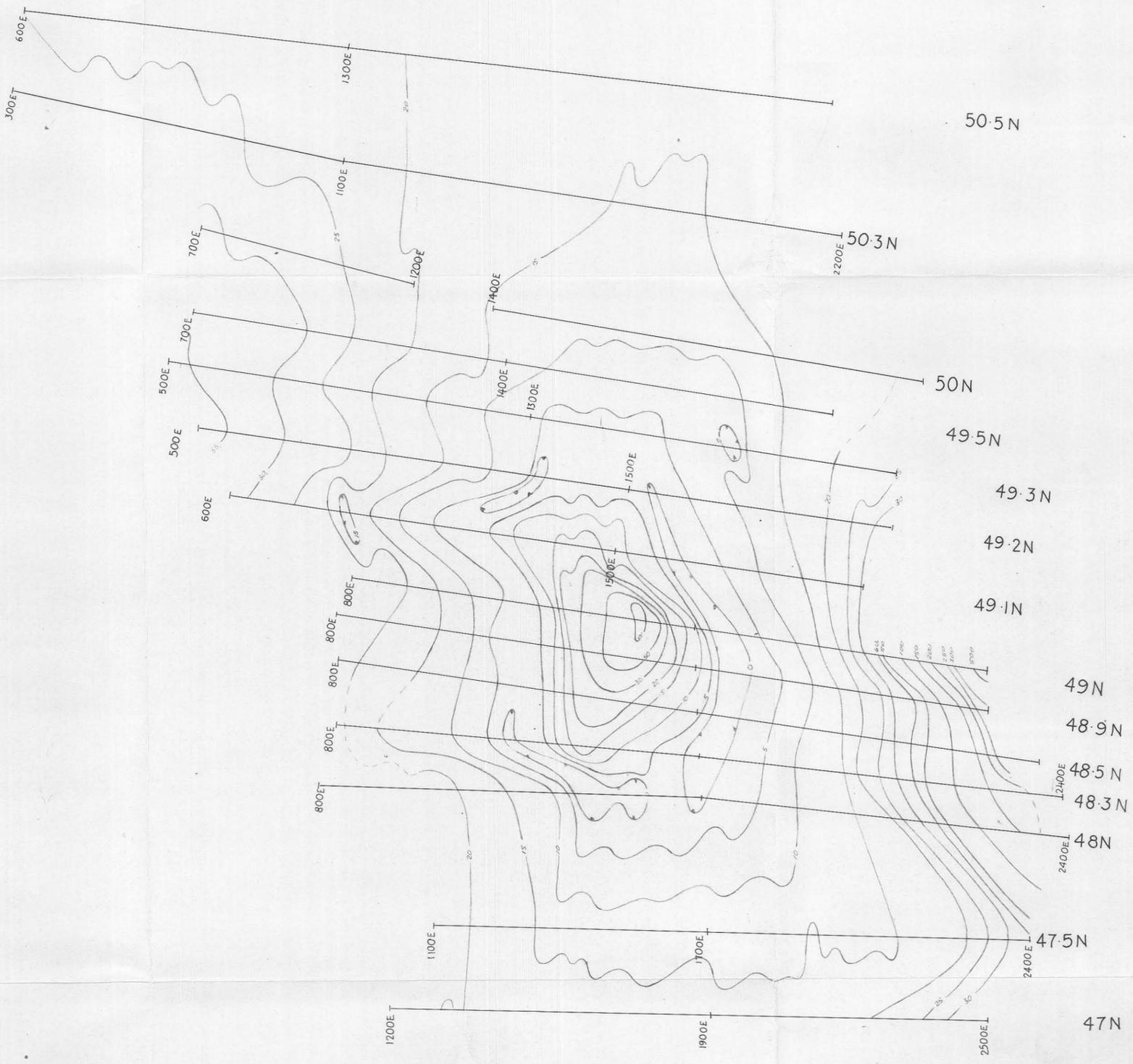
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Job No TAS-073B

PLATE 2.



84-2250



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NR. QUEENSTOWN - TAS

APPLIED POTENTIAL SURVEY

**Vs
CONTOUR PLAN**

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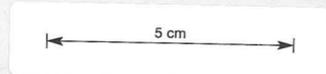


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SCALE 1:5000 ft.

Job No TAS-073B

PLATE 3



84-2250 020