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DEPARTMENT OF MINES
SOUTH AUSTRALIA

SECOND REPORT ON

GEOPHYSICAL INVESTIGATIONS

in the vicinity of the Tarcoola Mine Area

by
B.J. Taylor
Geophysical Assistant

GEOLOGICAL SURVEY
EXPLORATION GEOPHYSICS

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

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GEOPHYSICAL INVESTIGATIONS

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ABSTRACT

Further Electromagnetic and Induced Polarization work was carried out in the Tarcoola Blocks and Brown Hill areas at Tarcoola to extend and substantiate previous investigations. The results established the validity of I.P. anomalies in the Brown Hill area, and indicated that the E.M. method was unsuccessful as a geophysical tool in the Tarcoola Blocks area. Inconclusive I.P. results were obtained in the Tarcoola Blocks area, and further work is recommended to test the validity of these results. An appendix dealing with a magnetometer survey in the areas is included in the report.

INTRODUCTION

Further geophysical investigations were carried out at Tarcoola to substantiate previous work described in the first report, and to extend the area already surveyed. The survey was carried out in April 1965. Induced Polarization and Electromagnetic methods were used in the Tarcoola Blocks and Brown Hill areas by the writer, and a magnetometer survey concurrently carried out by B.E. Milton and J.P. Hayes. Appendix A by B.E. Milton containing results of the Magnetometer survey is included in the report.

Steel stakes were used instead of porous pots for receiver electrodes as there was insufficient moisture in the overburden to permit sufficiently low contact resistance. Variations in readings caused by the change of electrode type were negligible. Lines 11,000E and 6,2000E were resurveyed in the area near Brown Hill, and large I.P. anomalies in very low resistivity rock on these lines were reproduced very closely in both resistivity and Frequency Effect.

REFERENCES

References as in and including First Report on Tarcoola Area; G.S. 3024, Report Book 59/128, dated 23rd November, 1964.

METHODS USED

Induced Polarisation

Across the Tarcoola Blocks area, 100' dipole - dipole configuration was used on lines 8,600E, 7,200E, 6,800E, 6,500E, 6,000E, 5,600E, 10,200E, 10,400E, and 10,600E. In the Brown Hill area, lines 11,000E and 6,200E were resurveyed using 200' dipole-dipole configuration, to determine whether anomalies previously obtained could be duplicated. It was considered that the anomalies in this area could have been caused by coupling, (electromagnetic), as the resistivities were extremely low.

Two extra lines were inserted between 11,000E and 6,200 E in the approximate positions of lines 10,200E, and 9,400E in this area. In the absence of a surveyor the lines were established by the author using ranging poles and chain. If there is sufficient interest in the anomalies in this area, it should be completely resurveyed using the high power I.P. transmitter to enable all of the wider separation readings to be obtained.

Steel stakes were used for receiver electrodes as the contact impedance of copper sulphate filled porous pot electrodes was too high, and negative Frequency Effects were frequently recorded.

Fig. I shows location of lines surveyed and positions of anomalies.

ELECTROMAGNETIC

Lines in the Tarcoola Blocks area surveyed by the I.P. equipment, were also read using the 400 c/s E.M. equipment. The lines from 10,000E to 8,000E surveyed previously with the Turam method were also extended to 8,800N. This was done to help establish whether the effect of a water pipe was causing any or all of the E.M. anomalies. The survey was delayed for two weeks, as the compensator phase control potentiometer became intermittently open circuit, and was replaced. Line 10,000E was read again so that phase readings using the new potentiometer could be corrected.

DISCUSSION OF RESULTS

Tarcoola Blocks Area

Induced Polarization

Lines 10,000E to 10,600E

Contours of Resistivity, Frequency Effect, and Metal Factpr are shown on Fig. II. Resistivity contours of all these lines are similar. In each case the conglomerate outcrop is in a similar position with respect to the resistivity contours. The Frequency Effect contours however, vary. On line 10,000E there is a marked "low" in the n = 3 and 4 readings nearest the suspected position of the conglomerate bed, while on lines 10,200E and 10,400E there are much higher F.E. readings in the vicinity of the conglomerate bed (at n = 5 on 10,200E, the F.E. is approximately 3%). It is suspected that the increase in F.E. values between n = 2 and 3 in this area is an expression of depth of weathering. On line 10,500E, there is a gradual increase in F.E. readings with depth. This could suggest that weathering is deeper here, or that there is less polarizeable material nearer surface. Line 10,600E shows F.E. readings which are much higher nearer surface (1.6 and 1.7% at n = 3). This could suggest that weathering is not as deep, or that polarizeable material is nearer surface. It is unlikely that depth of weathering would alter so greatly over 200' and therefore the effect is more likely to be caused by variations in polarizeable material in or near the conglomerate. There is also a possibility that the higher frequency effects are caused by the use of steel receiving electrodes instead of porous pots. However, on lines 11,000E and 6,200E, similar results were recorded using both porous pots and steel stakes.

<u>Lines 8,000E to 5,600E</u>

Contours of Resistivity, Frequency Effect, and Metal Factor are shown on Fig. III. The position of the Jaspilite Conglomerate bed shown on the contours has been estimated from the magnetic survey that was carried out in conjunction with this survey (see appendix A). These are approximations and the actual positions have not been marked as this area has not yet been geologically mapped.

Line 8,000E was covered in the previous survey where porous pots were used as receiver electrodes. Frequency Effects in the area where the Jaspilite Conglomerate outcrop is considered located, are low compared with Frequency Effects in similar areas on the lines on which steel stakes have been used. On lines 7,600E and 7,200E anomalous Frequency Effect readings at "n = 5" below 9,450N on both lines are associated with a resistivity "low" and are near the area through which the conglomerate bed is considered located. A frequency Effect is in a similar position on line 6,800E, below 9,550N, but the resistivity "low" is higher and centred below 9,450N. From this it could be suggested that the Frequency Effect anomaly may not be directly associated with the resistivity low, and a separate correlation of resistivity and Frequency Effect may exist.

A similar effect is noticeable on line 6,400E, below 9,150N, but this anomaly is much further south of the Jaspilite Conglomerate bed and could not be associated with it. It has a displaced resistivity anomaly located near it. The Jaspilite Conglomerate bed on this line is in an area where there is no marked change in Frequency Effect readings.

Line 6,000E has a broad but nearer surface Frequency Effect anomaly below 9,350N to 9,650N which could be associated with the anomaly on 6,400E. A broad but deeper F.E. anomaly below 9,100N to 9,600N on line 5,600E has a resistivity "low" associated with it and could be related to the anomaly on 6,000E. It is also unrelated to the Jaspilite bed.

If the anomalies on all these lines are correlatable, then it is suggested that the cause of these anomalies does not lie in the Jaspilite bed, but near and parallel to it between 7,600E and 6,800E, where it is angled further away from th Jaspilite Conglomerate and further into the adjacent beds to 5,600E. The cause of these anomalies would be nearest surface on line 6,000E. A possible cause of the anomalies could be from graphite or carbonaceous material positioned in the quartzite bed adjacent to the Jaspilite Conglomerate bed.

If anomalies on 6,800E and 6,400E have no common cause then there could be an association of the anomalies on lines 7,600E, 7,200E and 6,800E with the Jaspilite Conglomerate bed. In this case a possible cause of these anomalies could be increased mineralization in the Jaspilite Conglomerate bed. A small amount of copper mineralization was discovered in the core from diamond drill-hole ID 1. Frequency Effect readings on line 9,200E in the approximate area of the mineralization intersection were low compared with those on these recent lines.

Electro-Magnetic

Centres of anomalies and a correlation of them are shown on the map of the area (Fig. 1). Three correlatable conducting zones have been delineated. They are all sub-parallel to one another, and also the Jaspilite outcrop so far mapped. The zone which is mapped at 9,550N on line 5,600E is correlateable through to 9,250N on line 10,600E although it tends to be weak on the more easterly lines. There could be a connection of the zone at 8,850N on line 8,600E with that at 8,900N on line 6,800E. There was insufficient southerly extension to the lines to cover this anomaly fully. Correlation exists between line 10,000E and 10,600E for the zone previously mapped from 8,000E to 10,000E. This extension is sub-parallel to the anticipated direction of the Jaspilite outcrop.

The E.M. anomalies are probably caused by the shale beds interbedded with the quartzites, and by carbonaceous material within the different beds. The only E.M. zone that could have some connection with the Jaspilite bed, is the zone that is nearest to the Jaspilite outcrop. The estimations of depth to axis of conductors on lines 10,000E, 10,200E, 10,400E, and 10,600E are 100' , 100', 80' and 80' respectively. In all cases the axes are at least 100' south of the Jaspilite bed, and in the highly conductive adjacent bed.

It is therefore considered that the cause of this zone of E.M. anomalies is not associated with the Jaspilite bed.

Profiles of Phase Differences and Ratios are not included in the report but are held in the Geophysics (Exploration) Section.

Brown Hill Area

It was considered possible that the very high Frequency Effect anomalies previously obtained in this area were caused by coupling (electromagnetic). If this were so it would be unlikely that the anomaly could be duplicated. Lines 11,000E and 6,200E were resurveyed and results compared with previous results. Contours of Resistivity and Frequency Effect of the two surveys are compared on Fig. V. It is noticeable that the contours and Frequency Effect values are similar, thereby establishing the existence of an anomalous zone in this area.

Contours of Resistivity and Frequency Effect of lines 11,000E, 10,200E, 9,400E, and 6,200E are shown on Fig. IV and it can be seen that the anomalies can be correlated over all lines as shown in Fig. I.

The Frequency Effect anomalies on all lines straddle the change from less than 4 ohm-meters to greater than 4 ohm - meters, but less than 20 ohm-metres divisions (as shown in first report). This indicates a change in bedding in this area which suggests that the Frequency Effect anomalies can be associated with the bedding contact, or its cause is near to the contact but in the less than 4 ohm-metre bed.

CONCLUSIONS AND RECOMMENDATIONS

From work carried out in this recent survey, it is concluded that the use of Electromagnetic Methods in finding mineralisation in the Jaspilite Conglomerate bed is unsuccessful, as the conductance of the adjacent beds, and the position of the water-pipe mentioned in the first report, tends to distort or obliterate any effect from mineralization in the Jaspilite Conglomerate bed.

If Frequency Effect readings using steel stakes as receiver electrodes are of similar value to those using porous pots, anomalies on lines 7,600E, 7,200E and 6,800E are of interest with respect to mineralization in the Jaspilite Conglomerate bed, and should be tested by drilling. It is recommended that lines 8,000E, and 9,200E be resurveyed using the I.P. method, but using steel stakes as receiving electrodes instead of porous pots. A comparison of readings can be made using both types of electrodes. If there is little difference in results, drilling is recommended on the lines previously mentioned.

Further I.P. work is recommended in the Brown Hill area to delineate the extent of the large anomalies. The high-power transmitter unit should be used in this area when available so that a maximum number of reliable readings can be obtained. Drilling of the anomalies is strongly recommended to establish their origin, and to determine whether further geophysical investigation is justified.

B Taylor

14.7.65
BJT:AWK

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APPENDIX A

DEPARTMENT OF MINES
SOUTH AUSTRALIA

REPORT OF A GROUND MAGNETIC SURVEY RESULTING FROM A TEST OF MAGNETIC INSTRUMENTS IN THE TARCOOLA AREA

INTRODUCTION

Values of the vertical component of the earth's magnetic field were measured by B.J. Taylor on four lines at Tarcoola during the first I.P. and E.M. Survey in June/July 1964. A magnetic anomaly on line 11000E between 15800N and 16200N suggested a relationship with a jaspilite conglomerate bed in the Brown Hill Area.

Field testing of a vehicle mounted nuclear precession magnetometer (ELSEC Proton Magnetometer type 592/F) was necessary in an area free of power lines, fences, and other sources of interference, and it was decided to survey the area covered by electrical methods at Tarcoola as part of the testing programme. Apart from the freedom from magnetic interference, Taylor's preliminary magnetic data showed an area of very little magnetic disturbance bounded by a sharp, distinctive anomalous high, providing excellent conditions for testing the equipment.

REFERENCES

Specification and Operating Instructions for a Proton Magnetometer Type 592/F - Littlemore Scientific Engineering Co.

METHODS USED

The vehicle mounted magnetometer measures the total force of the earth's magnetic field at discrete time intervals of 4 or 7 seconds and the value is recorded on a paper chart by a pen recorder. The drive of the pen recorder is linked to the speedometer drive of the vehicle and the speedometer is calibrated to read .01 mile. The drive mechanism developed a fault which could not be remedied in the field and it was necessary to stop the vehicle at regular intervals (.05 mile) and record the magnetic values in writing. The vertical force component was obtained for comparison on line 15000E using a Jalander flux gate magnetometer, and this instrument was also used to occupy stations in areas where the vehicle could not be driven, and on several lines while repairs were being made to the vehicle mounted instrument.

Navigation of the vehicle was accomplished by keeping line with ranging poles or, where scrub was too high, 35 feet telescopic whip aerials with a flag attached. This method was adequate for the restricted area covered and heading errors were negligible.

The results from both instruments have been plotted as profiles (fig. VI), as though compatible, but interpretation is based on a qualitative appraisal of the magnetic structure and not on actual values. Different symbols have been used to distinguish the total force measurements and the vertical component.

DISCUSSION OF RESULTS

A series of magnetic high anomalies of varying magnitude can be correlated from lines 15000E to 7800E in the Brown Hill region, and the line of anomalies is parallel to geological strike where mapped. On lines 9400E, 10200E, 10800E and 11000E the high values coincide with a jaspilite conglomerate bed and it appears that the bed can be extrapolated to 15000E along the line of anomalous magnetic intensity. Extrapolation to the west is not as simple as a high value on line 9400E is displaced to the north, and on 7800E to the south, while 8600E is in line with anomalies from 10200E to 15000E and the conglomerate outcrop. Lines 7000E, 6200E and 5000E were not extended far enough north to indicate whether the magnetic anomalies continue to the west.

The shape of the anomalies suggests a narrow, shallow source between 7800E and 11000E with the depth of burial increasing to the east of 11000E and decreasing again at 15000E.

Another feature common to lines of total force values (6200E to 11000E) is the nearly constant but small decrease in values to the north between co-ordinates approximately 11000N to 16000N indicating increasing depth of burial of granite.

A series of relatively small high anomalies have some consistency between 8000N and 10000N, but cannot be correlated with the same degree of certainty as those in the Brown Hill Area. The line of anomalies appears to be roughly parallel to the strike of the conglomerate bed, and the anomalous values probably originate from the jaspilite contained in this bed. The distinctive anomaly at 6200E 10000N is coincident with this bed.

Interpretation of the results must remain tentative without further surveying due to the necessity of numerous adjustments and repairs to the instrument being tested, and in part to the rugged topography at the northern and southern extremities of the lines.

CONCLUSIONS

A conglomerate bed containing jaspilite gives rise to pronounced magnetic high values in the Tarcoola area, and magnetic methods should be successful in tracing this bed below sand cover and extending geological knowledge beyond areas capable of being mapped.

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SENIOR GEOPHYSICIST,
(EXPLORATION)

FIG. 12

To accompany report by B.J. Taylor

61/2

S.A. DEPT. OF MINES (Topographic detail compiled from enlarged air photographs)

TARCOOLA AREA

E.M. & I.P. GRID & ANOMALIES

Associated Drawing	No.	No.	Amendment	Exd.	Date	Reg. No. / D.M. / Compiled from

Approved — Director of Mines | Passed

Drn. | Tcd. G.M. | Ckd. | Exd.

Scale: 395' to 1" (Approx)

64-1066 Bb

Date 26.11.64

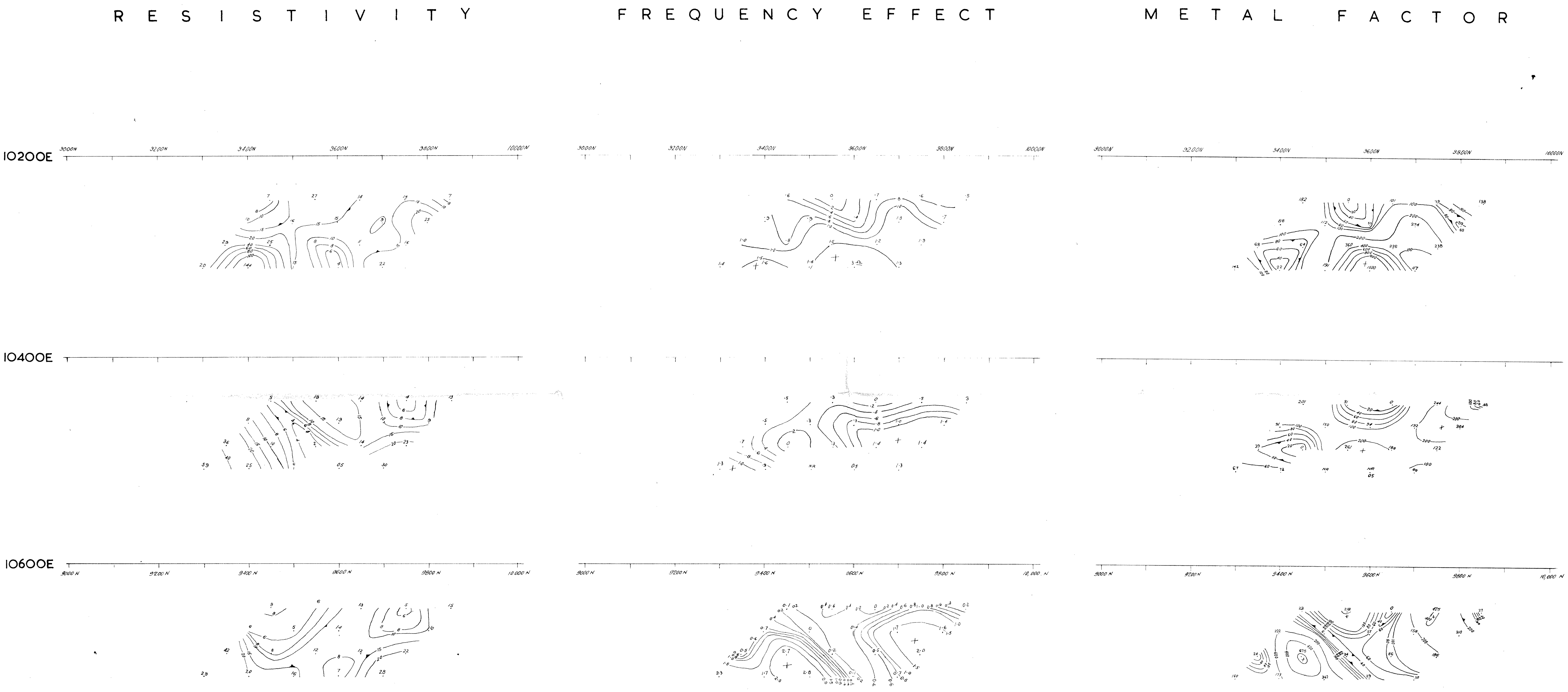


fig. 2 61/2

S.A. DEPT. OF MINES

TARCOOLA AREA

LINES 10200E, 10400E, 10600E.

CONTOURS OF RESISTIVITY, FREQUENCY EFFECT AND METAL FACTOR

Req. No.	
D.M.	
Compiled from	
Approved	Passed
Director of Mines	
Drn.	
Tcd.	
Ckd.	L.V.W.
Exd.	
Scale	100 ft/inch
	65729 Bb
Date	16th JULY 1965

Associated Drawing	No.	No.	Amendment	Exd.	Date

TARCOOLA AREA

LINES 5600E TO 7600E

CONTOURS OF RESISTIVITY, FREQUENCY EFFECT AND METAL FACTOR

61/2

FIG 3

SCALE: 100 FT TO 1 INCH

L65-96

5-6-65 Bb

TARCOOLA AREA

LINES 6200E TO 11000E

CONTOURS OF RESISTIVITY, FREQUENCY EFFECT AND METAL FACTOR

FIG. 4

61/2

SCALE: 200 FT. TO 1 INCH.

L65-97

T.P.S. 13-7-65. Bb

FIG. 5

S.A. DEPT. OF MINES

TARCOOLA AREA (BROWN HILL)
LINES 11000E & 6200E
COMPARISON OF CONTOURS OF RESISTIVITY AND FREQUENCY EFFECT USING TWO TYPES OF ELECTRODES.

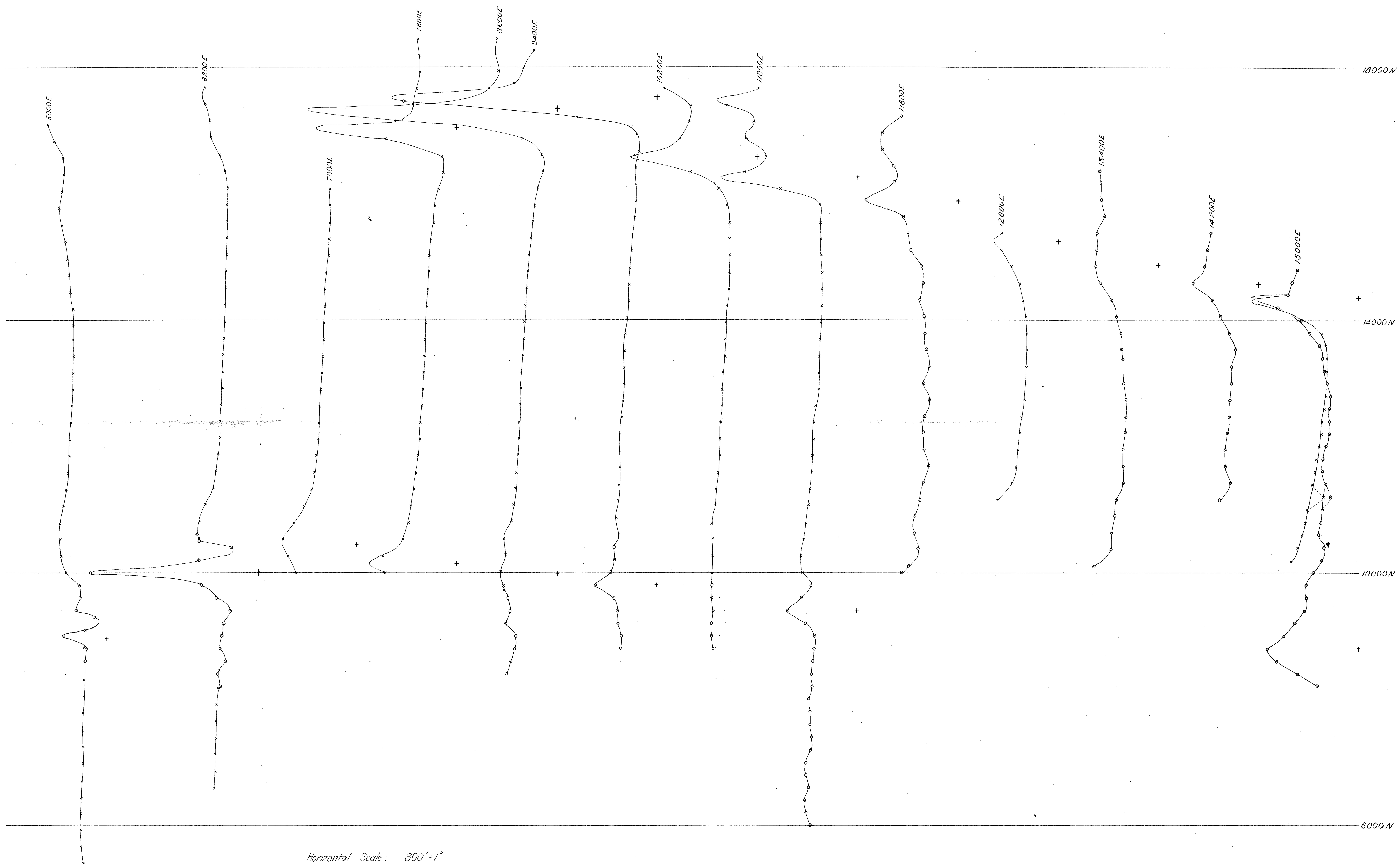
Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from

Approved | Passed
Director of Mines

Drn.
Tcd. R.H.
Ckd.
Exd.

Scale:
65-730
Bb
Date 5-7-65
61/2



Horizontal Scale: 800' = 1"

Vertical Scales: 800γ = 1"
400' = 1"

Total force measurements shown: ×

Vertical component measurements: ○

Magnetic high shown on base line: +

Interpretation: B.E.Milton

Date: 15th May 1965

To accompany Appendix A to Report on Geophysical Investigations in the vicinity of the Tarcoola Mine Area.

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S.A. DEPT. OF MINES

TARCOOLA AREA — MAGNETOMETER SURVEY
PROFILES OF MAGNETIC INTENSITY

Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from

Approved	Passed
Director of Mines	

Drn.
Tcd. R.H.
Ckd.
Exd.

Scale: As shown
65-726
Bb
Date: 1·7·65