

**GEOPHYSICAL SURVEYS
UNDERTAKEN ON THE
CURTIN SPRINGS PROSPECT
E.L. 5858
NORTHERN TERRITORY**

**FOR
KINGSGATE CONSOLIDATED LIMITED**

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CURTIN UNIVERSITY, W.A.
MARCH 1990**

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1. INTRODUCTION

Ground geophysical surveys were completed on E.L. 5858 (within Curtin Springs Station) during October and December 1989 on behalf of Kingsgate Consolidated Limited.

The surveys delineated previously recorded airborne magnetic anomalies S1, S2, S3 and N4 using ground magnetometer, with induced polarisation, electromagnetic (SIROTEM) and gravity surveys being carried out on selected sites.

The initial survey party in October 1989 comprised of Mr V. Wilson, Senior Lecturer in Geophysics at Curtin University of Technology, Perth and five members of the third year class studying the BAH.Sc. (Geophysics) course. In December, the party comprised of Mr Wilson, Mr J. Garlick of McKay & Schnellman Pty Ltd, Perth, consultant Geologists and two student members of the first party.

The locations of the airborne magnetic anomalies investigated during this work programme are shown at the Locality Plan (Figure 1) enclosed. They are discussed in Section 2.

2. LOCATION OF SURVEY AREAS

Horizon Seismic Peg S300 L82/11 (at the intersection of the seismic line and the old Ayers Rock Road - now an internal station road, north of the present Ayers Rock Road) was taken as our 00m work for the seismic line.

S2 anomaly was located by driving two hours south from our 00m peg down the seismic line and then heading at 274°T for a distance of 4640 metres. This location was pegged as 4640m W, 2000m S. Traverse line S2/1 was set through this point, for a distance of 1000 metres to the north (1000m S peg) and for a distance of 2000 metres to the south (4000m S metres). The line was pegged every 500 metres and its bearing was 0°T.

S1 anomaly was located by driving at a bearing of 190°T from our 4640m W, 2000m S peg at S2. At 5 kilometres from this peg, a peg was placed and marked 7000m S. Further pegs were set at 500 metre intervals to 12500m S. Traverse line S1/1 extends from 7000m S to 12500m S on this line. Traverse line S1/4 intersects S1/1 at 95505 on S1/1 and 00m W on S1/4.

Traverse line S1/2 was set 50 metres to the east of S1/1 and traverse line S1/3 50 metres to the west of S1/1.

Anomaly S3 was located driving to 8500m S down the seismic line and then 1900 metres due west.

Line S3/1 was read with the magnetometer for 1000 metres due north and due south of this location which was pegged as 00m S.

Traverse line N4/1 was located by driving 3000 metres due west of the bend in the seismic line (reached by station access track). From this location, pegged as 00m. Traverse line N4/1 extended 2000 metres to the west and 1000 metres to the east.

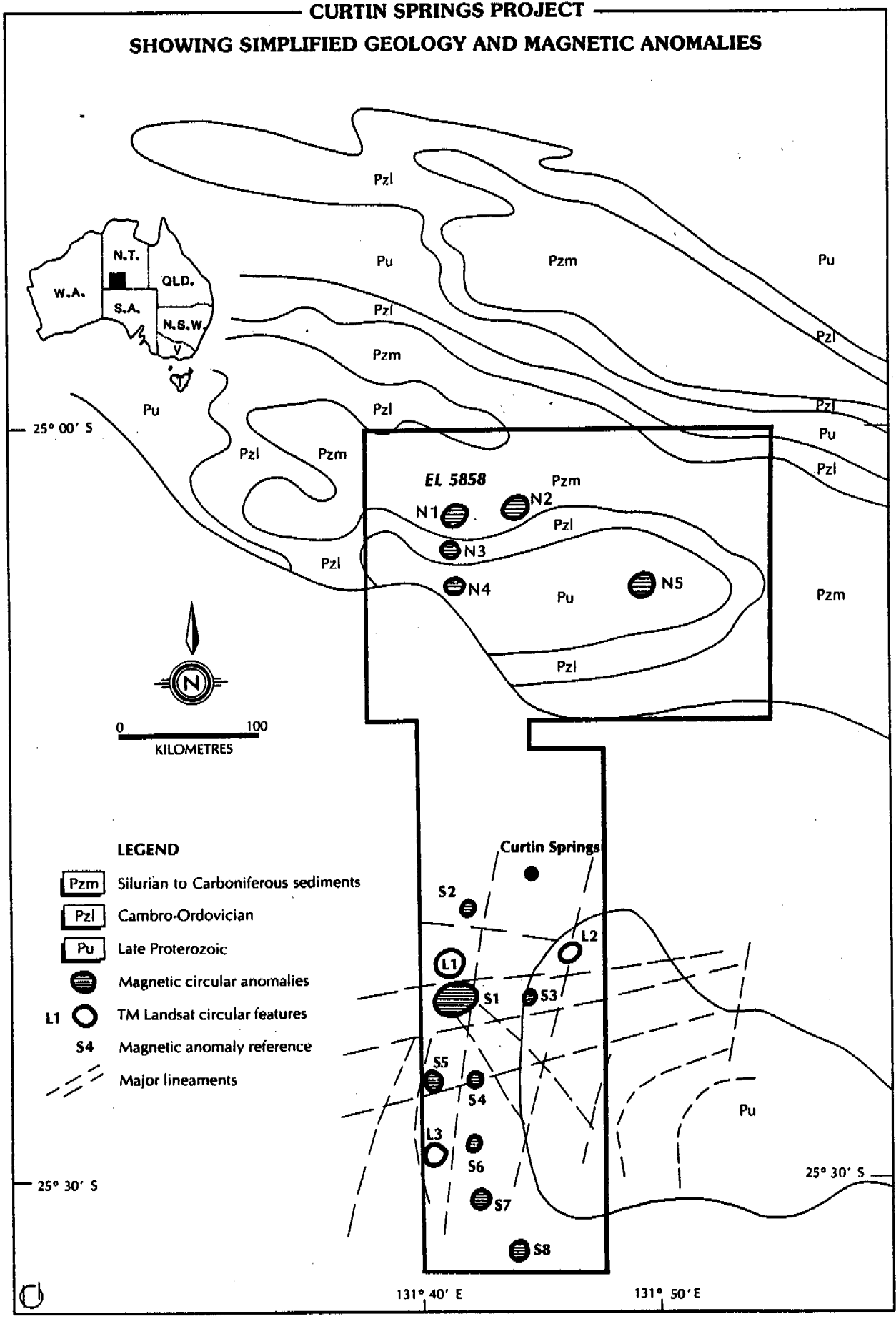


FIGURE 1

3. SURVEY PROCEDURE

3.1 General

Utilising base maps provided by the client, the ground expression of the airborne magnetic anomalies were located using compass, vehicle odometer and magnetometer.

Once the central portion of the anomaly was identified, a traverse line was pegged every 500 metres across the anomaly and ground magnetic traversing completed to determine the response. In the case of anomaly S1 an orthogonal line was traversed as well across the anomaly.

In the case of anomalies S1 and S2 additional survey work was completed along segments of these traverse lines. This additional work comprised gravity, E.M. (SIROTEM) and induced polarisation for S1 and gravity and E.M. for S2.

In the case of S1, two traverse lines of E.M. work were completed parallel to and 50 metres offset either side of the north-south trending magnetic traverse in December 1989. (S1/2 to the east and S1/3 to the west).

For S2, one traverse line of E.M. was completed 50 metres west of S2/1 on traverse line S2/2.

3.2 Ground Magnetic Survey

Two geometrics G856 memory magnetometers were used for the ground magnetic surveys - one as a station unit and one as a base station to permit observation of fluctuations in the geomagnetic field. The units read to a sensitivity of 0.1nT, and repeatability of readings were generally within range $\pm 5nT$.

Station spacing was 10 metres on all lines. A sensor height of 2 metres was used for both base and station units.

3.3 Gravity Survey

Gravity stations were read at 50 metre station spacings using a La Corte and Romberg Model G gravimeter, having a sensitivity of 0.01 milligals. Gravity readings were tied back to the base station within a 3 hour time interval. Levelling of all stations was accomplished using a Sokkisa Red Electronic Distance Measuring unit to an accuracy of ± 0.02 metres.

3.4 Time Domain E.M. Survey

A Sirotem Mark I unit was used for this survey. A single loop (100m x 100m) was used for both the transmitter and receiver.

3.5 Induced Polarisation

A 100 metre dipole spacing dipole-dipole spread was attempted over the region found to exhibit anomalous Bouguer Gravity. Both Hunter Mark 4 and Elliott time domain receivers were used in conjunction with a 7.5kVA Hunter Mark 3 Transmitter. Although satisfactory results were achieved for apparent resistivities, the low current achieved and the small chargeabilities present did not permit the acquisition of satisfactory chargeability data.

Transmitter electrodes were alfoil sheets in 0.2 x 2 x 1 with pits, saturated with saline water. Receiver electrodes were porous pots with clean copper electrodes in a saturated salution of copper sulphate.

TABLE 1 - MAGNETICS

	<u>LINE NO.</u>	<u>BEARING (T)</u>	<u>EXTENT OF TRAVERSE (m)</u>
S1	S1/1	10°	12500S - 7000S
	S1/4	90°	3000W - 2450E
S2	S2/1	0°	4000S - 1000N
S3	S3/1	0°	1000S - 1000N
N4	N4/1	90°	2000W - 1000E

TABLE 2 - GRAVITY

S1	S1/1	10°	11000S - 9100S
S2	S2/1	0°	3000S - 1500S

TABLE 3 - ELECTROMAGNETICS

S1	S1/1	10°	10950S - 7600S
	S1/2 (50m E of S1/1)	10°	10450S - 9450S
	S1/3 (50m W of S1/1)	10°	10650S - 9050S
S2	S2/2 (50m of S2/1)	0°	3500S - 1050S

TABLE 4 - INDUCED POLARISATION

S1	S1/1	10°	10500S - 9500S
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4. DISCUSSION OF RESULTS

The results are presented on Figures 2 to 17 at the rear of the report.

Where computer modelling has been attempted, the computed values are presented on the same figure as the field data.

4.1 Anomaly S1

The anomaly at S1 defined as line S1/1 is presented as Figure 2.

Applying the approximation rules (Area, Width, Peters, Tibung, Hankel, Thalen, Slope Distance and Morse-min) the depth to the top of the magnetic body would appear to be somewhere in the depth range of 500 - 1000 metres. These rules are indeed very approximate, assuming vertical slabs, or pipes having infinite depth extent in near vertical field. The inclinations at Curtin Springs is approximately -55° implying that these rules could only provide a rough idea of depth.

Using a Curtin programme G.POLY (for 2, 2½D models) Figure 3 and 4 provide models which fit the magnetic high but not the southern negative part of the curve. Resonance is a possible course for this misfit. Succceptibility was chosen to be 0.04 SI units.

Using Curtin Programme VERCYL for a 3D vertical cylinder results in the model shown in Figure 5. This only provides an approximate fit but shows the horizontal extent of a pipe having a succceptibility of 0.01S.I. units.

The east-west line S1/4 was modelled using VERCYL to provide the model at Figure 6. The model used was the same as for S1/1 and as seen it approximates the field curve, however the east-west anomaly is in fact broader.

The magnetics would indicate that the causative feature of the S1 magnetic anomaly is a vertical body having a wide areal extent with a depth to its top of 600 - 950 metres and with succceptibility of 0.01 - 0.04 SI units.

The gravity anomaly on line S1/1 had two distinct peaks of small amplitudes (0.49 and 0.37 milligabs). A possible model for these is presented at Figure 7.

The Sirottem traverse lines indicate the possibility of conductors at:

S1/1	10200 ms
S1/1	7800 ms
S1/2	10100 ms
S1/2	9825 ms
S1/3	9350 ms
S1/3	9500 ms
S1/3	9900 ms

The results are presented in Figures 8, 9 and 10.

The decay for the anomaly on S2/2 at 9825 ms (taken for peak at 9950ms) gives a time constant of 4.3 ms which is of interest in terms of mineral exploration. (See Figure 11).

The anomaly at this site is most easily analysed of those indicated on all these lines and would appear to occur at a depth of approximately 200 metres. For this reason a test hole site has been pegged at 98255 on S1/2.

The I.P. provided poor data for chargeabilities (small with much noise). The apparent resistivities indicates uniform resistivities of 10-20 down to approximately 150 metres.

4.2 Anomaly S2

Models of the magnetic traverse on S2/1 are presented at Figures 13 and 14. The data used above is shown at Figure 12.

The 2.5D programme provides a complicated intrusion as a possibility, extending to within 300 metres of the surface. The approximate curve methods give a depth to top of the body as being approximately 300 m.

The vertical cylinder programme provides a depth of 425 metres to the top of the body. The susceptibility contact in both cores indicates a rock type of relatively high magnetite content (contacts of 0.045 SI and 0.012 SI).

The gravity survey indicates a of small amplitudes (0.7, 0.47 milligabs) of 0.2 g/cc density contact. It is clear that the causal body between 2300S and 2700S agrees in being above both magnetic models, and the body between 1650S and 1900S probably relates to the small increase seen in the magnetics between these locations, but not modelled. (See Figure 15).

The E.M. (SIROTEM) survey did not indicate discrete conductors. However it did indicate a worked change to were conductive material from 1700S to 1000S - perhaps related to the more resistive intrusion south of 1700S.

4.3 Anomaly S3

The magnetic results from this line, modelled by VERCYL indicate a cylinder 250 metres below surface with susceptibility contact 0.01 S.I. (Figure 16).

4.4 Anomaly N4

The magnetic profile (Figure 17) indicates a fault zone (between 800W - 100E) comprising magnetic material close to the surface and separating more magnetic material to the west from less magnetic material to the east.

5. CONCLUSIONS

The results from the survey have been modelled to give some idea of the possible causes of the geophysical responses determined. Though it is not possible to determine the causal bodies uniquely these models provide a basis for drillsite locations.

Three units were located whilst the party was on site in December:

S1/2	9825S	Test E.M. response
S1/1	10000S	Test gravity response
S2/1	2400S	Test gravity response

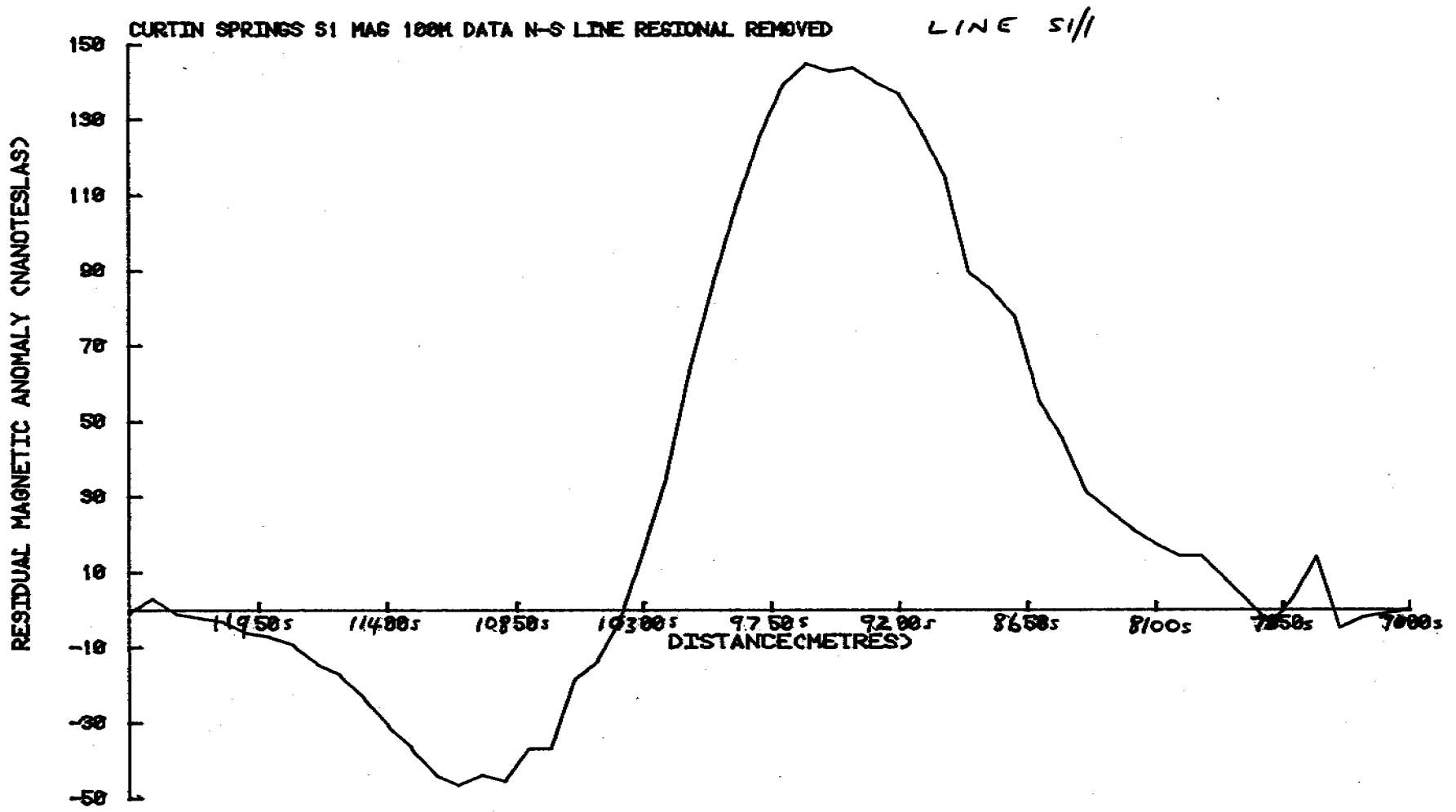
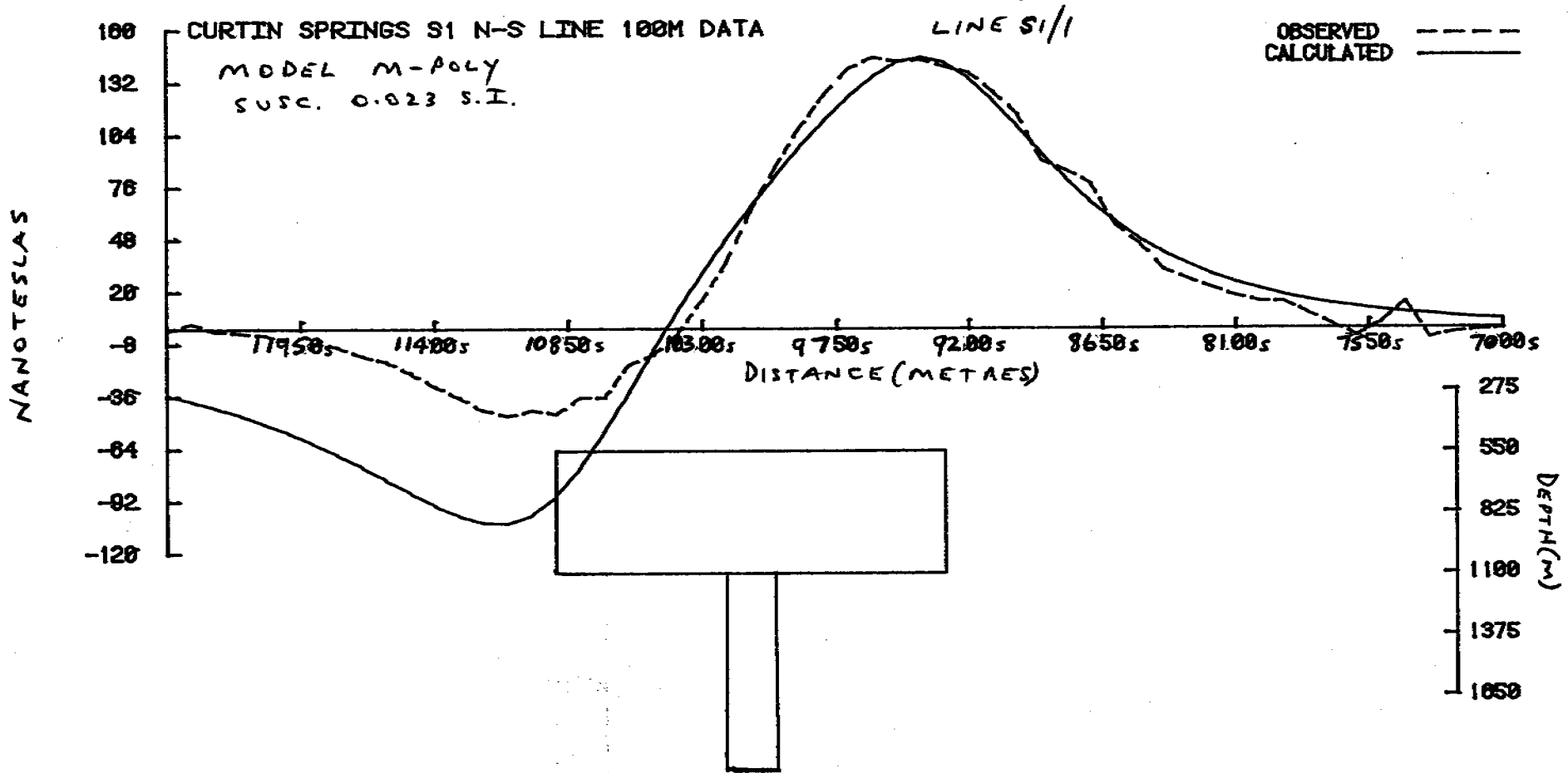


FIGURE 2

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DEPT. OF EXPLORATION GEOPHYSICS CURTIN UNIVERSITY

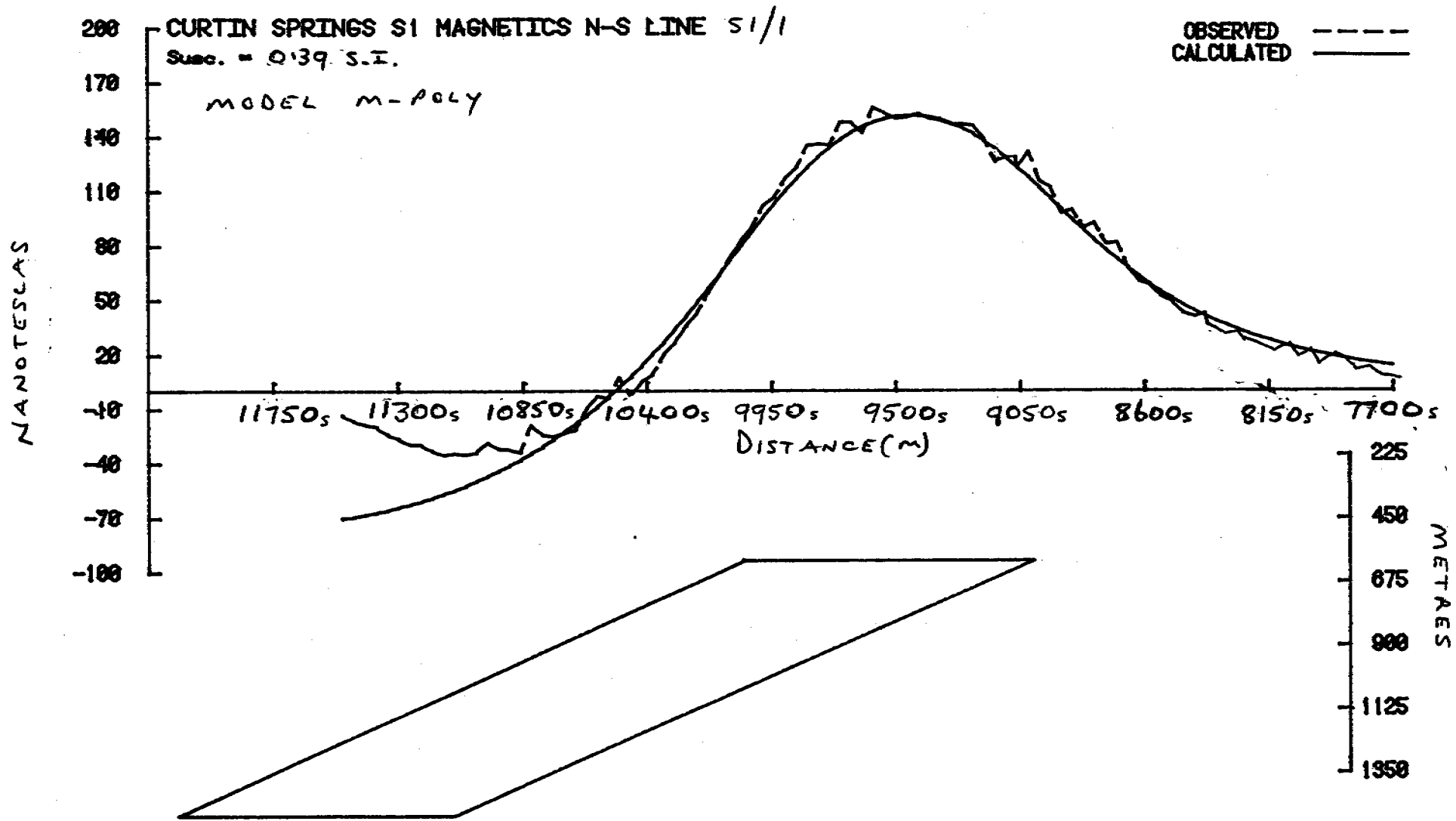


FIGURE 4

DEPT. EXPLORATION GEOPHYSICS
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LINE S1/1 VERCYL MODEL MAGNETICS

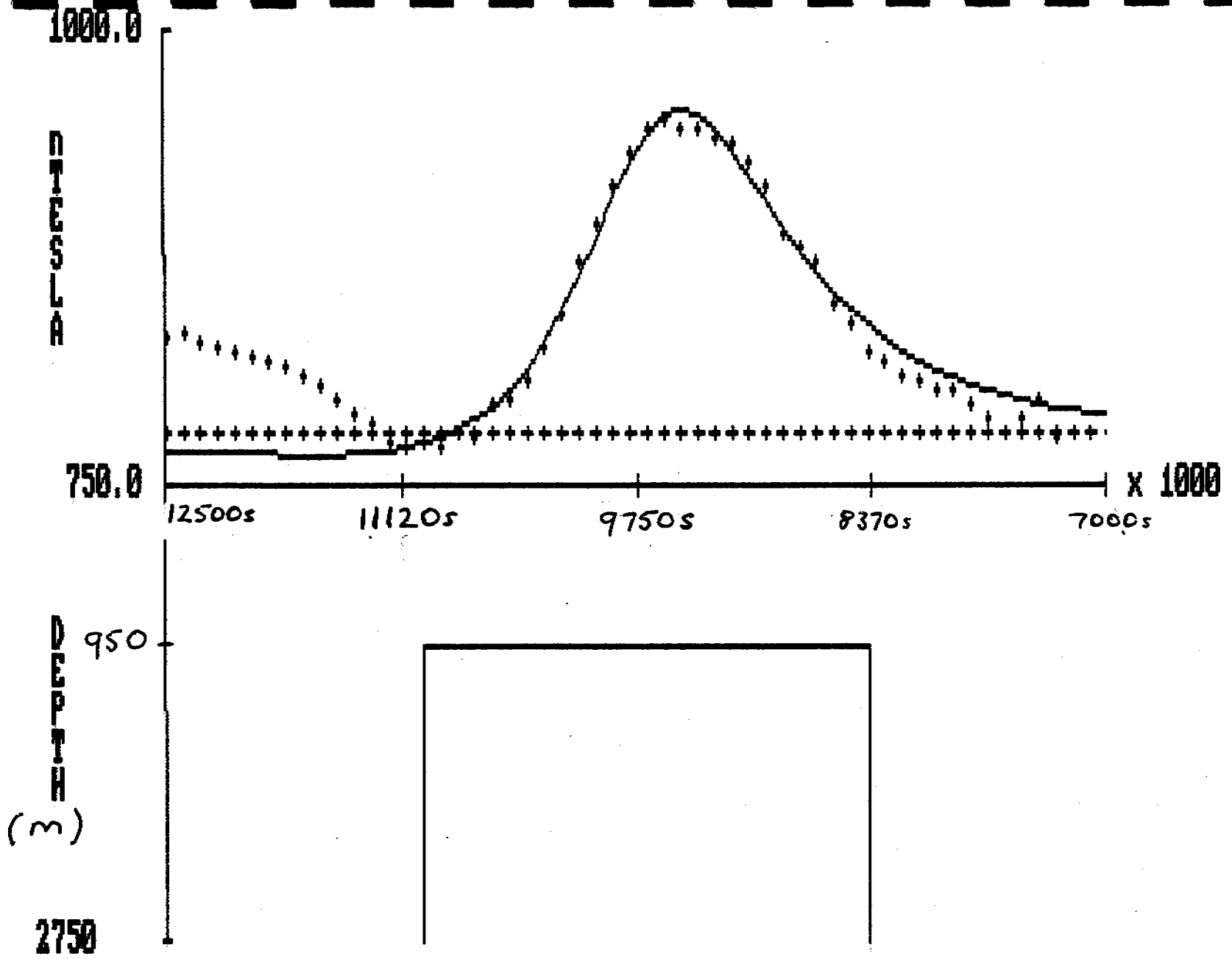


FIGURE 5

B

VERTICAL CYLINDER

PARAMETERS ARE :

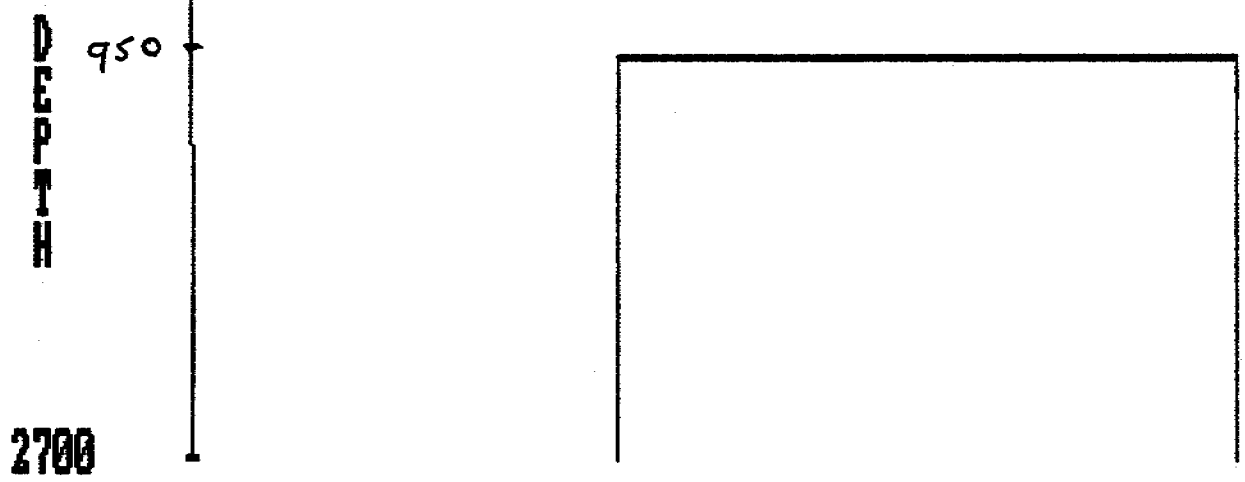
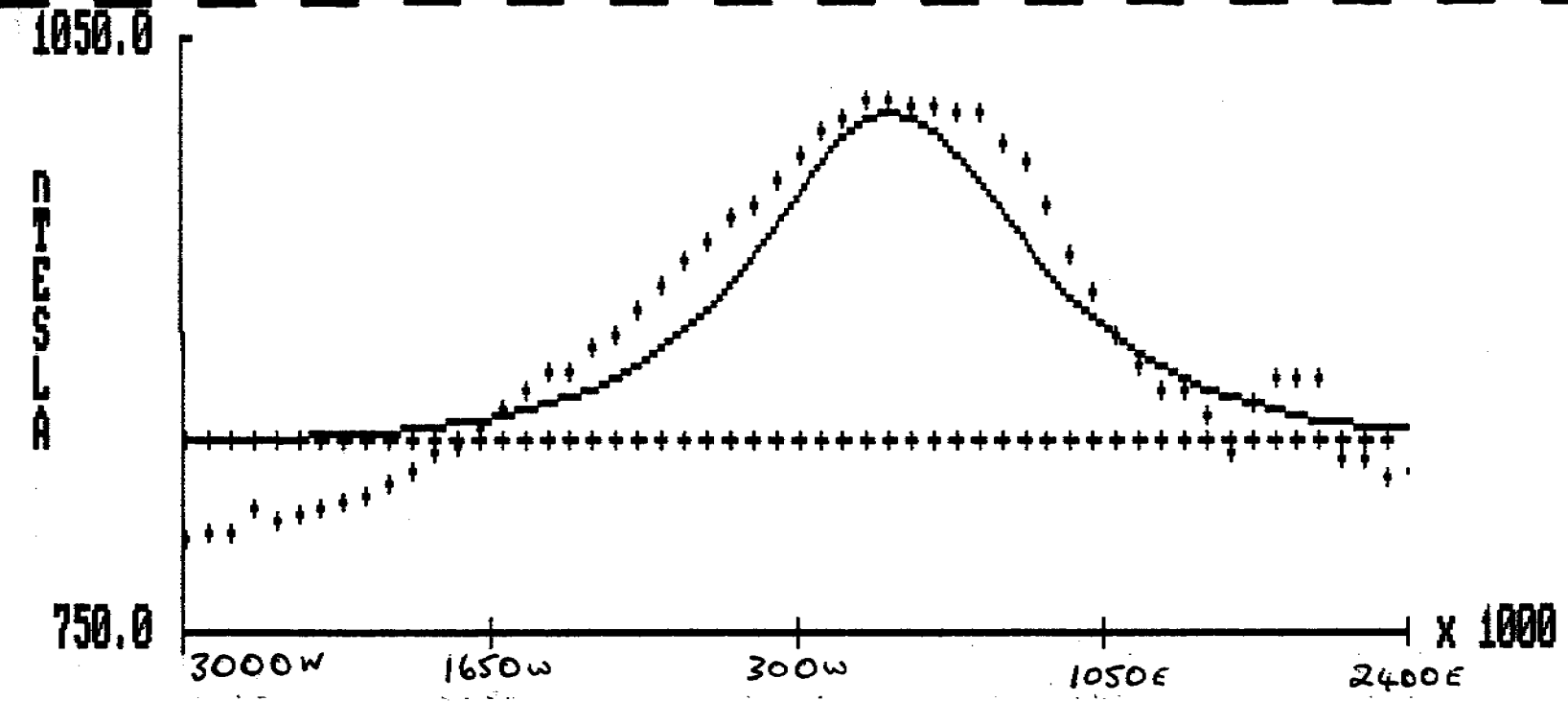
INTENSITY OF INDUCING FIELD = 55000 nTESLA
 INCLINATION OF INDUCING FIELD = -55.0 DEGREES
 DECLINATION OF INDUCING FIELD = 4.0 DEGREES
 BEARING OF MAGNETIC NORTH = -6.0 DEGREES
 SUSCEPTIBILITY CONTRAST = 0.0100
 RADIUS = 1300 METRES
 DEPTH = 950.0 METRES
 DEPTH EXTENT = 4000.0 METRES
 CENTRE IS AT 2900 X METRES
 CONSTANT REGIONAL IS 780.0 nTESLA
 LINEAR REGIONAL COMPONENT IS 0.000 nTESLA/METRE

RMS% ERROR = 2.9747

XPOS	CALC.	FIELD	dG
100.0	771.2	832.0	-60.8
200.0	770.9	835.0	-64.1
300.0	770.5	830.0	-59.5
400.0	770.2	828.0	-57.8
500.0	769.9	826.0	-56.1
600.0	769.6	822.0	-52.4
700.0	769.4	820.0	-50.6
800.0	769.2	817.0	-47.8
900.0	769.1	811.0	-41.9
1000.0	769.1	807.0	-37.9
1100.0	769.3	800.0	-30.7
1200.0	769.7	792.0	-22.3
1300.0	770.4	785.0	-14.6
1400.0	771.5	777.0	-5.5
1500.0	773.0	773.0	+0.0
1600.0	775.2	775.0	+0.2
1700.0	778.2	772.0	+6.2
1800.0	782.3	780.0	+2.3
1900.0	787.7	779.0	+8.7
2000.0	794.9	796.0	-1.1
2100.0	804.1	800.0	+4.1
2200.0	815.7	810.0	+5.7
2300.0	830.1	827.0	+3.1
2400.0	847.2	846.0	+1.2
2500.0	866.7	873.0	-6.3
2600.0	887.7	895.0	-7.3
2700.0	908.8	915.0	-6.2
2800.0	927.9	932.0	-4.1
2900.0	943.0	945.0	-2.0
3000.0	952.5	950.0	+2.5
3100.0	955.6	947.0	+8.6
3200.0	952.6	947.0	+5.6
3300.0	944.6	942.0	+2.6
3400.0	933.3	938.0	-4.7
3500.0	919.9	927.0	-7.1
3600.0	906.0	914.0	-8.0
3700.0	892.2	888.0	+4.2
3800.0	879.2	882.0	-2.8
3900.0	867.4	874.0	-6.6
4000.0	856.7	851.0	+5.7
4100.0	847.3	840.0	+7.3
4200.0	839.0	825.0	+14.0
4300.0	831.8	819.0	+12.8
4400.0	825.5	813.0	+12.5

4700.0	811.0	803.0	+8.0
4800.0	807.4	796.0	+11.4
4900.0	804.3	789.0	+15.3
5000.0	801.5	782.0	+19.5
5100.0	799.1	788.0	+11.1
5200.0	796.9	798.0	-1.1
5300.0	795.1	778.0	+17.1
5400.0	793.4	780.0	+13.4
5500.0	791.9	780.0	+11.9
5600.0	790.7	780.0	+10.7

5-



VERCYL MODEL LINE S11.

FIGURE 6

VERTICAL CYLINDER

PARAMETERS ARE :

INTENSITY OF INDUCING FIELD = 55000 nTESLA
 INCLINATION OF INDUCING FIELD = -55.0 DEGREES
 DECLINATION OF INDUCING FIELD = 4.0 DEGREES
 BEARING OF MAGNETIC NORTH = -86.0 DEGREES
 SUSCEPTIBILITY CONTRAST = 0.0100
 RADIUS = 1300 METRES
 DEPTH = 950.0 METRES
 DEPTH EXTENT= 4000.0 METRES
 CENTRE IS AT 3200 X METRES
 CONSTANT REGIONAL IS 850.0 nTESLA
 LINEAR REGIONAL COMPONENT IS 0.000 nTESLA/METRE

RMS% ERROR = 2.8575

XPOS	CALC.	FIELD	dG
100.0	849.0	800.0	+49.0
200.0	849.2	802.0	+47.2
300.0	849.4	804.0	+45.4
400.0	849.7	814.0	+35.7
500.0	850.1	810.0	+40.1
600.0	850.5	813.0	+37.5
700.0	851.0	814.0	+37.0
800.0	851.6	818.0	+33.6
900.0	852.3	822.0	+30.3
1000.0	853.2	828.0	+25.2
1100.0	854.2	833.0	+21.2
1200.0	855.4	843.0	+12.4
1300.0	856.9	846.0	+10.9
1400.0	858.7	855.0	+3.7
1500.0	860.9	865.0	-4.1
1600.0	863.5	873.0	-9.5
1700.0	866.6	883.0	-16.4
1800.0	870.3	882.0	-11.7
1900.0	874.9	896.0	-21.1
2000.0	880.3	902.0	-21.7
2100.0	886.9	914.0	-27.1
2200.0	894.8	926.0	-31.2
2300.0	904.1	938.0	-33.9
2400.0	915.0	948.0	-33.0
2500.0	927.7	959.0	-31.3
2600.0	941.8	968.0	-26.2
2700.0	957.2	980.0	-22.8
2800.0	972.9	991.0	-18.1
2900.0	987.9	1003.0	-15.1
3000.0	1000.5	1010.0	-9.5
3100.0	1009.3	1020.0	-10.7
3200.0	1013.0	1020.0	-7.0
3300.0	1011.1	1016.0	-4.9
3400.0	1003.8	1016.0	-12.2
3500.0	992.4	1014.0	-21.6
3600.0	978.4	1014.0	-35.6
3700.0	963.2	996.0	-32.8
3800.0	948.1	987.0	-38.9
3900.0	934.0	967.0	-33.0
4000.0	921.2	942.0	-20.8
4100.0	910.0	922.0	-12.0
4200.0	900.3	902.0	-1.7
4300.0	892.1	887.0	+5.1
4400.0	885.2	873.0	+12.2

4700.0	870.4	843.0	+27.4
4800.0	866.9	867.0	-0.1
4900.0	864.1	879.0	-14.9
5000.0	861.6	879.0	-17.4
5100.0	859.6	879.0	-19.4
5200.0	857.9	839.0	+18.9
5300.0	856.5	839.0	+17.5
5400.0	855.2	831.0	+24.2
5500.0	854.2	834.0	+20.2

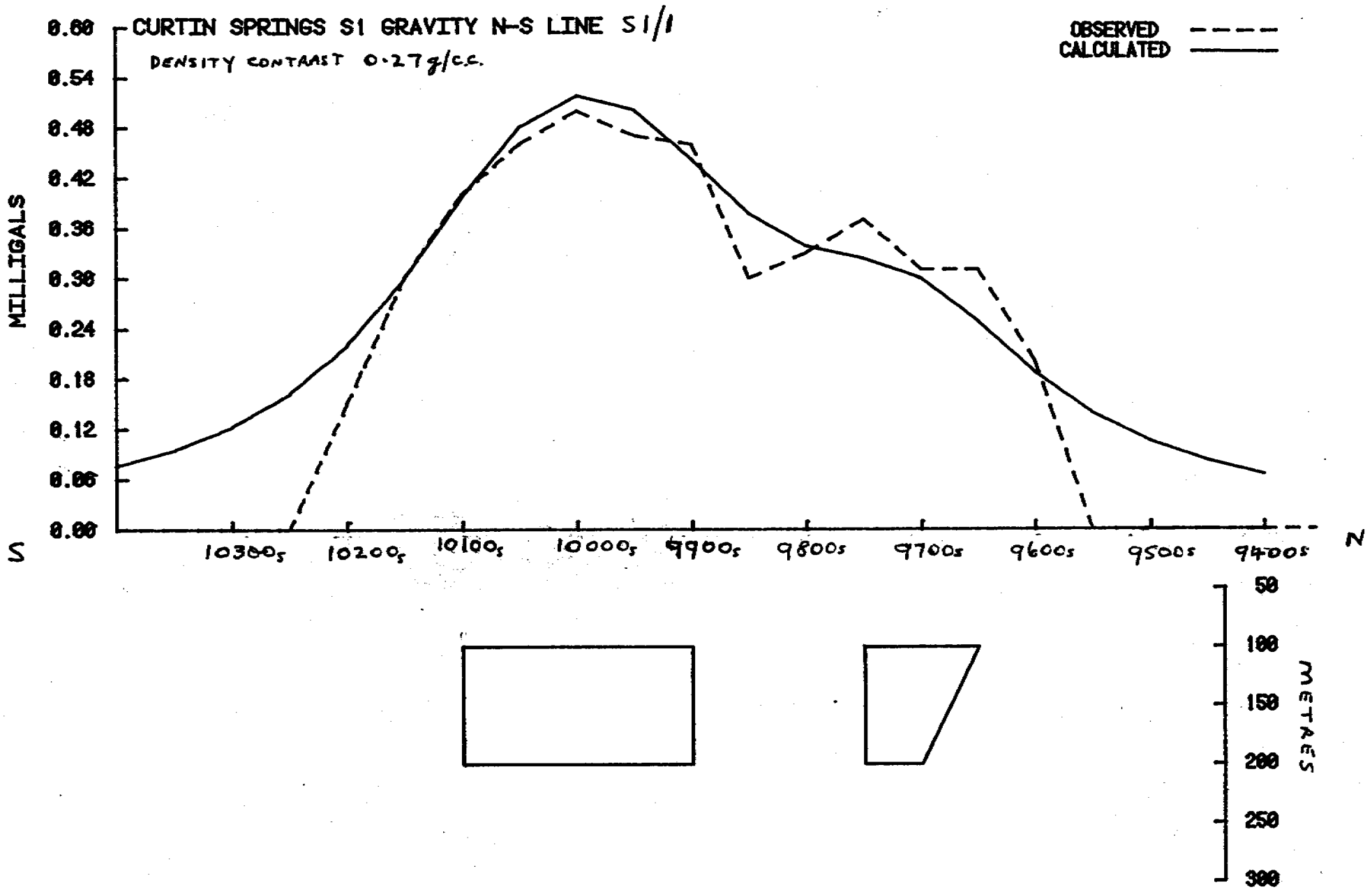


FIGURE 7

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SIROTEM RESPONSE CURVE ANOMALY S1 - CENTRE LINE

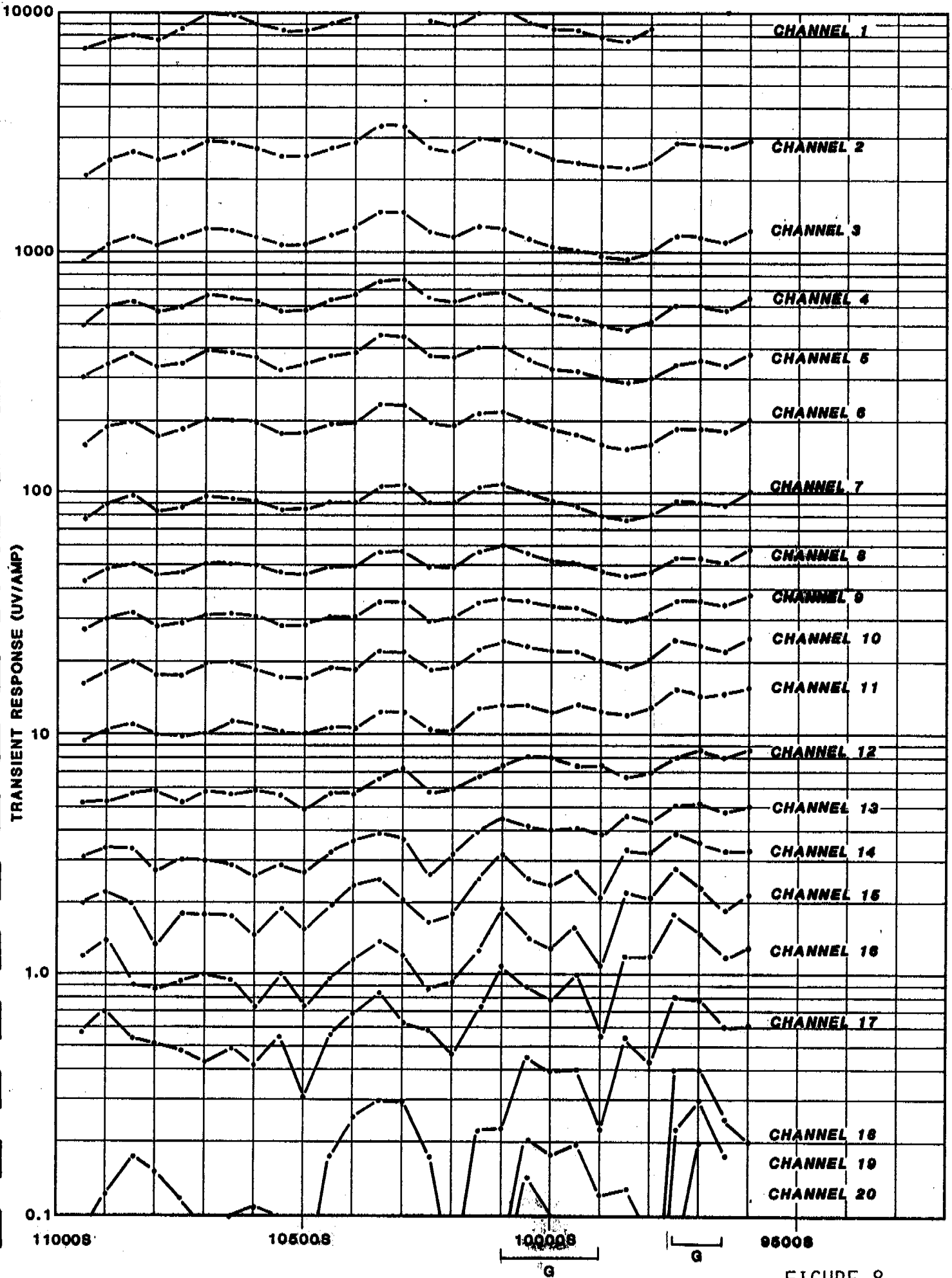


FIGURE 8

SIROTEM RESPONSE CURVE ANOMALY S1 - 50m WEST LINE

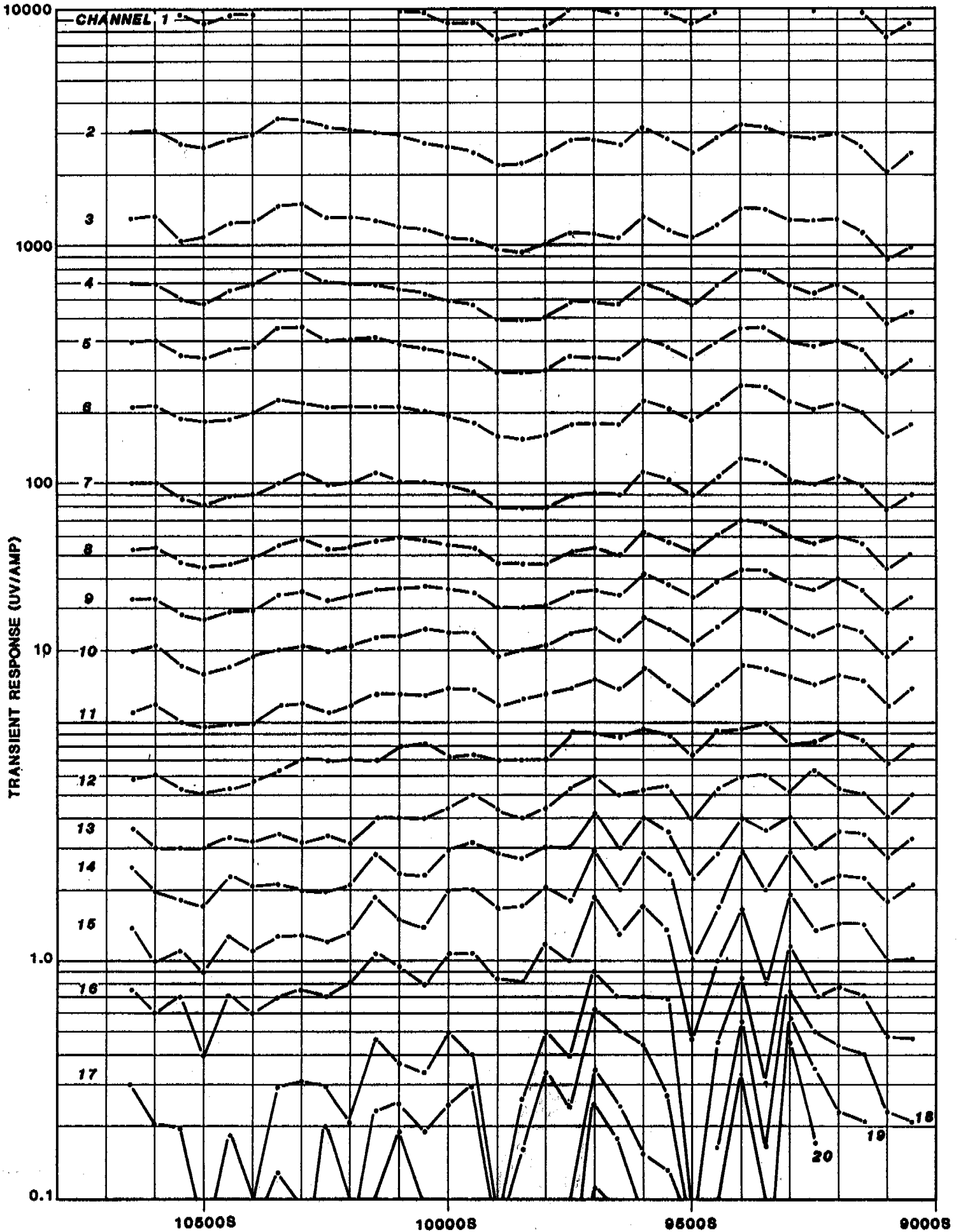


FIGURE 9

2

SIROTEM RESPONSE CURVE ANOMALY S1 - 50m EAST LINE

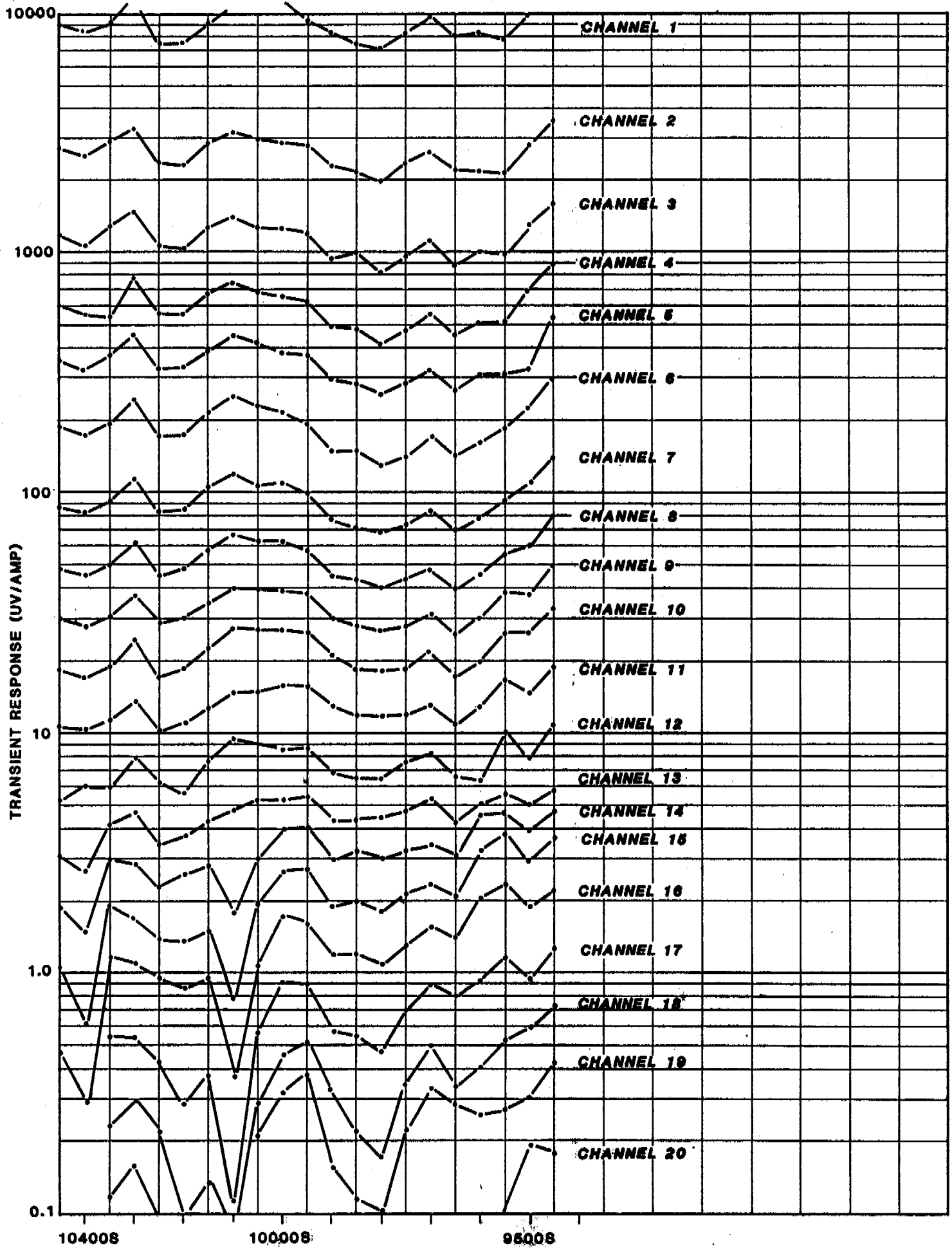
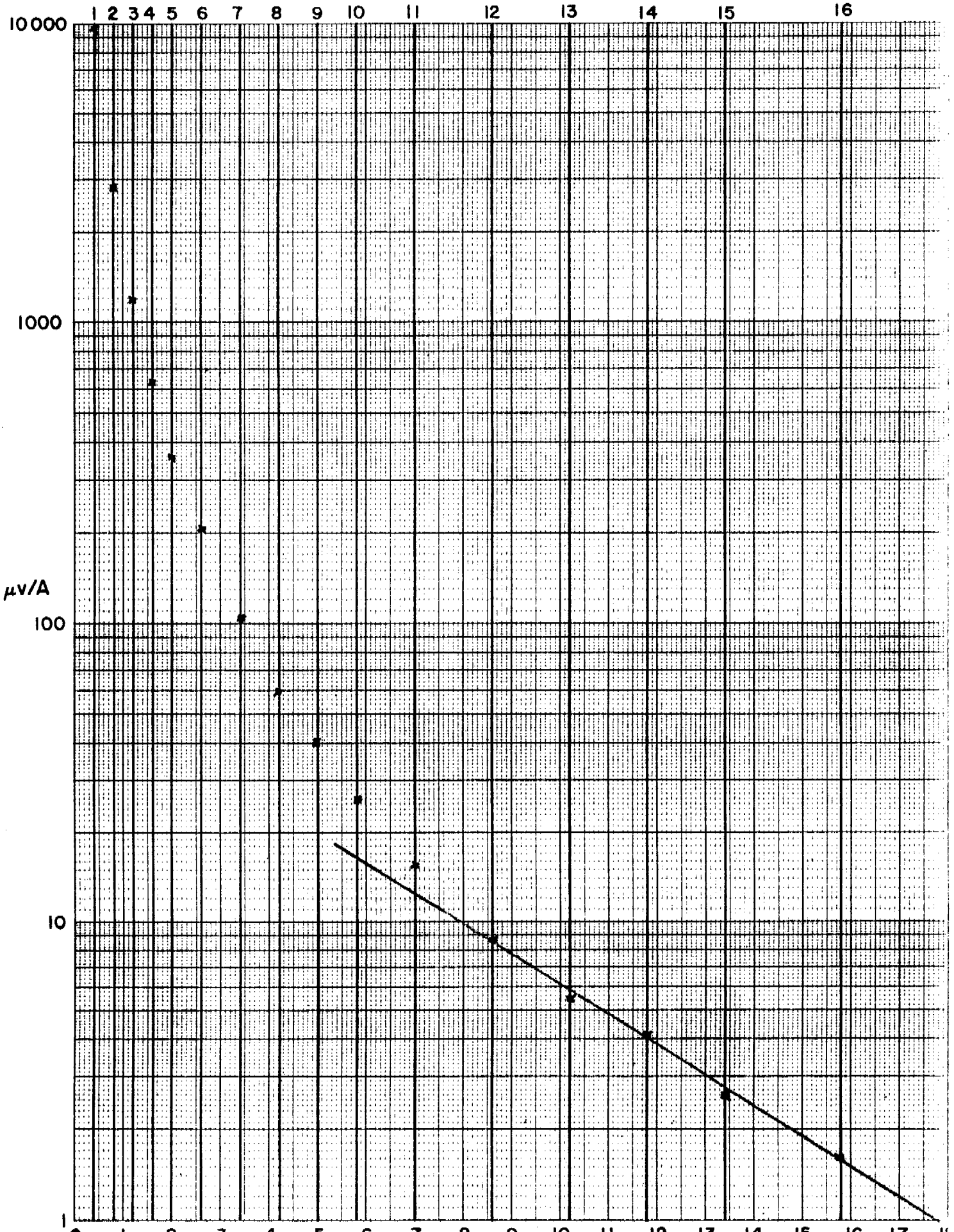


FIGURE 10

22



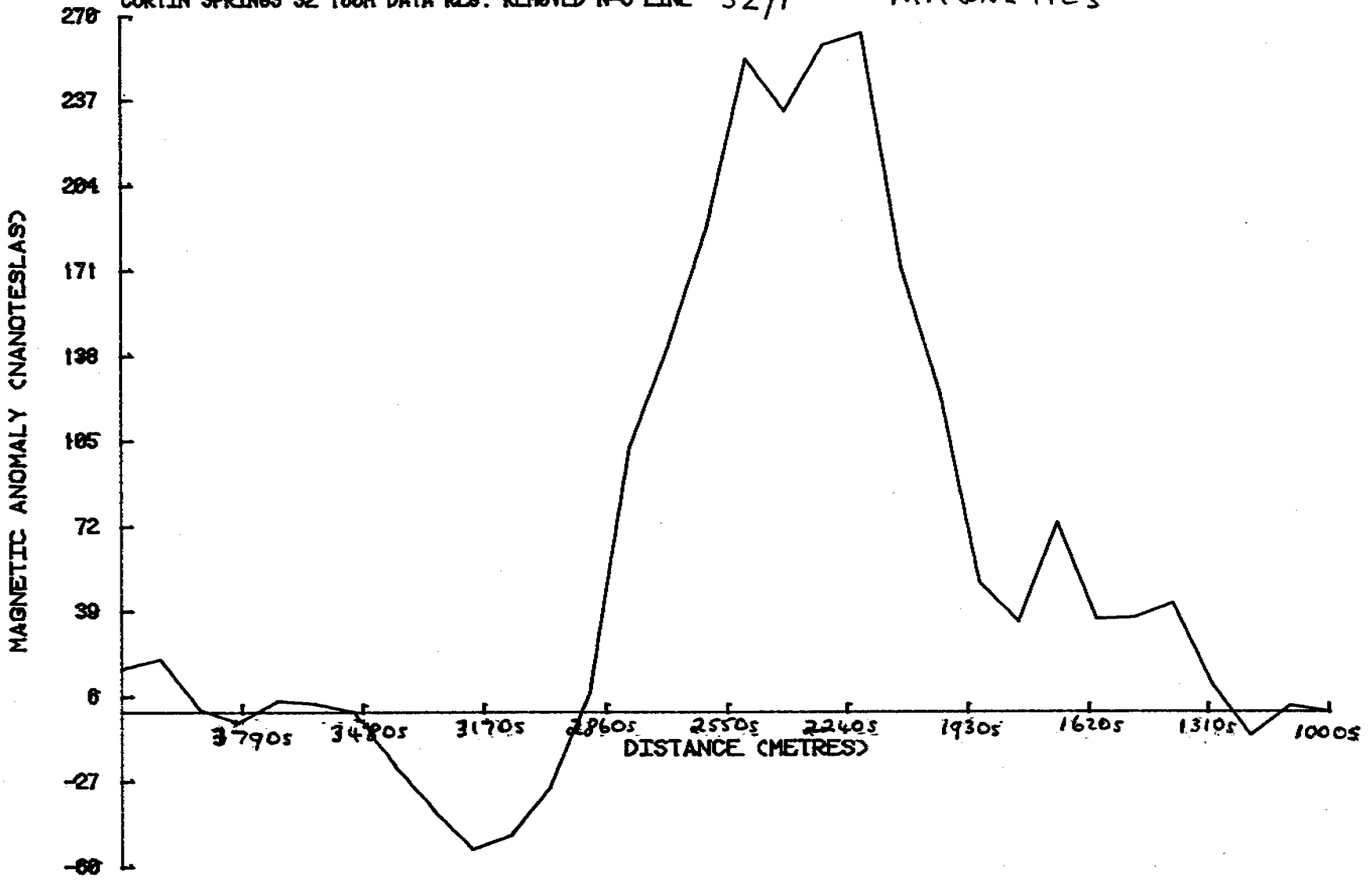
PROJECT CURTIN
SPRINGS

Nominal mean delay (m/sec's)

LINE 51 STATION 9950

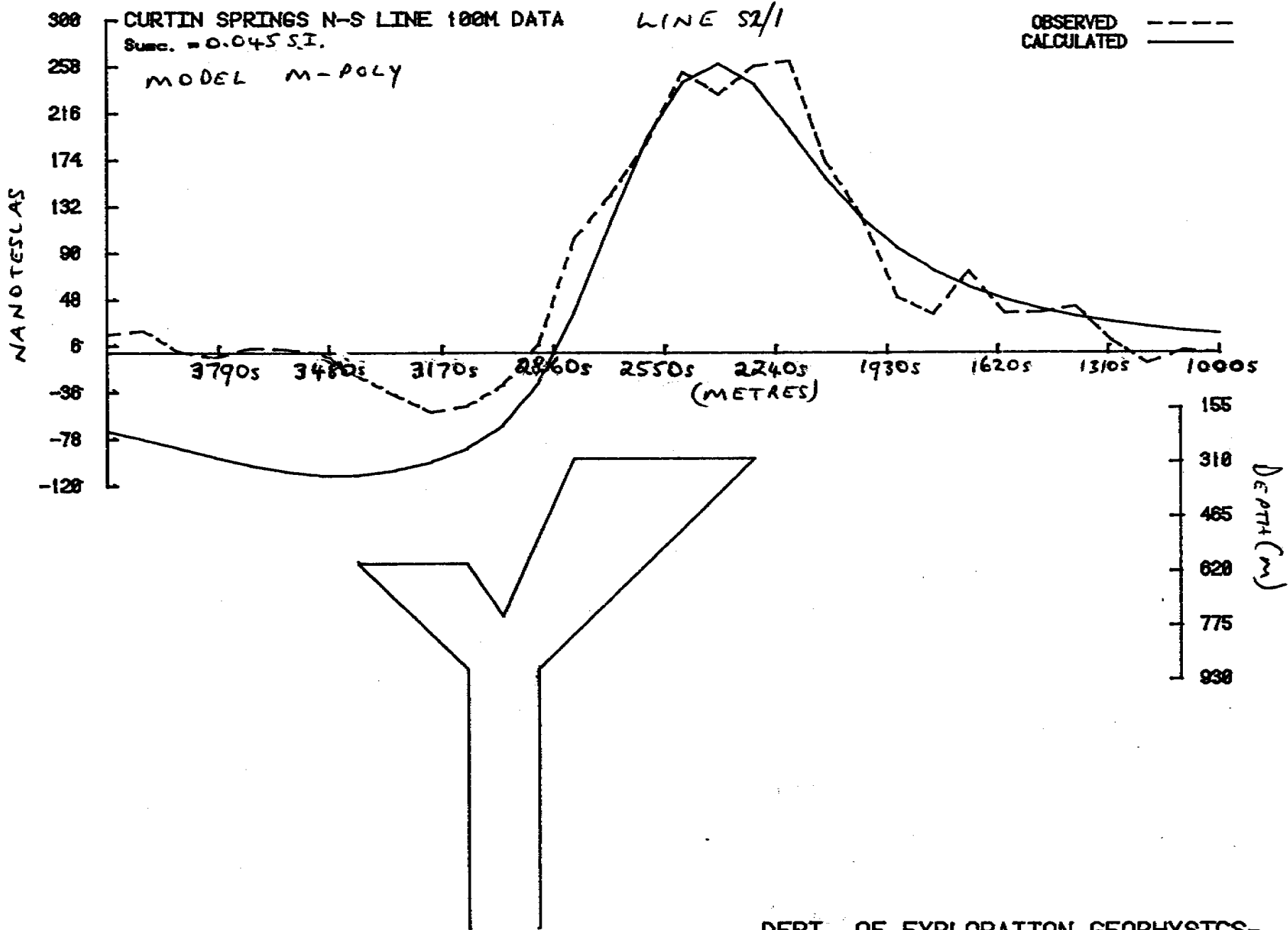
$\tau = 4.26 \text{ ms}$

SIROTEM DECAY PLOT



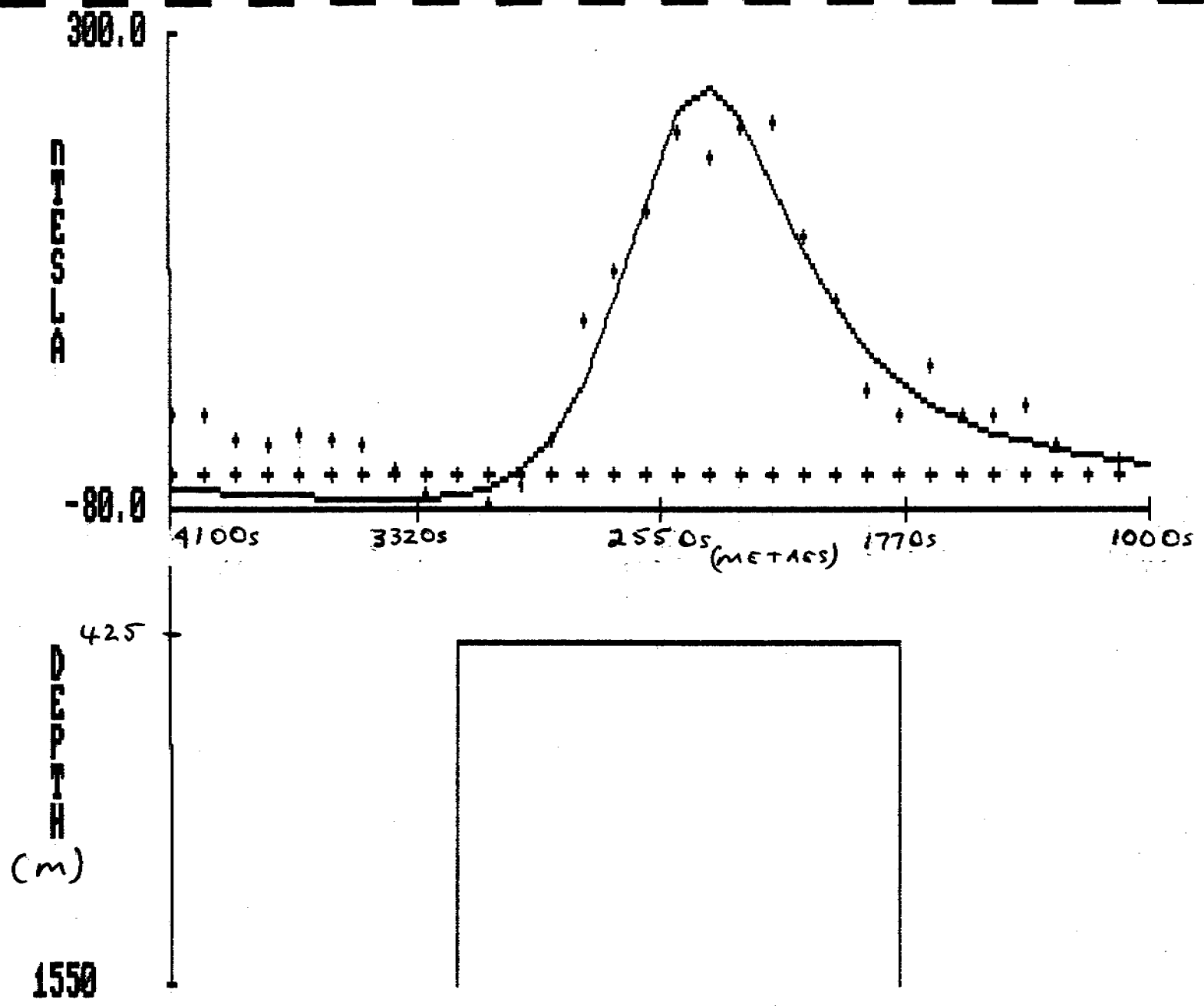
DEPT. OF EXPLORATION GEOPHYSICS- CURTIN UNIVERSITY

FIGURE 12



DEPT. OF EXPLORATION GEOPHYSICS-
 CURTIN UNIVERSITY

he



MODEL VERCYL LINE S2/1

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FIGURE 1A

070

VERTICAL CYLINDER

PARAMETERS ARE :

INTENSITY OF INDUCING FIELD = 55000 nTESLA
 INCLINATION OF INDUCING FIELD = -55.0 DEGREES
 DECLINATION OF INDUCING FIELD = 4.0 DEGREES
 BEARING OF MAGNETIC NORTH = -0.0 DEGREES
 SUSCEPTIBILITY CONTRAST = 0.0120
 RADIUS = 700.0 METRES
 DEPTH = 425.0 METRES
 DEPTH EXTENT= 2000.0 METRES
 CENTRE IS AT %1700 X METRES
 CONSTANT REGIONAL IS -50.0 nTESLA
 LINEAR REGIONAL COMPONENT IS 0.000 nTESLA/METRE

RMS% ERROR = %1228855092.220769

XPOS	CALC.	FIELD	dG	
100.0	-61.2	-3.0	-58.2	-(41005)
200.0	-62.2	0.0	-62.2	
300.0	-63.4	-20.0	-43.4	
400.0	-64.6	-26.0	-38.6	
500.0	-65.9	-18.0	-47.9	
600.0	-67.0	-20.0	-47.0	
700.0	-67.9	-24.0	-43.9	
800.0	-68.3	-45.0	-23.3	
900.0	-67.7	-63.0	-4.7	
1000.0	-65.0	-79.0	+14.0	
1100.0	-58.7	-74.0	+15.3	
1200.0	-45.8	-56.0	+10.2	
1300.0	-21.5	-20.0	-1.5	
1400.0	21.1	74.0	-52.9	
1500.0	86.8	113.0	-26.2	
1600.0	168.3	159.0	+9.3	
1700.0	236.8	223.0	+13.8	
1800.0	258.7	202.0	+56.7	
1900.0	231.5	227.0	+4.5	
2000.0	180.2	231.0	-50.8	
2100.0	127.8	140.0	-12.2	
2200.0	84.3	90.0	-5.7	
2300.0	50.9	16.0	+34.9	
2400.0	26.2	0.0	+26.2	
2500.0	8.0	38.0	-30.0	
2600.0	-5.5	0.0	-5.5	
2700.0	-15.5	0.0	-15.5	
2800.0	-23.1	5.0	-28.1	
2900.0	-28.9	-27.0	-1.9	
3000.0	-33.3	-48.0	+14.7	
3100.0	-36.8	-37.0	+0.2	
3200.0	-39.5	-40.0	+0.5	

-(10005)

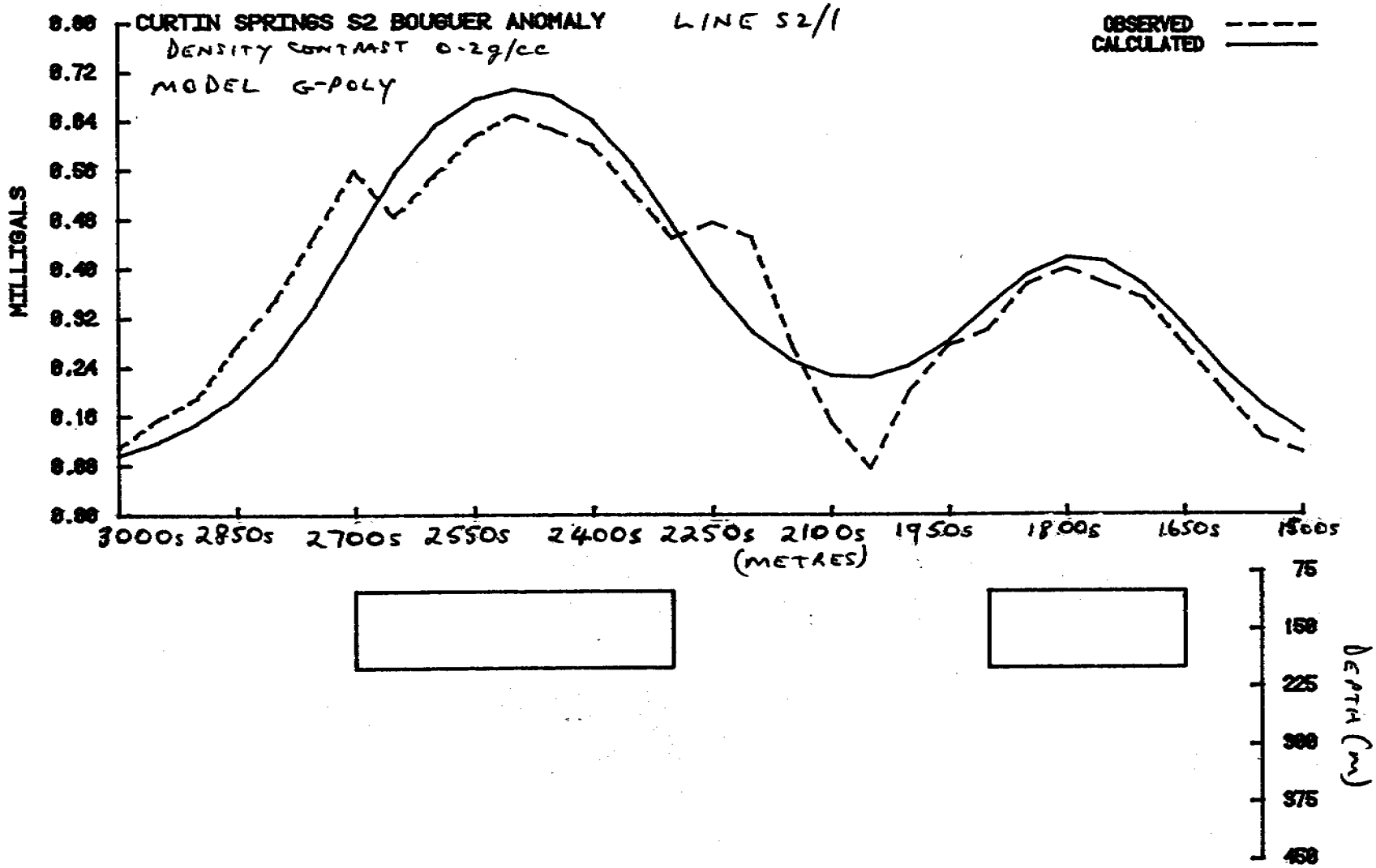
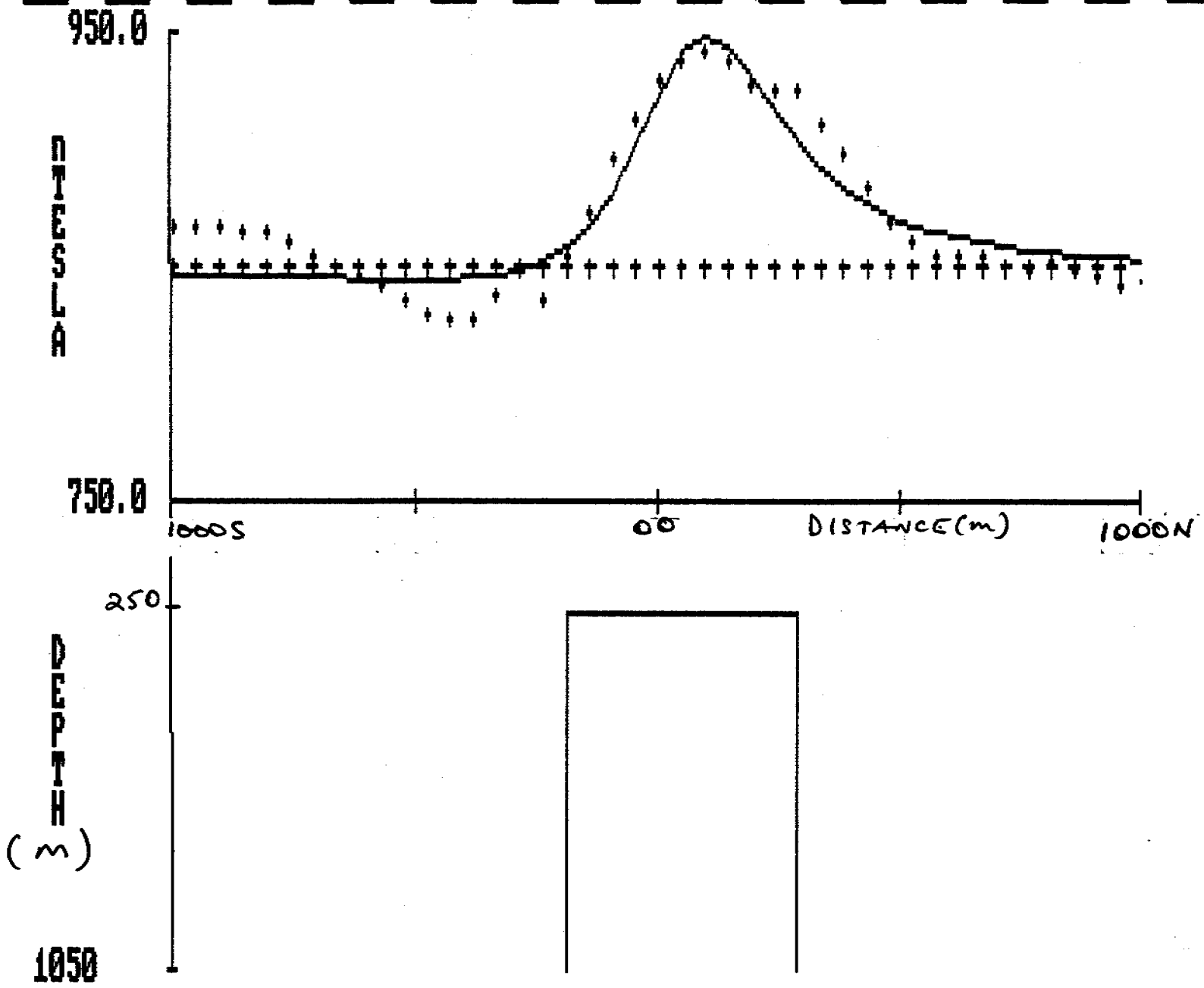


FIGURE 15

27



LINE 53/1 MAGNETICS
MODEL VERCYL

JP

FIGURE 16

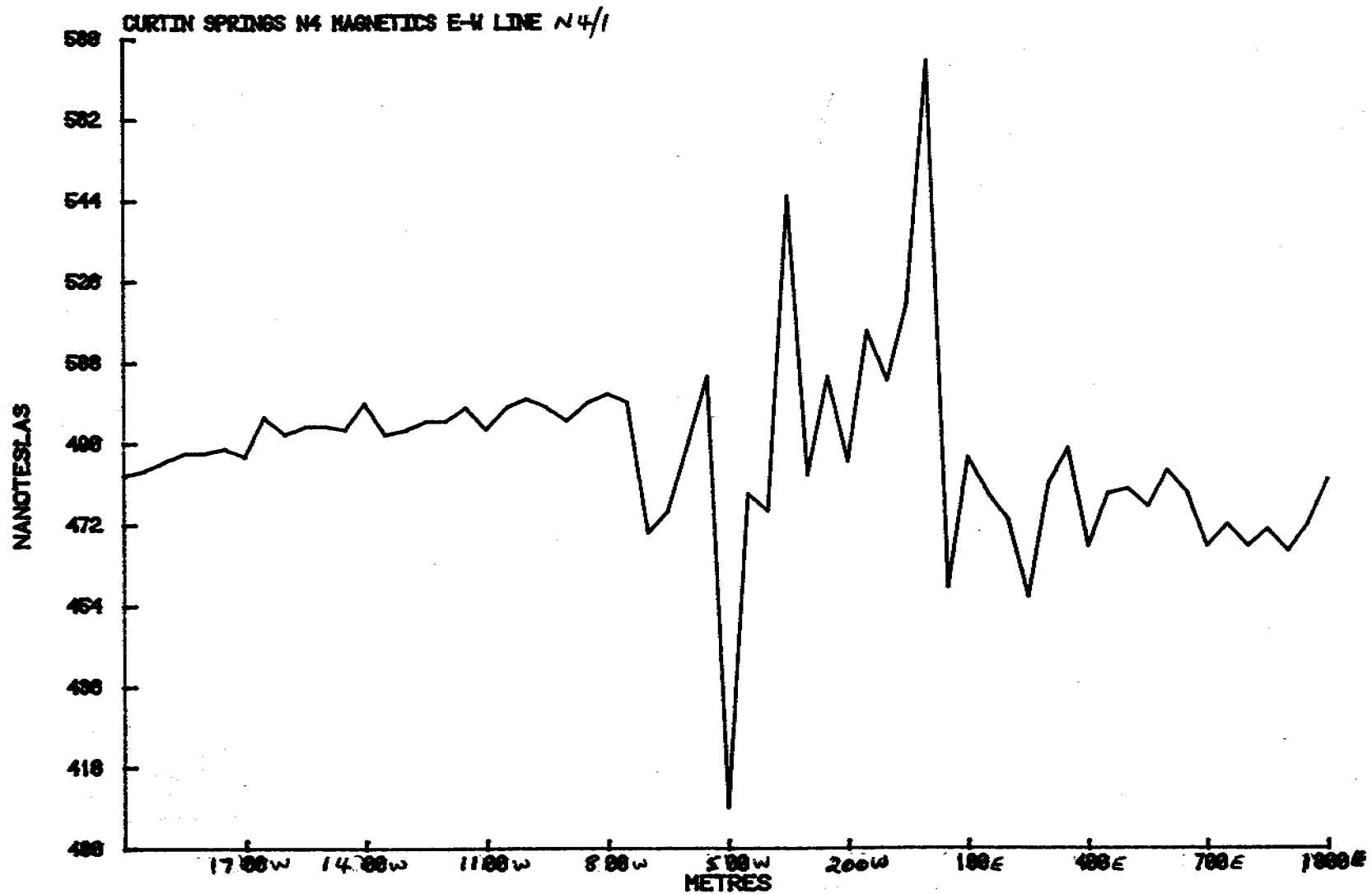
VERTICAL CYLINDER

PARAMETERS ARE :

INTENSITY OF INDUCING FIELD = 55000 nTESLA
 INCLINATION OF INDUCING FIELD = -55.0 DEGREES
 DECLINATION OF INDUCING FIELD = 4.0 DEGREES
 BEARING OF MAGNETIC NORTH = -4.0 DEGREES
 SUSCEPTIBILITY CONTRAST = 0.0100
 RADIUS = 250.0 METRES
 DEPTH = 250.0 METRES
 DEPTH EXTENT= 2000.0 METRES
 CENTRE IS AT X1100 X METRES
 CONSTANT REGIONAL IS 850.0 nTESLA
 LINEAR REGIONAL COMPONENT IS 0.000 nTESLA/METRE

RMS% ERROR = 1.3241

XPOS	CALC.	FIELD	dG
0.0	847.3	868.0	-20.7
50.0	847.1	867.0	-19.9
100.0	847.0	867.0	-20.0
150.0	846.8	865.0	-18.2
200.0	846.6	865.0	-18.4
250.0	846.4	862.0	-15.6
300.0	846.1	855.0	-8.9
350.0	845.9	851.0	-5.1
400.0	845.7	847.0	-1.3
450.0	845.6	843.0	+2.6
500.0	845.4	837.0	+8.4
550.0	845.4	831.0	+14.4
600.0	845.6	829.0	+16.6
650.0	846.2	829.0	+17.2
700.0	847.2	839.0	+8.2
750.0	849.2	850.0	-0.8
800.0	852.7	837.0	+15.7
850.0	858.5	855.0	+3.5
900.0	868.1	873.0	-4.9
950.0	882.4	897.0	-14.6
1000.0	901.8	913.0	-11.2
1050.0	923.4	930.0	-6.6
1100.0	940.8	938.0	+2.8
1150.0	947.7	942.0	+5.7
1200.0	943.0	938.0	+5.0
1250.0	931.0	928.0	+3.0
1300.0	917.0	925.0	-8.0
1350.0	903.9	925.0	-21.1
1400.0	893.0	911.0	-18.0
1450.0	884.3	898.0	-13.7
1500.0	877.5	885.0	-7.5
1550.0	872.3	870.0	+2.3
1600.0	868.2	861.0	+7.2
1650.0	865.0	855.0	+10.0
1700.0	862.5	855.0	+7.5
1750.0	860.5	855.0	+5.5
1800.0	858.9	851.0	+7.9
1850.0	857.5	849.0	+8.5
1900.0	856.4	853.0	+3.4
1950.0	855.5	849.0	+6.5
2000.0	854.8	847.0	+7.8
2050.0	854.1	843.0	+11.1
2100.0	853.6	845.0	+8.6



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FIGURE 17

cc