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REPORT ON TURAIR
AIRBORNE ELECTROMAGNETIC-MAGNETIC SURVEY
QUEEN HILL E.L., ZEEHAN
N.W. TASMANIA
ON BEHALF OF
THE GIPPSLAND-COMINCO JOINT VENTURE

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THE GIPPSLAND-COMINCO JOINT VENTURE

BY

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SYDNEY, N.S.W.

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C O N T E N T S

Acknowledgement

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Appendix 'Turair'

Figure 1 - Locality Plan

Plate 1 - Turair Conductor Axes Map & Magnetic Contour Plan.

(1x completed copy, 2x preliminary copies)

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The author wishes to acknowledge the valuable discussions on the geology and geophysics of the area held with Mr. C. Barnes of Gippsland Minerals N.L., and Mr. L. Gentle of Cominco Exploration Pty. Ltd., prior to, and subsequent to, the execution of the survey discussed in this report.

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GEOPHYSICAL CONSULTANTS AND CONTRACTORS

S U M M A R Y

A combined helicopter-borne Turair-Magnetometer survey of the Queen Hill Exploration Licence near Zeehan, carried out on behalf of the Gippsland-Cominco Joint Venture by Scintrex Pty. Ltd., recorded some 95 distortions in the Turair electromagnetic profiles. Of these, some 16 are considered of prime importance, 29 of secondary importance, and the remainder of lesser interest.

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INTRODUCTION

A Turair airborne electromagnetic-magnetic survey was carried out by Scintrex Pty. Ltd. on 5th and 6th February 1973, over the Queen Hill Exploration Licence, near Zeehan, N.W. Tasmania, on behalf of the Gippsland Minerals N.L. - Cominco Exploration Pty. Ltd. joint venture.

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

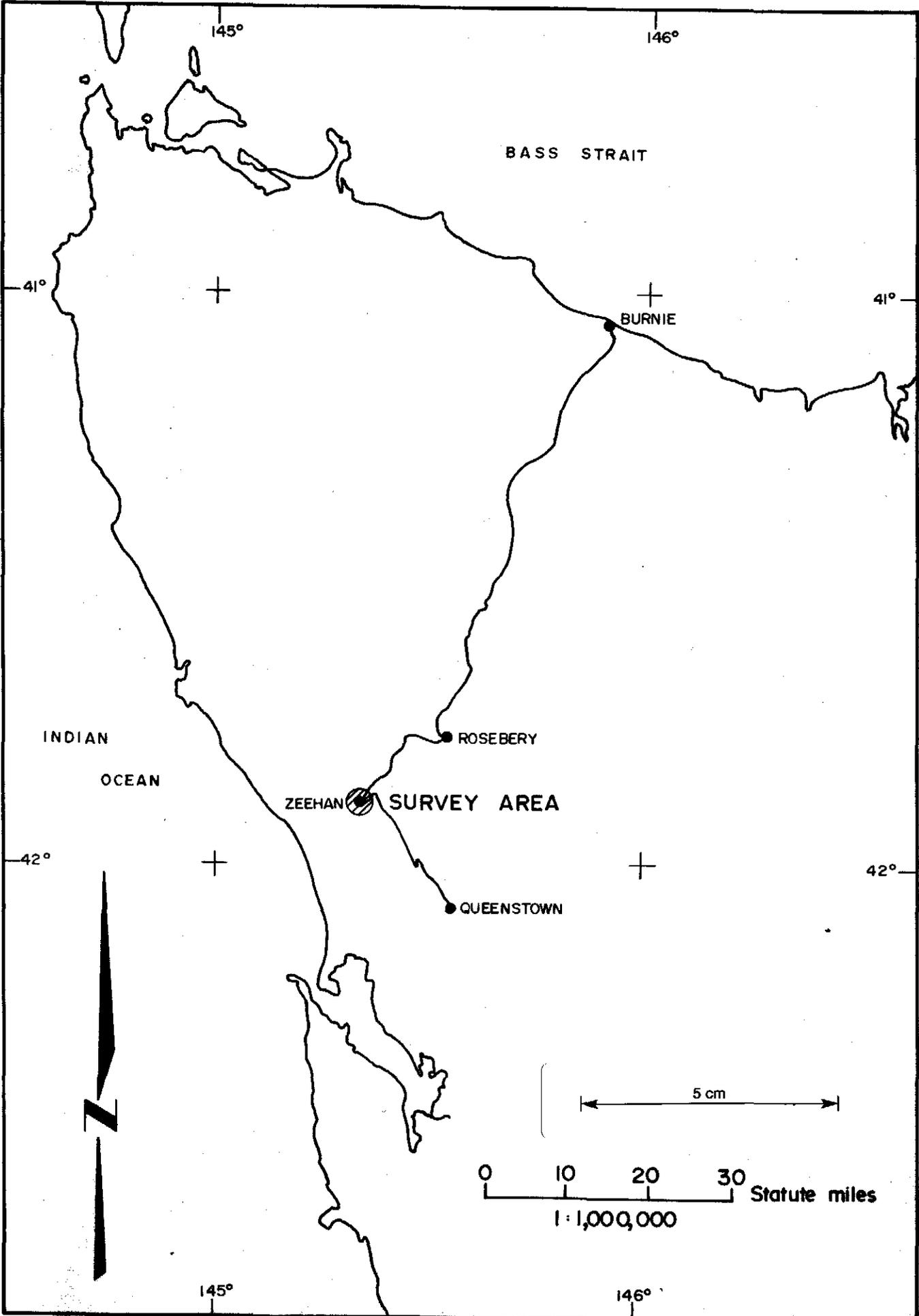
The present survey area, comprising approximately 20 square kilometers is located north, west and south of Zeehan which is situated on the eastern boundary of the survey area. The terrain ranges from flat to reasonably steep in places.

005

E.L. 4771, QUEEN HILL LOCALITY PLAN

Figure 1

686007



Some 42 survey lines were flown, totalling about 134 kilometers of which a number of lines were resurveyed. The flight direction was approximately east-west with a nominal interline spacing of 150 meters and the mean terrain clearance of the E.M. 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, utilising a Scintrex Turair-II unit at 400 Hz 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-AHQ subcontracted from Rotor-Work Helicopters Pty. Ltd.

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

Detailed geological information is available, although this is at present being compiled in meaningful form at the scale of the photomosaic presentation. In addition, geological mapping is at present being undertaken in areas of interest as defined in the present survey.

The primary target mineralisation for the present

survey system is massive sulphide mineralisation (i.e. interconnection of the conductive sulphide mineralisation to form an electrical conductor). The type deposit being the Gippsland body as defined on line 13E on Queen Hill.

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

PRESENTATION OF DATA

The original data records are presented in one binder, the data being recorded on a 6 channel, heat sensitive strip chart recorder and operated at a speed of 10cm per minute. The chart is 38cm wide with each channel being 5cm 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 two channels. a detailed channel with full scale deflection (FSD) of 100 gammas, and a second channel with FSD of 1000 gammas.

The fiducial marks are recorded on the event markers, the intervals 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 recovered are shown on the 1:10,000 photomosaic. The points are recovered with the aid of the on-board tracking camera.

DISCUSSION OF RESULTS

The flight lines together with the contoured magnetic data and graded electromagnetic conductors are shown on the 1 : 10,000 photomosaic overlay, Plate 1, and Table 1 gives details of the conductors. The 42 survey lines flown covered 134 kilometers and some distortions in the electromagnetic data profiles are considered to be worthy of comment.

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 feet often occurs, normally in the direction of flight.

Generally the anomalous electromagnetic responses recorded

were of low amplitude, both in phase and in ratio, and many are very close to the noise level.

The type deposit which is the object of the present survey, is the Gippsland orebody as defined by drilling at Queen Hill. Scintrex Pty. Ltd. carried out down-hole induced polarization and resistivity surveys which clearly showed the ore zone to be some 200 times more conductive than the enclosing host rocks. In addition this conduction was used to map the strike extent of the ore zone by the Applied Potential method. Also it was shown that Clarkes Lode, a semi-parallel intersecting pyrite-pyrrhotite-cassiterite lode is somewhat more conducting. The calculated down-hole conductivity thickness products using a 1.5m three array logger in a Direct Current mode were, Clarkes Lodes - 20 mhos and Gippsland Body - 5 mhos.

The Turair installation traversed the Gippsland, Clarkes and Taylors sulphide zones between fiducials 260 to 270 on line 13E. Over this zone multiple conduction was observed with peaks at 262, 264 and 267 which probably represent the above three sulphide zones. The conductivity-width product is of the order of 25 mhos which agrees well with that calculated from the down hole work. The depth to source below ground level is estimated to be of the order of 50m. In addition, a small 8 gamma magnetic high was recorded

at fiducial 263 $\frac{1}{2}$.

The data demonstrated the Gippsland body to be conductive and detectable by the Turair system, but not unequivocally so as both Clarkes and Taylors Lodes also were shown to respond. The small magnetic high is probably associated with the occurrence of pyrrhotite in Clarkes Lode.

It should be noted that the frequency of electromagnetic anomalies located on this survey is some 5 to 10 times greater on a line kilometer basis than observed over an average survey area on the West Coast. This is no doubt due to the scores of mineralized showings and small mines, predominantly silver-lead, which occur within the survey area. These shows are at present being mapped and their relationship to the Turair anomalies will become clear as this programme proceeds. It is probable that man-made conductors in the area cause a number of the electromagnetic distortions recorded in the survey. As positional information in this survey was exceptionally good, it will be possible to investigate and identify the conductors due to artificial sources.

At this stage the Turair data is discussed from a purely geophysical basis and the author will be pleased to make further comment as soon as the mapping programme is complete.

The characteristics of each conductor are summarized in Table 1 and brief comments on each significant distortion

are made below.

Anomalies 1, 2 & 3 (1W/055, 063 & 078) These three very minor responses are barely above noise level and are considered to be of tertiary interest only. There is no magnetic correlation.

Anomaly 4 (2E/145) This above background response may be associated with anomaly 2. The 25 mhos conductivity width product shows multiple conduction, therefore the calculated depth of 65m is probably excessive. It is of secondary interest.

Anomaly 5 (2E/176) A very weak response which is of tertiary interest only, and has a conductivity-width product of 35 mhos at a depth of 50m.

Anomalies 6 & 7 (3W/242 & 271) These two electromagnetic distortions are barely above background and are considered to be of minor interest only.

Anomalies 8, 9 & 10 (4W/407, 417 & 490) These three above background responses have conductivity-width products of 30, 15 and 22 respectively. Anomalies 9 and 10 are of secondary interest and 8 is of tertiary interest.

Anomaly 11 (6W/651) This is a very minor response of little significance.

Anomaly 11A (6W/612 - 625) A very broad anomaly of tertiary interest only is due to multiple conduction probably within the overburden.

Anomaly 12 (7E/671) This small but definite anomaly in both

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phase and field strength ratio was recorded in an area of high noise. The calculated conductivity-width product of 20 mhos is associated with a shallow near surface source. This anomaly should be followed up as a target of secondary importance.

Anomalies 13, 14 & 15 (9E/690, 694 & 702) Within a zone of surface conductivity between fiducials 688 and 706, three distinct anomalies were defined and are designated anomalies 13, 14 and 15 respectively. The surface conductivity is typical of a conductive swamp or tailings dam. Anomalies 14 and 15 are worth following up on a secondary basis, and anomaly 13 on a tertiary basis only.

Anomaly 16 (9E/708) This minor response of 12 mhos is associated with a magnetic high. This response is considered to be of secondary interest at best.

Anomaly 17 (9E/726) A broad weak response may be due to surface conduction rather than a source at the calculated maximum depth of 85m. This zone is considered to be of tertiary importance only.

Anomaly 18 (10W/018) A very definite response of the order of 20 mhos. The calculated maximum depth to the source is 15m. This anomaly should be followed up as a primary target. There is a small 5 - 6 gamma magnetic high coincident with the electromagnetic response.

Anomalies 19 & 20 (10W/027 $\frac{1}{2}$ & 047) These two very minor responses are barely above the noise level and are considered to be of minor interest only.

Anomaly 21 (11E/128) This anomaly may form part of a conductor which includes anomalies 16, 20, 24 and 27. This 10 mho anomaly is well above noise level and is coincident with a semi-regional magnetic high. The depth to source is calculated to be of the order of 25m and this anomaly is considered to be of primary interest.

Anomaly 22 (12W/156 $\frac{1}{2}$) This small but definite anomaly has a maximum depth of the order of 30m and a conductivity-width product of 15 mhos coincident with a magnetic response of the order of 10 gammas. This anomaly should be investigated further as a primary target.

Anomaly 23 (12W/179 - 190) This multiple conductor is of very similar appearance to anomaly 26 which is clearly associated with the Gippsland ore zone and Clarkes Lode on Queen Hill. Within this broad anomaly, a number of parallel conductors have been identified at 180 $\frac{1}{2}$, 184 and 189. This is a definite zone of interest and should be followed up in some detail as a primary target.

Anomaly 24 (12W/172) This is a minor response, barely above background and is of minor interest only.

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Anomaly 25 (12W/165) as above.

Anomaly 26 This anomaly is described above on page 11. *page 6?*

Anomaly 27 (13E/278) This is a very minor distortion of little interest.

Anomaly 28 (13E/281) This small but above background surface or near surface response of about 17 mhos should be followed up as a secondary target.

Anomaly 29 (14W/327) A broad, weak but above background response gives a conductivity-thickness product of about 17 mhos. The maximum calculated depth of 75m is probably excessive due to multiple conduction. It is of secondary interest.

Anomaly 30 (14W/334) Again there is evidence of multiple conduction, but the response is significantly above background noise level. The 27 mho response is coincident with a broad magnetic high of about 5 or 10 gammas. This anomaly is considered to be of primary interest.

Anomaly 31 (14W/319) This very minor response is of little interest.

Anomaly 32 (15E/391-401) This zone of multiple conduction which correlates with a broad 5 gamma or so magnetic high, has very similar characteristics to anomaly 30 on line 14W. This anomaly is recommended for follow-up as a primary target,

and it also shows similarities to the Queen Hill anomaly.
Pyrrhotite has been recorded near the surface at this location.

Anomaly 33 (15E/408) This minor but above background response of 14 mhos occurs on the flank of a magnetic high, and is of secondary interest.

Anomaly 34 (15E/390) This response was recorded mostly on the phase shift channel and thus the conductivity-width product is a low 8 mhos. The response is recommended for follow-up on a secondary basis only.

Anomaly 35 (16W/455) This small but definite response, having a 15 - 22 mho conductivity-width product at a maximum depth of the order of 55m, is recommended for follow-up on a primary basis.

Anomaly 36 (17E/517) The definite responses indicate conductivity-width products of the order of 15 mhos at a depth of about 45m. The electromagnetic response occurs coincident with a regional magnetic high and is recommended for follow-up on a primary basis.

Anomaly 37 (18W/590) A broad response which may be due to either multiple nearer surface conductors or a single conductor at depth. Recommended for follow-up as a secondary target.

Anomaly 38 (18W/580) This minor response of less than 10 mhos

at a maximum depth of 10m should be followed up only on a tertiary basis as it is of minor geophysical significance.

Anomaly 39 (19E/640) This small but definite response is more definite on the phase profile. The conductivity-width product is of the order of 15 mhos and has a maximum depth of the order of 50m. A minor regional high is associated with this response. A primary to secondary priority is given to this target.

Anomalies 40, 41, 44, 46, 48, 49, 53, 55, 56, 62, 63, 64, 67, 68, 69, 74, 76, 80, 81, 88, 90 and 92. This series of anomalies appears to mark the contact of the limestone (east) between lines 19E and 37E and northwards to perhaps 42W, (Chas Barnes) To the south of line 26W, this line of anomalies also follows a road and it was initially thought that these represented a series of responses along an artificial conductor, a possibility which still should not be ruled out. *old tramway?*

Of these conductors the following are considered worthy of comment.

Anomaly 44 (21E/766) The very low conductivity-width product of 3 mhos was indicated to come from a source at a maximum depth of 44m. There may be a 3 - 4 gamma magnetic response coincident with this electromagnetic anomaly. It is recommended for follow-up as a primary target.

018

Anomaly 48 (23E/879) This is a definite anomaly and is coincident with a minor magnetic high. The response is mostly in the phase channel and the calculated conductivity-width product of 4 mhos is low. The maximum depth is considered to be of the order of 50m. This anomaly is recommended for follow-up as a primary target.

Anomaly 53 (25E/1018) This response is similar to that observed on 23E (48) and is recommended for follow-up as a secondary priority.

Anomaly 63 (29W/1379) A very broad multiple conductor having a conductivity-width product of the order of 7 mhos. It is recommended for follow-up as a target of tertiary importance.

Anomaly 64 (30W/1578) This broad banded 5 mho conductor well above background, is recommended for ground investigation on a secondary priority only.

Anomaly 67 (31E/1740) This excellent phase response is accompanied by very little response in the field strength ratio. The conductivity-width product is a low 1 mho but is well above background. Follow-up on a primary basis is recommended.

Anomaly 69 (33E/1964) This very strong phase response has very little accompanying field strength ratio distortion and this is reflected in the very low conductivity-width product of 2 mhos. This response could be due to water filled shear zones

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but should nevertheless receive attention as a secondary target.

Anomaly 74 (35E/2170 $\frac{1}{2}$) This small but definite anomaly of conductivity width product of 3 mhos, is recommended for follow-up as a target of secondary importance.

Anomaly 92 (42W/2850) This small but definite response in both phase and ratio has a conductivity-width product of 18 mhos and a calculated maximum depth of the order of 55m. Follow-up is recommended on a secondary basis only.

Anomalies to the west of the contact are commented on below.

Anomaly 42 (20W/686) Minor response and of tertiary interest only.

Anomaly 43 (21E/760) This is an excellent response and the conductivity width product of 14 mhos was observed at a maximum depth of about 60m. There is probably a minor magnetic response of 3 - 5 gammas associated with this high. This response is recommended for follow-up as a primary target.

Anomaly 45 (22W/831) This very minor response is not considered to be of significance.

Anomaly 47 (23E/857) This is a very minor insignificant response and is not recommended for follow-up.

Anomalies 50 & 51 (24W/928 & 940) Both responses are minor and of little geophysical interest.

Anomaly 52 (25E/991) Of minor interest only.

Anomaly 54 (26W/1091) This anomaly shows an excellent phase response with some field strength ratio. In addition, some minor distortion in the magnetometer channel was noted. This 10 mho anomaly is recommended for further investigation as a secondary target. (This anomaly may be associated with 57).

Anomaly 57 (27W/1224) Excellent response on the phase channel with some field strength ratio produces a conductivity-width product of the order of 5 mhos. This anomaly is recommended for follow-up as a secondary target in association with anomaly 54 on line 26W.

Anomaly 58 (27W/1238) This very minor response is not considered to be of significance and is not recommended for follow-up.

Anomaly 59 (28E/1282) This minor response is not recommended for further investigation.

Anomalies 60 & 61 (28E/1320 & 1333) These two responses are definite and above background. The calculated conductivity-width products are low but well above background. There is no doubt that multiple conduction is associated with both, which makes an evaluation of depth difficult. Both are recommended for follow-up as secondary targets.

Anomaly 65 (30W/1623) This definite response is seen clearly on both electromagnetic channels, and is probably due to two or more conductive bands within the resolution of the system.

The conductivity-width product indicated is 18 mhos and the maximum depth to source is of the order of 80m.

Anomaly 66 (31E/1714) The minor electromagnetic distortions which make up this anomaly are not recommended for further attention.

Anomaly 70 (33E/1926) This very minor response would not be considered significant geophysically. However, it does occur in the vicinity of the old Big Ben Shaft and therefore may be worthy of further consideration. It is recommended for additional work on a tertiary basis only.

Anomalies 71 & 72 (34W/2028 & 2044) These two anomalies are seen mostly on the phase channel and yield conductivity-width products of the order of 15 mhos. They are recommended for follow-up on a primary basis.

Anomaly 73 (35E/2159) This 12 mho response comes from a source calculated to be at a maximum depth of 30m. The anomaly is recommended for follow-up as a secondary target.

Anomalies 75 - 78 (36W/2221, 2229, 2249 & 2266) All responses are minor and not considered to be geophysically significant. Therefore no follow-up work is recommended.

Anomaly 79 (37E/2371) This broad 10 - 15 mho response could be due to surface conduction. The multiple nature certainly makes the calculated maximum depth of 140m excessive. No

follow-up is recommended.

Anomalies 81 - 84 (38W/2438, 2458, 2470 & 2492) These responses are mostly in the phase and are broad. They look like very weak surface conduction and as such, no follow-up is recommended on 81, 83 and 84. 82 is a somewhat more material conductor and this is recommended for follow-up on a tertiary basis.

Anomalies 85 & 86 (39E/2567 & 2577) These responses are minor and should receive attention as secondary or tertiary targets only.

Anomaly 87 (40W/2681) This moderate response, having a 10 mho conductivity-width product is due to more than one conductive zone. The maximum depth calculated, is therefore, probably excessive. It is recommended for further ground investigation as a secondary target only.

Anomaly 89 (41E/2780) This definite response of 9 mhos is associated with a very weak magnetic high of about 3 - 4 gammas. The calculated maximum depth is perhaps 60m. This anomaly is recommended for follow-up as a secondary priority only.

Anomalies 90 & 91 (41E/2809 & 2754) These minor responses are not considered to be of significance and no additional work is recommended.

Anomalies 93 & 95 (42W/2870 & 2932) These two responses are very weak and are not recommended for further investigation.

Anomaly 94 (42W/2907) The conductivity-width product calculated for this small but definite conductor is very high due to the absence of any significant phase response. This anomaly is suggested for follow-up as a secondary target.

Anomaly 96 (42W/2876 $\frac{1}{2}$) This response is wholly field strength ratio and may be due to the proximity of the transmitting loop. However, as this is only a possibility, this anomaly of high conductivity-width is recommended for follow-up as a secondary target.

CONCLUSIONS AND RECOMMENDATIONS

The frequency of electromagnetic distortions deemed to be of possible significance in the present survey was five times that noted on other survey areas on the West Coast. The majority of these are considered to have a geological origin, however, a number may prove to be artificial conductors as the area has been subject to cables, pipelines and tramlines for some time. Careful ground evaluation of conductors should however, resolve these in most cases.

Attempts were made to precisely locate all significant Turair conductors on the relevant fiducial.

However, this was only possible in some 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 noises. The latter indicates the very resistive nature of the rock units and overburden over which the survey was flown. Therefore the weak to moderate 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 occurring 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 some Turair conductors 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 utilised to better define the sources on the ground.

Those conductors which are within 25m of the surface may be able to be followed up using the Self Potential method. However, it should be noted that this method works only if the conductor traverses the water table. Therefore only where this is known to be true should this method be used as a diagnostic follow-up tool.

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 in a 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 a 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 60 - 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 commented on in detail. We shall be pleased to do so when the geological compilation now in progress is complete. cursory comparison between the magnetic data and the known geology do not suggest any correlation whatsoever. Furthermore the relatively pronounced magnetic feature in the Queen Hill area cannot be explained from the geological data to date. A proton precession magnetometer ground survey on existing lines is strongly recommended to ascertain the magnetic properties of mapped rock units and in particular, the spilites.

A number of the significant Turair conductors including the Queen Hill anomaly (26) have a minor but distinct magnetic correlation. This suggests the presence of either pyrrhotite or magnetite. As the type deposit, Queen Hill, has such a signature, other anomalies having similar magnetic highs have obviously enhanced geophysical interest.

In summary, those anomalies recommended for follow-up as Primary targets are, 18, 21, 22, 23, 26, 30, 32, 35, 36, 39, 44, 48, 67, 43, 71, and 72.

Those of Secondary interest only include: 4, 9, 10, 12, 14, 15, 16, 28, 29, 33, 34, 37, 53, 64, 69, 74, 92, 54, 57, 60, 61, 65, 73, 85, 86, 87, 89, 94, 96.

Those electromagnetic distortions of Tertiary interest only, are: 1, 2, 3, 5, 8, 11A, 13, 17, 38, 63, 42, 70 and 82.

Those of Minor interest only include: 11, 19, 20, 24, 25, 27 and 37 and 52.

! ? secondary?

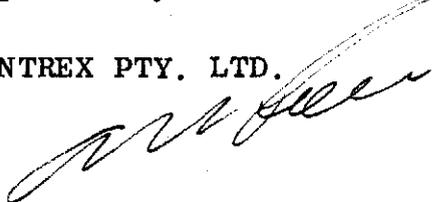
Those considered of no significance include: 40, 41, 45, 46, 47, 49, 50, 51, 55, 56, 58, 62, 66, 68, 75, 76, 77, 78, 79, 80, 81, 83, 84, 88, 90, 93, and 95.

It should be emphasised that this is a purely geophysical evaluation based on an analysis of the conductivity width products, definition, and correlation with magnetic data. Of far greater significance is the geological setting of these conductors. This must be the ultimate priority rating.

I look forward to reviewing the data in the light of the geologic compilation and mapping, now in progress.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.



A.W. HOWLAND-ROSE, M.Sc., D.I.C., AMAusIMM, FGS.

GEOPHYSICIST

TABLE 1

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 (#) are considered to be significant.

Anomaly No.	Line	Fiducial	Conductivity (mhos)	Depth (metres)	Magnetics	Comments
1	1W	055	10	35	-	Weak
2	1W	063*	40	65	-	Weak
3	1W	078	20	85	-	Weak
4	2E	145	25	65	-	Weak - moderate
5	2E	176*	35	120	-	Weak
6	3W	242*	10	40	Shoulder	Very weak
7	3W	271*	30	60	"	Weak
8	4W	407	30	near surface	-	
9	4W	417	15	75	-	
10	4W	490	22	200	-	
11	6W	615	20	near surface	-	Very minor
11A	6W	612-625	high	" ?	-	Banded conductor
12	7E	671	20	"	Shoulder	
13	9E	690	18	"		
14	9E	694*	12	80	-	
15	9E	702	10	35 (max)	-	

TABLE I

Anomaly No.	Line	Fiducial	Conductivity (mhos)	Depth (metres)	Magnetics	Comments
16	9E	708	12	65 (max)	-	
17	9E	726	10	85 (max)	-	
18#	10W	018	20	15	6½ high	Definite reverse
19	10W	027½	15	near surface		Minor
20	10W	047	20	75	-	Minor
21#	11E	128*	10	25	-	Definite
22#	12W	156½	15	30	10½ high	Definite
23#	12W	179-90 (184*)	10	20?	-	Definite, multiple
24	12W	172	10	35?	-	Minor
25	12W	165	15	30	-	
26#	13E	265*	25	?	10½ high	Queen Hill
27	13E	278	15	near surface	-	
28	13E	281	17?	near surface	-	
29	14W	327*	14	75?	-	Multiple
30#	14W	334*	27	120	5½ high	Definite, multiple
31	14W	319	12	20	10½ high	Minor
32#	15E	397*	16		-	Definite, multiple
33	15E	408	14	50	-	Minor
34	15E	390	8	45	-	

TABLE I

Anomaly No.	Line	Fiducial	Conductivity (mhos)	Depth (metres)	Magnetics	Comments
35#	16W	455*	15/22	55	-	Good
36#	17E	517*	15	45?	broad high	
37	18W	590*	14/23	60	-	
38	18W	580	10 ⁻	10	-	Weak
39#	19E	640	15	50	7½ high	Definite
40	19E	649	6		-	Definite
41	20W	672	4	120	Flank	Broad, weak
42	20W	686*	26	100	-	Weak
43#	21E	760*	14	60	3-5½ high	Definite
44#	21E	766	3	45	3-4½ high	Definite
45	22W	831	10/15	?	-	Weak
46	22W	788	5	14?	8½ high	
47	23E	857	10 ⁻	?	4½ shoulder	Very weak
48#	23E	879	4	50	10½ peak	Definite
49	24W	895	3	40	-	Weak
50	24W	928	1	35	-	Weak
51	24W	940	1	40	-	Weak
52	25E	991	10 ⁻		-	
53	25E	1018	4		10½ shoulder	
54	26W	1091*	10	?	6½ peak	Definite

TABLE I

Anomaly No.	Line	Fiducial	Conductivity (mhos)	Depth (metres)	Magnetics	Comments
55	26W	1040	4	?	-	
56	27W	1168	4	30	flank 5½ high	Weak
57	27W	1224	5 ⁻	115	-	
58	27W	1238	1	80		
59	28E	1282	15	40	-	Weak
60	28E	1320*	17	?		Definite
61	28E	1333	6	?	5½ high	Definite
62	28E	1336	3	30	-	Weak
63	29W	1379	7	?	-	Multiple
64	30W	1578	5	?	-	Good
65	30W	1623*	18	80?	-	Good
66	31E	1714	18	200	-	Weak
67#	31E	1740	1	80	-	Good
68	32W	1804	5	110	-	Moderate
69	33E	1964	2	160	-	Strong
70	33E	1926	34	65	-	Very weak
71#	34W	2028*	15	80	5½ high	Moderate
72#	34W	2044	14	85	-	Moderate
73	35E	2159	12	30	-	Weak
74	35E	2170½	3	150?	-	Definite

TABLE I

Anomaly No.	Line	Fiducial	Conductivity (mhos)	Depth (metres)	Magnetics	Comments
75	36W	2221	45	45	-	Weak
76	36W	2229	3	35	-	Weak
77	36W	2249	15/22	125?	-	Banded, weak
78	36W	2266	17	35	+4%	Weak
79	37E	2371	10/15	140	-	Multiple, weak
80	37E	2387	5	140	-	Multiple, weak
81	38W	2438	16/27	?	-	Multiple, weak
82	38W	2458	8	?	-	Multiple, moderate
83	38W	2470	27	90	-	Multiple, weak
84	38W	2492	15	60	-	Multiple, weak
85	39E	2567	15	90	-	Very weak
86	39E	2577	18/24	?	-	Multiple
87	40W	2681	10	70	-	Moderate
88	40W	2647	8	80	-	Weak, multiple
89	41E	2780*	9	60	-	Definite
90	41E	2809	9	65	-	Weak
91	41E	2754	16	100	-	Weak
92	42W	2850	18	55	-	Moderate
93	42W	2870	16	near surface	-	Weak
94	42W	2907	10/100	140	-	Definite
95	42W	2932	34?	65	-	Weak
96	42W	2876 $\frac{1}{2}$	10/100	40	-	Definite

APPENDIX "TURAIR"

SURVEY EQUIPMENT AND PROCEDURES

SEMI-AIRBORNE ELECTROMAGNETIC SYSTEM - TURAIR 2

APPENDIX "TURAIR"SURVEY EQUIPMENT AND PROCEDURESSEMI-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.

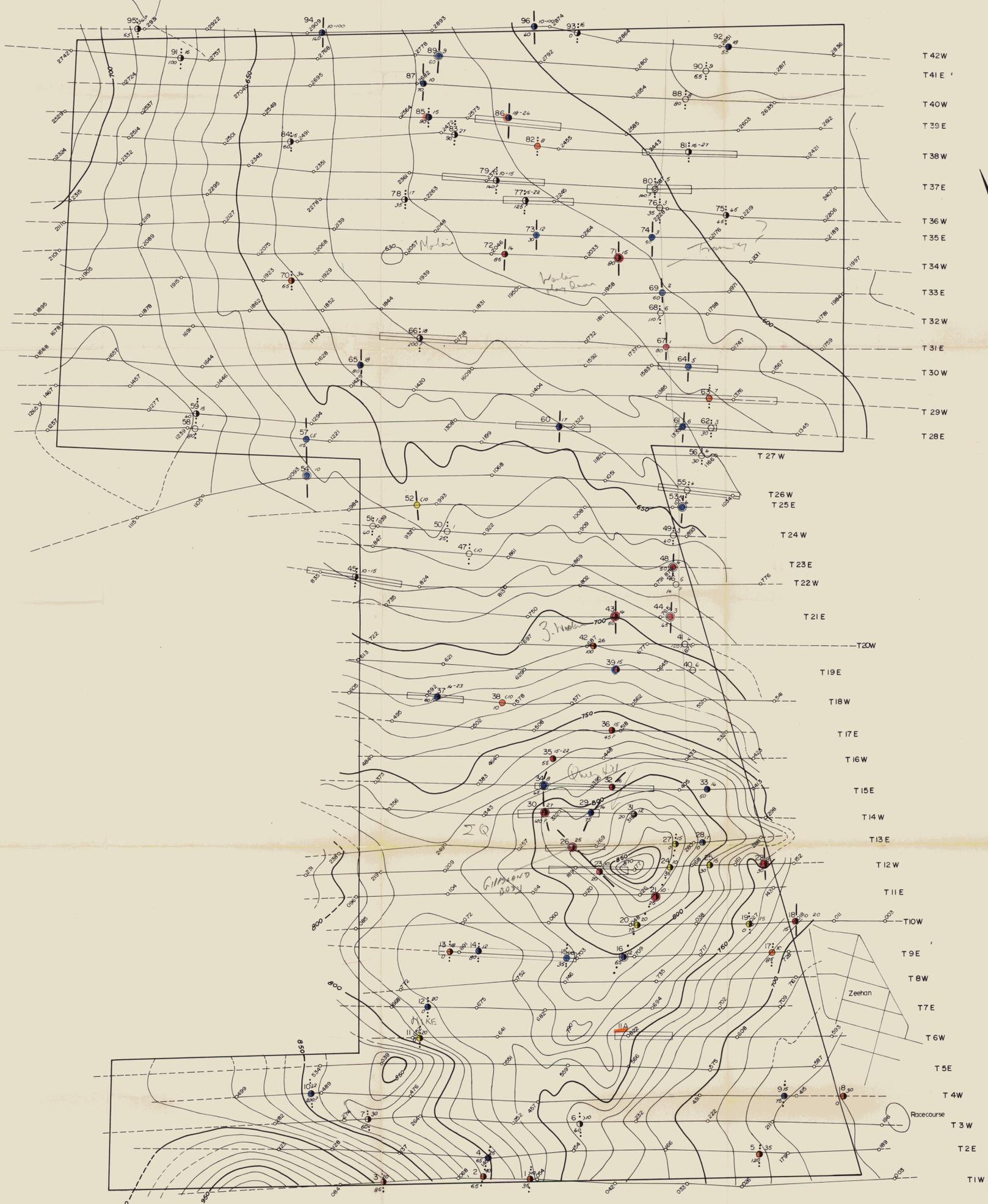
At one or more points during each flight, the scale sensitivities and zero levels are checked by means of calibration and zeroing signals respectively. The reference or zero level for each Turair electromagnetic trace is an arbitrary one, and is obtained empirically from the regional level of each section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



LEGEND

- Definite
- Weak
- Direct magnetic correlation
- 0 - 10 mhos
- 10 - 100 mhos
- ▬ Banded conductor
- Anomaly number
- Depth in metres
- ▬ 50 Gammas
- ▬ 10 Gammas
- ▬ Tie points

PRIMARY ●

SECONDARY ●

TERTIARY ●

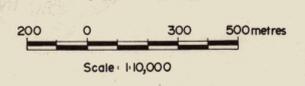
MINOR ●

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TURAIR CONDUCTOR AXES &
 AEROMAGNETIC SURVEY
 MAGNETIC CONTOUR PLAN



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