REPORT ON TURAIR AIRBORNE ELECTROMAGNETIC-MAGNETIC SURVEYS IN THE ZEEHAN AREA

by

SCINTREX PTY. LTD.

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REPORT ON TURAIR
AIRBORNE ELECTROMAGNETIC-MAGNETIC SURVEYS
IN THE ZEEHAN AREA
N.W. TASMANIA

ON BEHALF OF

GEOPHOTO RESOURCES CONSULTANTS

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REPORT ON TURAIR AIRBORNE ELECTROMAGNETIC-MAGNETIC SURVEYS IN THE ZEEHAN AREA N.W. TASMANIA ON BEHALF OF GEOPHOTO RESOURCES CONSULTANTS

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SYDNEY, N.S.W.

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CONTENTS

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GEOPHYSICAL CONSULTANTS AND CONTRACTORS

SUMMARY

Scintrex Pty. Ltd. executed 471 line kilometers of combined Turair and magnetic surveys over portions of the Amber Creek, McIntyre, Dundas and Dundas (Extended) Exploration Licences on behalf of Geophoto Consultants.

Some 41 electromagnetic distortions were noted, of which 8 are considered for follow-up as primary targets and 25 as secondary targets, the remainder being considered to be of minor interest only.

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The author wishes to acknowledge the valuable conversations held with Mr. L. Di Scala of Geophoto Resources Consultants, prior to, during and subsequent to the execution of the surveys discussed in this report.

REPORT ON TURAIR AIRBORNE ELECTROMAGNETIC-MAGNETIC SURVEYS IN THE ZEEHAN AREA N.W. TASMANIA ON BEHALF OF GEOPHOTO RESOURCES CONSULTANTS

INTRODUCTION

Turair airborne electromagnetic-magnetic surveys were carried out by Scintrex Pty. Ltd. between 28th. January and 5th. February, 1973, over four areas near Zeehan, N.W. Tasmania, on behalf of Geophoto Resources Consultants.

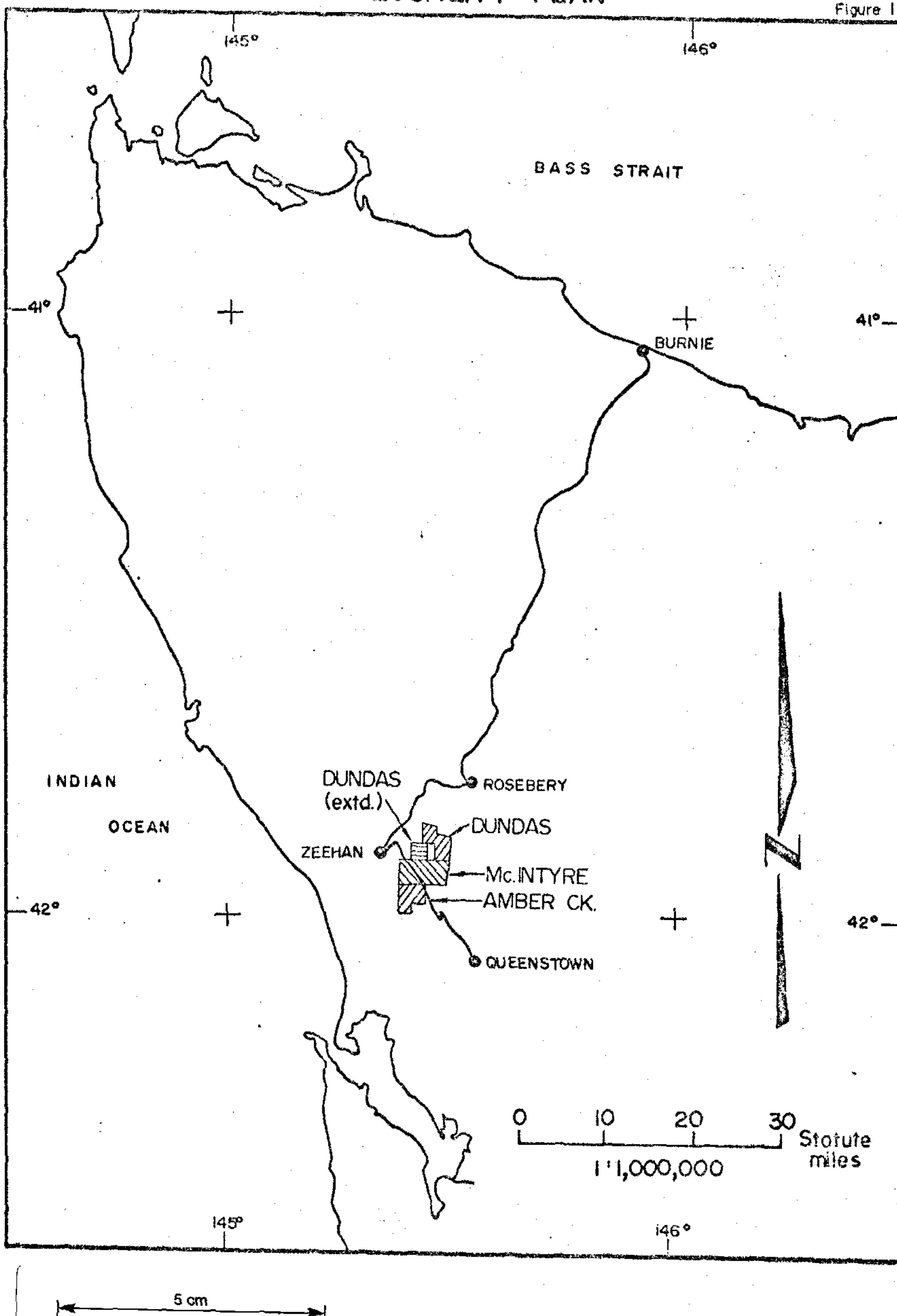
The purpose of the present airborne geophysical survey was to detect and locate any sub-surface conducting zones which may be indicative of sulphide mineralization. In addition the magnetic and electromagnetic data can aid the interpretation of the geology, and can be especially useful in covered areas.

The present surveys involved portions of four areas known as Amber Creek, McIntyre, Dundas and Dundas (Extended) where approximately 21, 43½, 13 and 4½ square kilometers respectively, were covered by turair.

In all some 91 lines were flown totaling about 471 line kilometers made up as follows:

LOCALITY PLAN

Figure 1



Area	No. of lines	Line k.m.
Amber Creek	1 - 27 (27)	141
McIntyre	28 - 51 (24)	218
Dundas	52 - 79 (28)	91
Dundas(Ext.)	80 - 91 (11)	21

The flight direction was approximately east-west with a nominal interline spacing of 200 meters and the mean terrain clearance of the EM bird (receiver coils) was determined by safety considerations, but was generally between 30m and 75m.

Measurements of both the electromagnetic and magnetic fields were made and recorded, utilizing a Scintrex Turair-11 unit at 400Hz and a Scintrex MAP-2 nuclear resonance total intensity magnetometer. This equipment, together with all necessary ancillary equipment was installed in a Bell 206A Jet Ranger helicopter, VH-RHQ subcontracted from Rotor-Work Helicopters Pty. Ltd.

The reader is referred to Appendix 2 for a general discussion of the Turair method.

The primary target mineralization for the present survey system is massive sulphide mineralization (i.e. interconnection of the conductive sulphide mineralization to form an electrical conductor).

Other potential conductors which may give rise to electromagnetic anomalies are interconnected graphite, mineralization water, saturated fault or shear zones, or zones of deep differential weathering (perhaps resulting from minor mineralization and alteration). The conductors can, however, be separated from massive sulphides conductors on the basis of their EM response.

PRESENTATION OF DATA

The original data records are presented in two binders, the data being recorded on a 6 channel, heat sensitive strip chart recorder and operated at a speed of 10 cm per minute. The chart is 38 cm wide with each channel being 5 cm wide. The parameters recorded and their details are as follows:

Altimeter: The altitude of the helicopter above the ground is recorded in an analog form, where approximately 1 cm = 100 feet below the helicopter. Calibration records of the altimeter are presented in the binder.

Amplitude: The amplitude of the signal output from the preamplifiers is recorded in analog form. It shows the automatic switchings that occur to keep the signal within the necessary amplitude range for the equipment operation.

Electromagnetics: Two sensitivities for the Turair records were used, and the records are annotated accordingly:

Field strength ratio (FSR) 1 cm = 1% and 0.5%

Phase difference 1 cm = 0.50 degrees and 0.25 degrees.

Magnetometer: The magnetic data is recorded on the event markers, the interval being 1.6 seconds. The flight log records are presented in a separate binder, and show the lines surveyed and which lines were recovered.

The survey flight lines and points were recovered on an approximate 1 : 10, 000 photomosaic. The points were recovered with the aid of an on-board tracking camera. Plates 1, 2, 3 and 4 represent the overlay plan of the 1 : 10,000 mosaics for Amber Creek, McIntyre, Dundas and Dundas (extended) respectively, and show 10 gammas magnetic contours, flight lines and significant Turair conductors.

INTERPRETATION

The electromagnetic records are interpreted to determine the presence of conducting bodies and to obtain some information relating to their character. The intervalometer time marks are synchronized with the positioning camera film strip and thereby permit the relating of the conductors with approximate ground locations. The terrain clearance is obtained from the altimeter data.

Normally, a plan is prepared, either using a subdued photomosaic or an overlay from a mosaic or topographic plan as base. The flight path of each survey line is obtained by means of "tie points", which are features on the mosaic or topographic plan, identified on the positioning camera film. The flight path is interpolated between these tie points.

Where field distortion occurs the curves indicate the location and the depth of the main current flow. The "current axis" is well defined when the current is concentrated, for instance, in thin, steeply dipping conductors. In wide, banded conductors, or in horizontal conductors such as overburden, the current is usually more dispersed and the anomalies yield less positive information.

(a) Peak Location

The peak location of the amplitude ratio using the horizontal coplanar coils is shown on the plan by a circle in the appropriate location. In the case of broad conductors or closely spaced multiple conductor zones there may be more than one peak, in which event all major peaks are shown. A conductor which is likely man-made is indicated by an X rather than by a circle.

As a rule the current axis is located right below the maximum field strength ratio deflection or the maximum phase anomaly. The depth under the traverse is indicated by the shape of the anomaly.

(b) Depth and Conductor Width

The "Half width", i.e. the distance between the points of half the maximum response amplitude is, for simple line current sources, approximately equal to the depth of the source under the detector. Flat-lying conductors (e.g. overburden) characteristically give rise to very large half widths, combined with rather irregular curve shapes. Here the half width may reflect the conductor width rather than the depth and the latter can usually not be determined. In cases where the conductivity zone is interpreted to have indicated on the plan by an open bar symbol along the flight line. Well defined peaks within this zone should be marked, and if possible interpretated as individual anomalies. The subsurface depth of the current axis (subtract detector altitude) is marked on the lower left of the peak location circle.

(c) Conductor Grading

Field strength ratio and phase difference anomaly amplitudes are dependent on the overall geometry as well as on target size and σt value. Their primary significance is in the degree of certainty they lend to detectability and quantitative interpretation. In the text they are distinguished as being of "primary", "secondary" or "tertiary" interest.

(d) Conductivity-Thickness Factor

The field strength ratios and phase differences provide a measure of the conductivity of the conducting bodies, i.e. good conductors are characterized by field strength distortion combined with relatively little phase shifting, whereas poor conductors affect the phase rather than the strength of the resultant field. On plates 1 - 4 0 - 10 mhos is unshaded and in excess of 100 mhos fully shaded.

The low amplitudes encountered in this survey made these determinations difficult.

For an accurate grading the conductivity-thickness factor (σt value) of individual conductors can be derived from the calculated in-phase and out-of-phase components, taking into consideration the exciting frequency and the strike length of conductor. The σt value is then marked on the upper-right side of the peak location circle.

Large, highly conducting bodies such as massive sulphides or graphite and seawater, etc., generally have high σt values. Moderate conductors will have σt values between 10 and 100 mhos. Poorly conducting bodies (e.g. most overburden and some sulphide and graphitic zones) will have σt values of less than 10 mhos. In areas where there is a clear differentiation in conductivity between the targets of potential economic interest and other possible conductors, the σt values may form the main basis for discrimination. When the conductivity ranges of economic and non-economic overlap, the σt value cannot, of course, be rigidly relied upon.

(e) Current Pattern

To obtain the projection of the current pattern, the anomalies are connected between lines, using depth σt values and other characteristics of the curves as criteria. The strike of the formation, if known, is also taken into consideration.

(f) <u>Magnetic Correlation</u>

With magnetic data available, any correlating magnetic expression is noted for the pertinent conductor peak. A conductor peak with direct magnetic correlation is indicated by a double concentric circle.

Location of a conductor on the flank of a magnetic anomaly is indicated by means of one half of a concentric circle on the side of the magnetic high.

The significance of direct or flank correlation depends on the search problem. In the former case the magnetic and conductive properties may be coincident or belong to two narrow adjoining zones. In the latter case the conductor may be located at the contact of a wider magnetic formation.

DISCUSSION OF RESULTS

Three adjacent areas, Amber Creek, McIntyre and Dundas were flown. The results of the magnetic and electromagnetic survey of these areas are shown on plates 1, 2 and 3 respectively. In addition, a small area, Dundas (Extended) was surveyed and this data is presented on plate 4.

Each electromagnetic anomaly being given a code number, is analysed where possible, for the following:

1. Location.
2. Anomalous field strength ratio in percent.
3. Anomalous phase difference in degrees.
4. Relevant magnetic character.
5. Depth estimation of current axis below the ground.
6. Correlation of anomalies on adjacent lines, being indicated by a common conductor.
7. Conductivity-thickness (σt) product.

The fiducial position of the anomalies as shown on Plate 1 is taken directly from the geophysical data with no adjustment taken into account for any displacement from its true position. A displacement of 100 to 200 ft. often occurs, normally in the direction of flight.

Generally the anomalous electromagnetic responses recorded were of extremely low amplitude, both in phase and in ratio, and the majority are very close to the noise level.

All three areas are covered by extremely resistive rock types and the overlying soils, moraines and button grass with one or two exceptions, are non-conductive as indicated by the absence of any phase or ratio response over the areas flown. The instrument is infact well below 0.1% ratio and 0.1° phase noise levels normally observed.

Each of the areas is discussed individually below.

AMBER CREEK

The flight lines, together with the contoured magnetic data and electromagnetic conductors are shown on the 1 : 10,000 photomosaic overlay, and Table I gives details of the conductors. The 27 lines flown, covered approximately 141 kilometers of line, and some 20 distortions in the electromagnetic profiles were recorded. Brief comments are made on each of these anomalies.

Anomaly 15 (4E/126½) This broad illdefined conductor of low amplitude has a conductivity width product of the order of 90 mhos and is directly related to a north-south trending magnetic response of about 70 gammas. This is the only line over this magnetic feature which shows any sign of conduction. The calculated maximum depth is 67m, but multiple conductors within the resolution of the system cannot be ruled out, and, if present, would materially reduce this depth. This anomaly is worth investigating further as a secondary target.

Anomaly 16 (6E/472) This anomaly is a broad low amplitude response of about 90 mhos. The calculated maximum depth is of the order of 125m but is excessive as more than one conductor is expected, This anomaly has no magnetic correlation and is of tertiary interest only.

Anomaly 17 (13W/959) The phase response is well above noise level and the conductivity width product is calculated to be of the order of 20 mhos. The depth of 105m is almost certainly excessive, as the anomaly is composite and has probably two sources situated at 957 and 960. There is no direct magnetic correlation. This anomaly is of secondary interest.

Anomaly 18 (14E/793) This above background response is significant on the phase response only and therefore shows very weak conduction of the order of 1 mho. A second weak response was also defined at 802, of secondary or tertiary interest only, broadly correlates with a weak magnetic high.

Anomaly 19 (14E/831,840) This anomaly is a broad, very weak multiple conductor which may represent conduction within the overburden. It is of minor interest only.

Anomaly 20 (19E/2296,12) Conduction of the order of 50 mhos was recorded over a broad zone with a possible single source within this zone at 2297. There is no direct magnetic correlation, and conduction within, or close to, the overburden is suspected. The anomaly is of tertiary interest only.

Anomalies 21, 22 & 23 (20W/2159, 2173 & 2177) These three responses of 50 mhos, 35 mhos and 75 mhos respectively, are calculated to occur at maximum depths of 125m, 97m and 50m respectively. These depths are probably excessive as multiple conductors are expected. There is no magnetic correlation and these anomalies are of secondary interest only.

Anomalies 24 & 25 (21E/2007 & 2012) The deep 115m sources calculated are probably excessive due to multiple conduction. Both are definite and of secondary interest. The calculated conductivity widths are of the order of 35 mhos.

Anomaly 26 (21E/2037) This minor response is a multiple conductor and shows a conductivity width product of the order of 70 mhos. It is of tertiary interest only.

Anomalies 27 & 28 (22W/1869½ & 1881) Within a broad zone of multiple conduction, two possible conductors were defined having conductivity widths of 42 and 30 mhos respectively. The depths are difficult to assess, but the sources lie within 100m of the surface. There is no magnetic correlation and both are of secondary interest only.

Anomalies 29 & 30 (23E/1705½ & 1709½) These two responses are multiple conductors showing high conductivity width products although the amplitudes are low. The maximum depths of about 90m are certainly excessive as multiple conduction occurs. It is of secondary interest only.

Anomaly 31 (27W/388) A minor but definite response indicating a conductivity width product in excess of 100 mhos was observed at a calculated maximum depth of 50m. Follow-up of this anomaly as a secondary target is recommended.

Anomalies 32A, B & C (27E/959, 966 & 972) Wholly field strength ratio responses have apparent maximum depths of the order of 80m, 80m and 50m respectively. They tie in a magnetically disturbed area, but there is no direct correlation with magnetics. These anomalies are recommended for follow-up as primary targets.

McINTYRE

The flight lines together with the contoured magnetic data and graded conductor axes are shown on the 1 : 10,000 photomosaic overlay, (Plate 2). Table II gives details of the defined Turair conductors.

Approximately 218 line kilometers of Turair survey over 24 lines yielded some 11 distortions in the electromagnetic profiles. Brief comments are set down below on each of these distortions.

Anomaly 1 (28W/687) A broad minor, but nevertheless above background, response on the field strength ratio shows little or no phase distortion indicating good conductivity source. The calculated maximum depth is of the order of 180m, but this is excessive due to the multiple nature of the conductor. There is a broad correlation with minor increase in magnetic intensity. This anomaly is of secondary or tertiary importance only.

Anomaly 2 (29E/578) A minor above noise level distortion in the field strength ratio correlates with a minor magnetic response of the order of 3 gammas. The depth to source calculates an on or near surface source. It is of secondary interest only.

Anomaly 3 (29E/561½) A surface response similar to Anomaly 2 is likewise of secondary interest only.

Anomaly 4 (29E/584½) As above but with 15 gammas magnetic peak.

Anomaly 5 (38E/3393½) A well defined banded conduction indicated a conductivity width product in excess of 100 mhos. The calculated maximum depth of 150m is certainly excessive. It is of secondary interest only.

Anomaly 6 (42W/2414) A very minor near surface response was recorded at this point only. This is of tertiary interest at best. There is no magnetic correlation.

Anomalies 7 & 8 (50W/340½ & 345) These two responses were some of the better conductors defined, and the maximum depths indicate the sources to be near surface. These two conductors are of primary importance, and are recommended for detailed follow-up.

Anomalies 9 & 9A (50W/374 & 378) Two local peaks within a banded conductor have been designated 9 and 9A. 9 is well defined and of primary/secondary importance, whereas 9A is of secondary interest at best. There is no correlation with the magnetic data. The multiple nature of the conductor makes the maximum depths unreliable.

Anomaly 10 (51E/072½) A banded conductor having a high conductivity width product was recorded centred at 072½, and is associated with a local magnetic high. This anomaly is of secondary interest only.

DUNDAS

Plate 3 presents the magnetic contour map and conductor axes plan, together with the flight line plan. As with plates 1 and 2, the scale is 1 : 10,000.

Over the 91 kilometers of line flown, only five electromagnetic anomalies were recorded. These are summarized on Table III and discussed briefly below.

Anomaly 11 & 11A (56W/262½ & 267) These two essentially phase responses are local peaks recorded within a banded conductor. The maximum calculated depths of 57m and 45m are, therefore, probably excessive. These conductors should be investigated further on a secondary basis only.

Anomaly 12 (62E/657) A small amplitude field strength ratio anomaly was defined at fiducial 657. There is little phase response, but nevertheless, there is a well defined anomaly, and the maximum depth is calculated to be of the order of 45m and multiple conduction is not suspected. This conductor is of secondary or perhaps primary interest.

Anomaly 13 (73E/2251) This minor response on both phase and field strength ratio correlates with a broad magnetic high. The calculated maximum depth of 190m is certainly excessive due to the banded nature of the conductor. It is of secondary or tertiary interest only.

Anomaly 14 (74W/2438) This is a minor response only, showing high conductivity width product of over 80 mhos and was recorded at a maximum depth of the order of 88m. This anomaly should be followed up as a target of secondary importance.

DUNDAS (EXTENDED)

Plate 4 shows the photomosaic overlay at a scale of 1 ; 10,800. This depicts magnetic contours at 10 gamma intervals and shows all five zones of electromagnetic conduction defined on the 11 lines flown. Brief comments are made on each conductor.

Anomaly 33 (87W/012-030) This broad zone of conduction is almost entirely shown in the phase profile resulting in a low conductivity thickness product of 2 mhos. This conduction correlates with a broad magnetic high of the order of 100 gammas. The cause is most likely to be conduction within the overburden and/or oxidation (if present). This anomaly is considered to be of tertiary interest only.

Note: Anomalies 34 - 37 inclusive have been positioned using the magnetic and altimeter data only, as the unavailibility of inflight photography precluded precise definition. The source of each conductor lies within the "box of error" shown on Plate 4.

Anomaly 34 (88W/160-166) This broadly correlates with anomaly 33 described above. Phase response only indicates a very low conductivity width product. This wide zone of conduction is coincident with a broad magnetic high of about 80 gammas. It is of tertiary interest only.

Anomaly 35 (88E/178) A small reverse anomaly occurs at fiducial 178. The apparent conductivity width product of the order of 40 mhos and the source is fairly shallow. This anomaly is of secondary or tertiary interest only.

Anomaly 36 (89W/116-123) This broad multiple conductor correlates with an 80 - 100 gamma magnetic high. The response is very similar to anomalies 33 and 34 to which it can be correlated. It is of tertiary interest only.

Anomaly 37 (9W/102) This reverse anomaly is quite definite and has a field strength ratio response of 0.3% with a phase response of about 0.5°, both significantly higher than the noise levels. Although a reverse response, this outstanding anomaly is recommended for follow-up as a primary target. The depth is considered to be of the order of 30m. However, as the helicopter speed is not accurately known, this figure could be in error.

CONCLUSIONS AND RECOMMENDATIONS

The monotonous nature of the survey area presented material problems in flight path recovery. The tie points shown on the photomosaic overlays are all unique points and are considered to be reliable. Where no such points were able to be located, survey lines have been dashed in. In the case of lines 78W and 79W, only one significant point was recovered after several days endeavour. Fortunately no distortions in the electromagnetic profile take place over these lines. Attempts were made to precisely locate all turair conductors on the relevant fiducial. However, this was only possible in a few cases. The fiducial on the table has been marked with an asterisk (*) where this was possible.

For the most part, the Turair traces are remarkably free of both instrumental and geologic noise. The latter indicates the very resistive nature of the rock units and overburden over which the survey was flown. Therefore the very weak distortions recorded on this survey are considered to have significance.

The anomalies have been graded for conductivity width product and for definition. However, of far greater significance in the present survey is the geological environment in which these conductors occur. Therefore the initial follow-up work should consist of an evaluation of the geology in the immediate vicinity of each electromagnetic conductor which has been given primary and secondary rating. Those occuring in geologically favourable environments should then be subjected to local ground surveys to locate and define the source precisely.

The low amplitude of the majority of the electromagnetic distortions registered in both phase and amplitude, and to a lesser extent, the variable helicopter speeds, introduced an error into the evaluation of the depth to source of the conductors below ground. Therefore. for low amplitude anomalies the indicated depth can be used as a guide only. In addition quite often multiple conductors within the resolution of the system are expected, in which circumstances depths will be excessive. Similarly, conductivity thickness values cannot be determined precisely, but as remarked above, this is not considered as significant as the environment in which the conductors occur.

Due to the difficult problems in unambiguously defining the precise location of each Turair conductor in the majority of cases in the present survey, it is felt that additional ground geophysical work will be required. Therefore the following comments are offered on the various potential geophysical follow-up methods which could be utilized to better define the sources on the ground .

For conductors whose maximum depth is considered to be less than 60 - 80m, a Turam electromagnetic method is suggested on the ground to accurately locate the source. At depths greater than this, difficulty is encountered resolving potential conduction from near surface geologic noise, although this has been successfully achieved ina number of cases. One point in favour of Turam is the extremely high resistivities of the rocks and overburden over the areas flown.

In those cases where the Turair anomaly has coincidence with, or is in close proximity to, a clear magnetic feature, ground follow-up using proton precession or fluxgate magnetometer may be used to locate the magnetic feature on the ground. This can only be suggested in a limited number of cases in this area.

For sources deeper than 60m - 80m, should a disseminated halo be suspected around a more conductive core, (a feature not uncommon to a variety of West Coast deposits), a gradient induced polarization method is a valid approach. This method has also been successfully applied, but it should be realised that any induced polarization/resistivity technique measures electrical parameters almost totally different to those tested in an electromagnetic method. (This approach is of course also valid for deposits closer to surface.)

The magnetic data has not been studied in detail. However, it has been discussed with Mr. L. Di Scala of Geophoto on a number of occassions. The following very brief comments are made.

1. The magnetic data indicates low amplitude magnetic anomalies over much of the area flown, indicative of sedimentary rock units only.

2. Between lines 24W and 40W on the south eastern section of

the McIntyre area, an area having up to 250 to 300 gammas above background, was noted. Discussions with Mr. L. Di Scala of Geophoto indicate that small outcrops of gabbro have been recorded in the area. The response is somewhat low for an ultrabasic but other ultrabasic zones on the North West coast have shown anomalously low magnetic responses. Therefore it is not impossible that the entire zone of magnetic disturbance may be due to ultrabasic intrusions. Mapping is recommended to investigate this further.

3. A north-south trending 50 to 60 gamma magnetic high was recorded on lines 1W to 11W on the southern section of the Amber Creek sheet. Magnetite bearing sandstones have been recorded in this area.

4. Weak electromagnetic conduction was noted coincident with a magnetic high on lines 87W, 88W and 89W in the north eastern section of the Dundas (Extended) sheet. (Plate 4) This conduction may be due to the more intense weathering of a somewhat more basic unit, or to weak conduction from within the unit itself. The associated electromagnetic conductors are not considered to be of interest.

In summary, those anomalies recommended for follow-up as primary targets are:

Amber Creek	32A, 32B & 32C
McIntyre	7, 8, 9 & 9A
Dundas	none
Dundas (Extended)	35

Targets recommended for follow-up and considered as of secondary importance only are:

Amber Creek	15, 17, 18, 21, 22, 23, 24, 25, 27, 28, 29, 30 & 31.
McIntyre	1, 2, 3, 4, 5 & 10.
Dundas	11, 11A, 12, 13 & 14.
Dundas (Extended)	35

The anomalies of little importance are considered to be:

Amber Creek	16, 19, 20 & 26
McIntyre	6
Dundas	none
Dundas (Extended)	33, 34 & 36

We would be pleased to discuss the geophysical results as soon as you have been able to make a geological evaluation of the conductors.

Respectfully submitted on behalf of:
SCINTREX PTY. LTD.

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GEOPHYSICIST

AMBER CREEK

684032

Anomaly No.	Line	Fiducials	Photo No.	Conductivity	Depth	Magnetics	Comments
15	4E	126½		90 mhos	67 m	70 high	minor
16	6E	472		90	125m	-	very minor
17	13W	959	0704	20	105m	-	moderate
18	14E	793		1	0	broad high	minor
19	14E	831/40	0704	1	0		minor
20	19E	2296/12		50			banded conductor
	19E	2297		50	125m		definite but minor
21	20W	2159	0704	50	125m		multiple
22	20W	2173		35	97m		multiple?
23	20W	2177		75	50m		multiple?
24	21E	2007		35	115m		definite multiple?
25	21E	2012		35	115m		" "
26	21E	2037		70	115m		minor & multiple
27	22W	1869½		42	100m		multiple
28	22W	1881		30	?		multiple
29	23E	1705½		40 mhos	85m		minor multiple
30	23E	1709½		125	95m		minor multiple
31	27W	388		100+	50m		definite, minor
32A	27E	959		100+	80m	mag flank	definite
32B	27E	966		100+	80m	" "	"
32C	27E	972		100+	50m	" "	"

684033

TABLE II

McINTYRE

A classification of all distortions in the phase shift and field strength ratio profiles. Those marked with an asterisk (*) have been picked on the fiducial and those marked with a (#) are considered to be significant.

Anomaly No.	Line	Fiducials	Photo No.	Conductivity	Depth	Magnetics	Comments
1	28W	687*	0698	100+	181	shoulder/ peak	Well defined, banded
2	29E	578*	0698	100+	0	3 & peak	minor
3	29E	561½	0698	100+	0	-	minor
4	29E	584½	0698	100+	0	15 & peak	minor
5	38W	3393½	0696	100+	150	-	well defined, banded
6	42W	2414	0696	100+	7	-	minor
7#	50W	340½	0691	100+	9	20 & high	well defined
8#	50W	345*	0691	100+	9	-	well defined
9#	50W	374	0689	100+	150	-	broad banded
9A	50W	378	0689	100+	13	-	broad banded
0	51E	072½	0689	100+	90	broad high	broad banded

TABLE III

DUNDAS

nomaly No.	Line	Fiducial	Photo.No.	Conductivity	Depth	Magnetics	Comments
1	56W	262½		4 mhos	57m		weak
1A	56W	267		4	45m		weak
2	62E	657*	Dundas R4 No. 173	100	45m		weak
3	73E	2251	Dundas R2	100	190m	broad high	weak and banded
4	74W	2438		80	88m		weak

TABLE IV

DUNDAS (EXTENDED)

Anomaly No.	Line	Fiducial	Photo No.	Conductivity	Depth	Magnetics	Comments
33	87W	012/030	7855	2 mhos	?	100 high	banded conductor
34	88W	160/166	7855	2	?	80 high	Banded conductor
35	88W	178	7854	40	?		
36	89W	116/23	7855	2	?	100 high	reverse
37	90W	102	7854	1	30m		reverse

APPENDIX "TURAIR"

SURVEY EQUIPMENT AND PROCEDURES

SEMI-AIRBORNE ELECTROMAGNETIC SYSTEM - TURAIR 2

APPENDIX "TURAIR"

SURVEY EQUIPMENT AND PROCEDURES

SEMI-AIRBORNE ELECTROMAGNETIC SYSTEM - TURAIR-2

In the application of electromagnetic prospecting methods, it has long been recognized that, other things being equal, much greater exploration depths can be attained with systems employing a fixed source than with systems where both source and receiver are moved in unison. This is an extremely important consideration in Australia where surface weathering may extend to considerable depth.

Most present-day airborne electromagnetic (AEM) systems are of the moving source type, and although such systems have tangible advantages over the ground versions, it appears difficult to increase their useful penetration substantially beyond their present range. Under very favourable conditions the better moving source AEM systems may reach exploration depths of as much as 300 ft. or in exceptional cases 370 ft. below the ground surface. This is sufficient for many search problems but in some areas the geologic and topographic conditions necessitate a much deeper penetration to conduct meaningful mineral surveys.

The foregoing considerations have led to the development of the Turair method for the purpose of deep electromagnetic exploration. The system, which can be described as a fixed source, semi-airborne, gradient measuring device, employs a large transmitting loop on the ground as a primary source. The horizontal gradients of amplitude and phase of the vertical magnetic field are measured from the air, along traverse lines across the source and perpendicular to the regional geological strike.

The Turair method, because of its semi-airborne character, is particularly suitable for the detailed, deep investigation of structures having geologically favourable characteristics or a magnetic expression suggesting favourable geology. Because of its potential depth of exploration, it can be employed in areas of deep sedimentary cover, deep weathering, or tall tree cover (tropical area), or in areas where shallower exploration has established the presence of ore deposits and a deeper search is desired. It is, because of its fixed source configuration, less affected by near-surface conduction and can be applied with a very low exciting frequency (e.g. 200 Hz or less). Finally, as a helicopter-borne system it can operate in mountainous topography. Terrain clearance has far less effect on the exploration depth of the Turair system than it has on moving source methods and it can penetrate deep talus cover and valley fillings.

Economic ore deposits may have strike lengths less than 600 ft. If we want to search for such targets, particularly at greater depths, line spacing should not be much greater and for the average survey a line spacing of one-eighth mile should be considered optimum.

EQUIPMENT

The Scintrex Turair-2 is a fixed source, semi-airborne electromagnetic system designed for helicopter operation.

The system embodies a fixed transmitter on the ground and a receiver carried in the helicopter. The size of the transmitting loop is guided by geological conditions and the character of the survey. A typical loop size is a 2 miles x 2 miles square - other shapes and sizes can be used. The loop is usually laid out from a truck or by helicopter. For airborne placement a special dispensing device is used which feeds out continuously, several miles of wire. The primary field of the present system is excited by means of a 15 Kw motor driven generator which supplies a current of 4-10 amperes into the transmitting loop. The system can operate at 200 or 400 Hz, the selected frequency depending on the geological conditions in the survey area.

The receiver system comprises 2 horizontal coplanar air-cored coils, rigidly mounted 7 feet apart in a "bird". This bird is towed approximately 100 feet below the helicopter by means of a cable which also carries the electrical signals from the bird. In Australia, measurements are normally taken inside the loop. In environments with more resistive surface layers, such as parts of Canada, measurements are also taken outside the loop, thus greatly increasing area that can be surveyed with one loop.

The quantities measured with this dual coil measuring electromagnetic system are the ratio of the field strength and the phase differences of the alternating magnetic field at the two coils. The changes in field strength ratio and phase difference are expressed in percent and degrees respectively, the noise level being less than 0.1 percent and 0.1 degrees. Both parameters are recorded in analogue form.

Flying towards or away from the loop the amplitude of the field detected at the coils changes gradually but considerably. An automatic switch connected to the signal detector amplifier changes so that the amplified output of the preamplifiers is within the signal strength limitations necessary for the equipment operation. These switching markers are sometimes evident on the recorder charts.

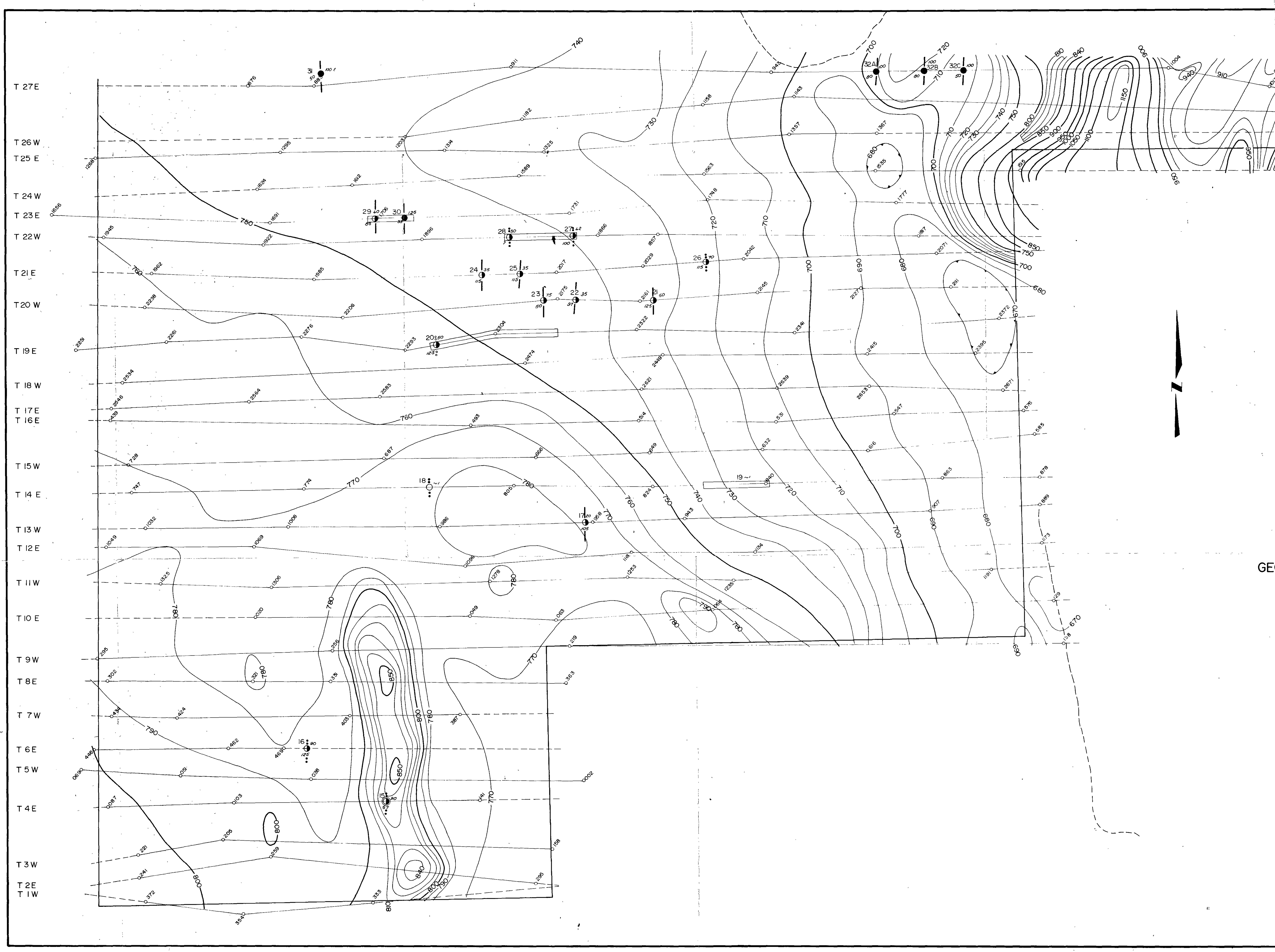
At one or more points during each flight, the scale sensitivities and zero levels are checked by means of calibration and zeroing signals respectively. The reference or zero level for each Turair electromagnetic trace is an arbitrary one, and is obtained empirically from the regional level of each section of a trace.

Since the gradients of the signals recorded within about 600 ft. to the loop sides are too strong, it is not possible to distinguish field changes due to conductors of geologic origin lying in these "blind zone" regions.

The field strength ratio and phase difference are recorded in such a way that flying "towards" the wire of loop's side system, a normal anomaly shows a positive sign (i.e. upward deflection), while flying "away" from the wire the sign is reversed. Reversed anomalies can also be the result of particular geometric situation, e.g. when the source is located on the hanging wall side of a flatly dipping conductor. Man-made disturbances including power lines, pipe lines, metal fences, railways, etc. may cause spurious anomalies. The former are recognizable as such when they appear as cyclic noise of irregular shape and phase relationship. Non-energized, grounded power lines (e.g. 3 phase systems) sometimes give rise to anomalies that are more difficult to identify. Such indications as well as those from pipe lines and metal fences, etc. are however, of short duration and can be distinguished from most geologic sources except for very narrow, near-surface conductors. In some instances, ground investigation may be necessary in order to resolve the ambiguity of possible sources. Although the airborne geophysical crew attempts to note visible man-made conductors of the above type, the ground moves by so rapidly at the low flight elevation employed that 100% recognition of such sources cannot always be expected from the air.

The normal terrain clearance of the bird is 100 - 200 ft. depending on the surface topography, tree cover, etc., with the helicopter 100 ft. above.

The established useful depth of the system for moderate-to-large conducting bodies of 1000 ft. in length, is at least 600 ft. sub-bird under conditions of low extraneous geologic noise, i.e. where the general level of conductivity of the overburden and rock types of the area is low.



GEOPHOTO RESOURCES CONSULTANTS

AMBER CREEK AREA
N.W. TASMANIA

TURAIR CONDUCTOR AXES &
AEROMAGNETIC SURVEY
MAGNETIC CONTOUR PLAN

5 cm

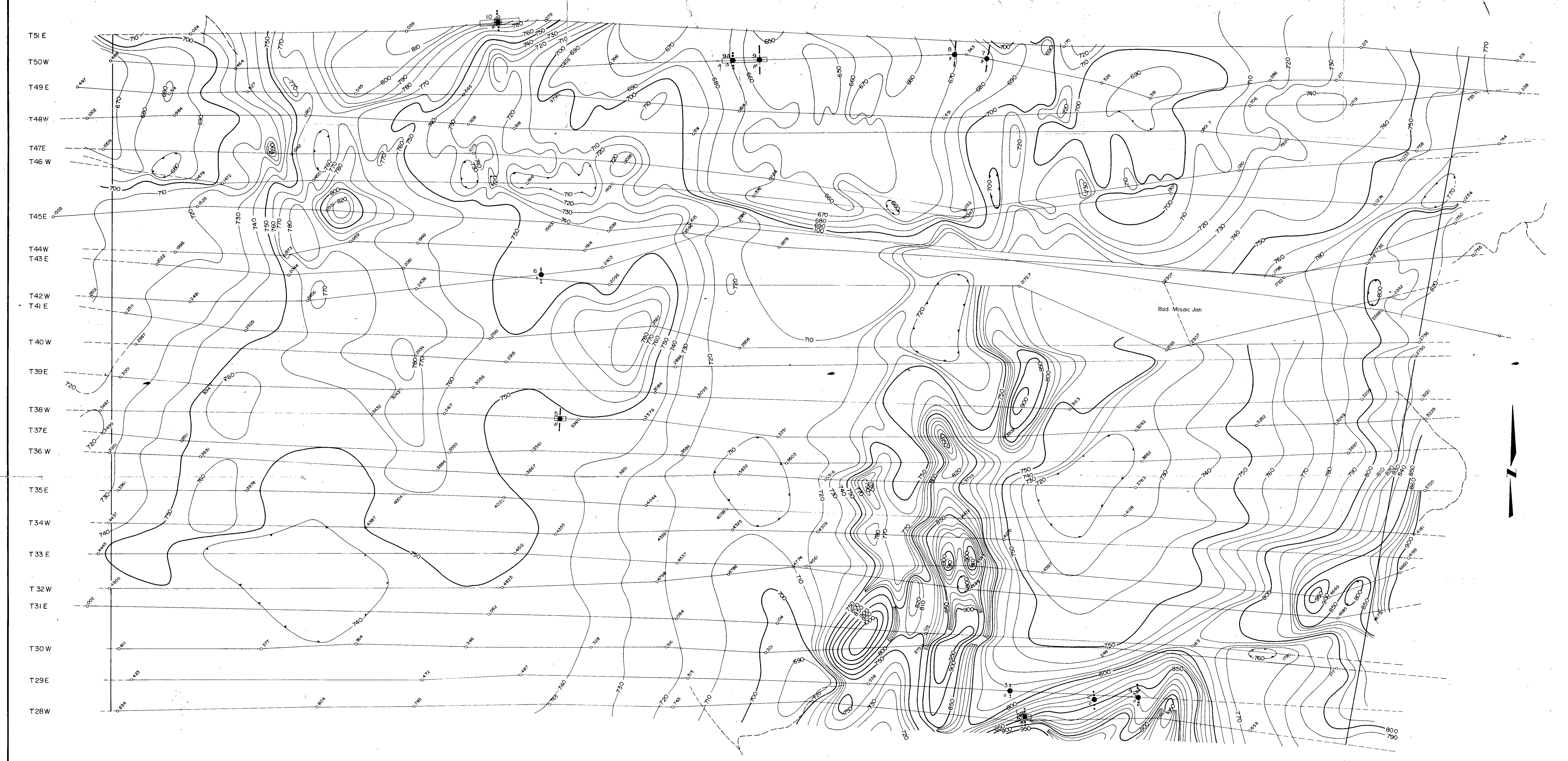
SURVEYED AND COMPILED BY
SCINTREX PTY. LTD.
APRIL - 1973

684041

200 0 300 500 metres
Scale: 1:10,000

73-949

JOB No. T1032 SHEET of 1 PLATE 1 2106 50/120



LEGEND

- ○ 10 – mhos
- ◑ 10 – 100 mhos
- ● 100 + mhos
- Banded conductor
- Direct magnetic correlation
- Anomaly number, Depth in meters, σ mhos
- Roads
- 50 Gammas
- 10 Gammas
- Surveyed lines
- Approx. positions of lines
- Tic points
- Weakly defined
- Well defined

3
2
1

GEOPHOTO RESOURCES CONSULTANTS

McINTYRE AREA
N.W. TASMANIA

TURAIR CONDUCTOR AXES &
AEROMAGNETIC SURVEY
MAGNETIC CONTOUR PLAN

5 cm

SURVEYED AND COMPILED BY
SCINTREX PTY. LTD.

APRIL – 1973

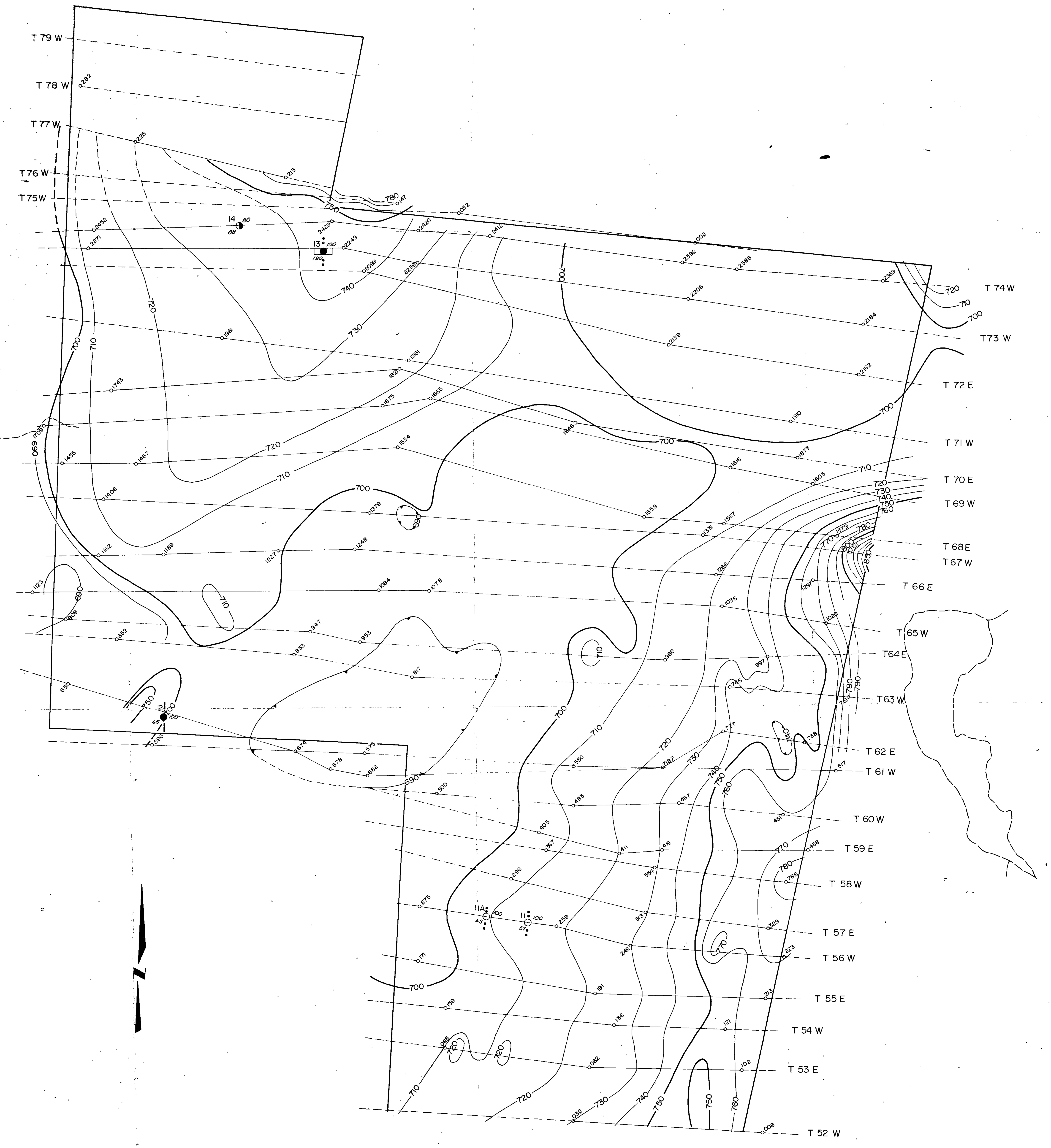
684042

200 0 300 500 metres

Scale : 1:10,000

73-949

JOB No. T1032 SHEET of 1 PLATE 2 2107



3
2
1

GEOPHOTO RESOURCES CONSULTANTS

DUNDAS AREA
N.W. TASMANIA

TURAIR CONDUCTOR AXES &
AEROMAGNETIC SURVEY
MAGNETIC CONTOUR PLAN

5 cm

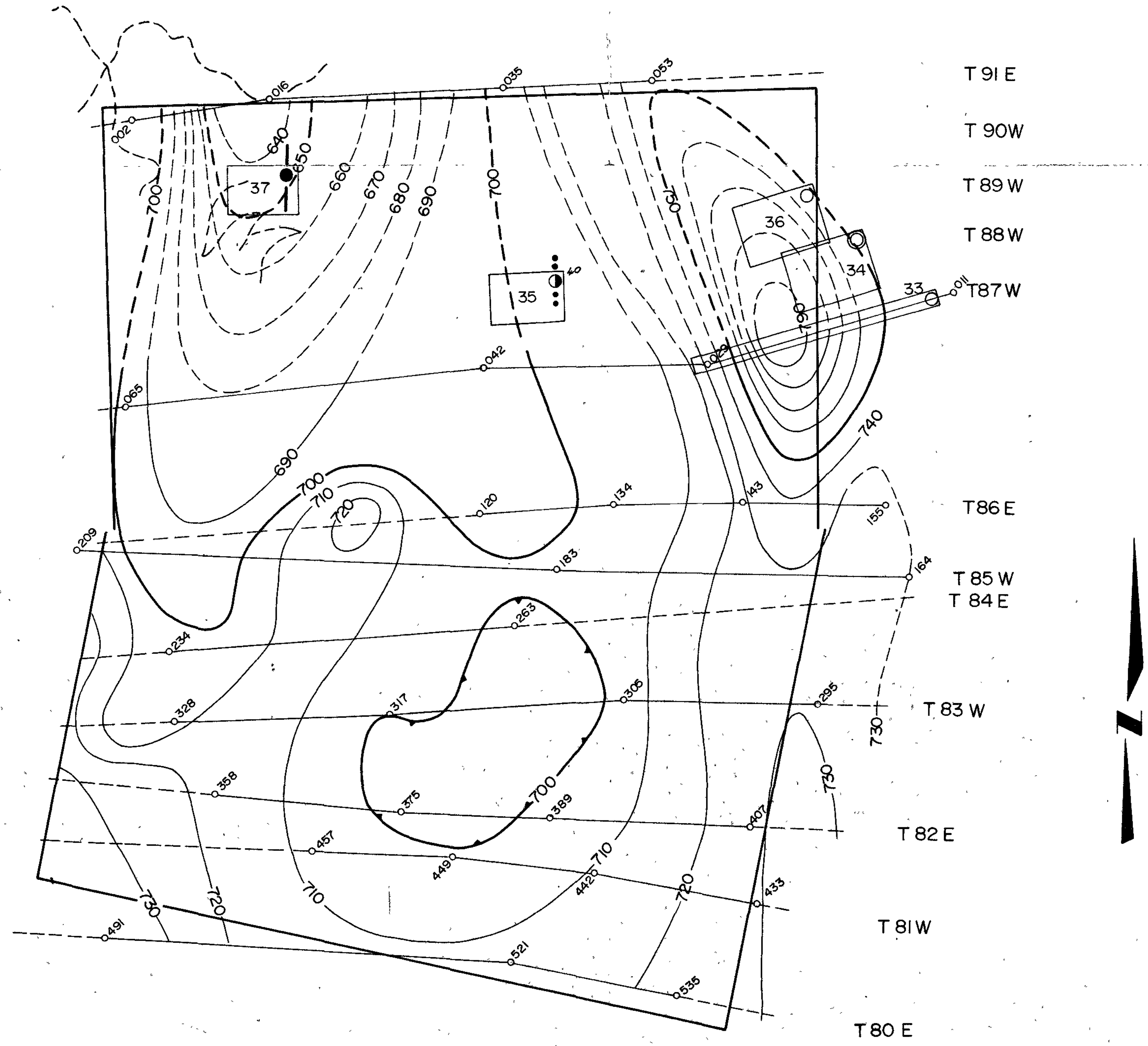
SURVEYED AND COMPILED BY
SCINTREX PTY. LTD.
APRIL - 1973

684043

200 0 300 500 metres
Scale : 1:10,000

73 - 949

JOB No. T1032 SHEET of 1 PLATE 3 2108 50/120



GEOPHOTO RESOURCES CONSULTANTS

DUNDAS EXTENSION
N.W. TASMANIA

TURAIR CONDUCTOR AXES & AEROMAGNETIC SURVEY MAGNETIC CONTOUR PLAN

5 cm

SURVEYED AND COMPILED BY

SCINTREX PTY. LTD.

APRIL - 1973

684044

200 0 200 400 metres

Scale: 1:10,800

73-949

JOB No. T1032 SHEET of 1 PLATE 4 2109 50/120