Open File Envelope No. 3777

EL 579 AND EL 974

MULGATHING ROCKS

PROGRESS AND FINAL REPORTS FOR THE PERIOD 16/1/80 TO 17/3/83

Submitted by

Afmeco Pty Ltd and BHP Minerals Ltd
1983

CONTENTS ENVELOPE 3777

TENEMENT: E.L.'s 974 & 579 Mulgathing - Rocks - N.W. Of Tarcoola.

TENEMENT HOLDER: AFMECO Pty Ltd.

AFMECO PTY. LTD.

11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

PA/aw 80-1364

20th May, 1980

Director-General,
Department of Mines and Energy,
P.O. Box 151,
EASTWOOD SA 5063

Dear Sir,

EXPLORATION LICENCE 579 - MULGATHING
QUARTERLY REPORT 16.1.80 to 15.4.80

Radiometry and magnetometry was flown over part of the area in late 1979 by Austirex Surveys Pty Ltd. Preliminary data from this survey was received and is being interpreted to provide the base for field work proposed for the next quarter.

Expenditure for the quarter was $32,294.84 as per the attached schedule.

Yours faithfully,
AFMECO PTY LTD

J.-P. POGGI,
Managing Director.

Enc. 1

RECEIVED
27 MAY 1980
DEPT. OF MINES
AND ENERGY
SECURITY
7777

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME ON E.L. 579, Quarter 16.1.80 to 15.4.80

PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	1,599.91
MATERIAL (DIRECT)	12.02
TRAVEL, ACCOMMODATION (DIRECT)	270.56
CONTRACTS, SUPPLIES	28,626.55
DRAFTING SERVICE, PREPARATION OF REPORTS & MISCELLANEOUS	247.95
MANAGEMENT/OVERHEADS	1,537.85
	$32,294.84

AFMECO PTY. LTD.
11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

PA/aw 80-2239

31st July, 1980

Director-General,
Department of Mines and Energy,
P.O. Box 151,
EASTWOOD SA 5063

Dear Sir,

EXPLORATION LICENCE 579 - MULGATHING
QUARTERLY REPORT 16.4.80 to 15.7.80

Final aerial magnetic and spectrometric data were received from the contractors.

Ground follow-up, together with geological mapping, sampling, and radiometriy were completed.

An interpretation of the geology of the area using geological and geophsyical data has begun.

Expenditure for the quarter was $9,987.16 as per the attached statement.

Yours faithfully,
AFMECO PTY LTD

J.-P. POGGI,
Managing Director.

Enc. 1

RECEIVED
5 AUG 1980
DEPT. OF MINES AND ENERGY
SECURITY

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME on E.L. 579, 16.4.80 to 15.7.80

PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	4,425.64
MATERIAL (DIRECT)	182.13
TRAVEL, ACCOMMODATION (DIRECT)	370.29
CONTRACTS, SUPPLIES	3,728.82
DRAFTING SERVICE, PREPARATION OF REPORTS & MISCELLANEOUS	804.70
MANAGEMENT/OVERHEADS	475.58
	$9,987.16

AFMECO PTY. LTD.

11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

PA/aw 80-3293

31st October, 1980

Director-General,
Department of Mines and Energy,
P.O. Box 151,
EASTWOOD SA 5063

Dear Sir,

EXPLORATION LICENCE ~~124~~ 579 - MULGATHING
QUARTERLY REPORT 16.7.80 to 15.10.80

The only ground work completed in the quarter was the surveying of a grid to cover a radiometric anomaly discovered during earlier work in preparation for drilling in the next quarter.

A report on earlier work in nearly completed and will be forwarded shortly.

Expenditure for the quarter was $12,067.94 as per the attached statement.

Yours faithfully,
AFMECO PTY LTD

J.-P. POGGI,
Managing Director.

Enc. 1

RECEIVED
4 NOV 1980
DEPT. OF MINES
AND ENERGY
SECURITY
3777

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME, Quarter 16.7.80 to 15.10.80

PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	5,410.87
MATERIAL (DIRECT)	603.00
TRAVEL, ACCOMMODATION (DIRECT)	1,878.86
CONTRACTS, SUPPLIES	2,967.10
DRAFTING SERVICE, PREPARATION OF REPORTS & MISCELLANEOUS	633.45
MANAGEMENT/OVERHEADS	574.66
	$12,067.94

009

AFMECO PTY. LTD.

1-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

TL/tb 81-3834

13th May, 1981

Director General,
Dept. of Mines & Energy,
P.O. Box 151,
EASTWOOD, S.A. 5063

Exploration Licence 579

Repts. p.e. 15.1.81 & 15.4.81.

Dear Sir,

During November and early December, a drilling programme was carried out on the above EL. using the "air core" technique in conjunction with partial diamond core recovery. A total of 1133.70 m, was drilled and the results and co-ordinates are appended on the attached schedule I.

An annual report is in preparation.

Expenditure for this period is shown as per the attached schedule II and III.

Yours faithfully,
AFMECO PTY. LTD.

p.p.
J.-P. POGGI
Managing Director

RECEIVED
21 MAY 1981
DEPT. OF MINES
AND ENERGY
SECURITY

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME EL. 579. QUARTER 16-10-80 to 15-1-81

PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	8,189.26
MATERIAL (DIRECT)	2,783.88
TRAVEL, ACCOMODATION (DIRECT)	3,717.71
CONTRACTS, SUPPLIES	77,153.64
DRAFTING SERVICE, PREP. OF REPORTS & MISCELLANEOUS	2,851.86
MANAGEMENT / OVERHEADS	4,734.82
	$ 99,431.17

151,55

EXPENDITURE COMMITMENT	$35,000.00
TOTAL REPORTED TO DATE	$153,181.11
PERMIT YEAR EXPIRES	15-1-81

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME EL. 579. QUARTER 16-1-81 to 15-4-81

PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	252.94
MATERIAL (DIRECT)	282.15
TRAVEL, ACCOMODATION (DIRECT)	300.03
CONTRACTS, SUPPLIES	580.00
DRAFTING SERVICE, PREP. OF REPORTS & MISCELLANEOUS	226.66
MANAGEMENT / OVERHEADS	82.09
	$ 1,723.87

HOLE SUMMARY

1. MULGATHING

HOLE NO.	COORDINATES (AMG)	DEPTH WITH AIR CORD (m)	DEPTH WITH DIAMOND (m)	TOTAL	FIELD DESCRIPTION OF ROCK TYPE
MUL 1	970E 736N	14.9	1.5	16.4	quartz felspar gneiss
2	031E 712N	18.3	1.2	19.5	fine grained quartz felspar gneiss
3	962E 676N	8.5	1.5	10.0	fine grained quartz flespar gneiss
4	030E 669N	71.5	1.5	73.0	chlorite schist
5	029E 632N	55.3	1.5	56.8	quartz felspar garnet gneiss
6	031E 576N	62.4	1.4	63.8	quartz felspar biotite gneiss
7	022E 504N	21.7	3.7	25.4	alternating quartz biotite? amphibole gneiss with acid? volcanic gneiss
8	944E 531N	43.0	1.6	44.6	? welded tuff
9	884E 552N	11.9	3.1	15.0	acid? volcanic gneiss
10	857E 592N	23.1	3.3	26.4	quartz felspar biotite gneiss with pyrite in fractures
11	780E 578N	24.9	1.8	26.7	quartz biotite felspar gneiss
12	686E 676N	134.3	2.5	136.8	quartz biotite felspar gneiss
13	714E 623N	75.2	1.6	76.8	fine banded metasedim
14	778E 615N	37.0	82.5	119.5	see text
15	777E 614N	108.1	48.9	140.0	gneiss
16	838E 605N	0	19.9	19.9	amphibolite
17	780E 600N	0	20.6	20.6	qtz-fel-bf gneiss
18	797E 620N	0	47.8	47.8	qtz-fel-bf-gn-gneiss
19	783E 639N	0	36.7	36.7	qtz-fel-bf-gneiss
20	708E 677N	0	158.0	158.0	basement not reached

COORS INSUFFICIENT TO LOCATE.

AFMECO PTY. LTD.
11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

TL/bp 81-4756
29th September 1981

The Director General
Department of Mines and Energy
P.O. BOX 151
EASTWOOD S.A. 5063

Dear Sir,

RE : Exploration Licence 579
Progress Report 16.4.81 - 15.7.81

No field work other than a general reconnaissance was carried out in this period.

A re-evaluation of the aerial magnetic and spectrometric survey flown by AUSTIREX SURVEYS PTY LTD was completed in preparation for a scout drilling programme scheduled to take place in November. As per your letter of 16th September 1981, we will advise you of drill site locations when planning is completed.

Expenditure for this period is shown as per the attached schedule.

Yours faithfully,
AFMECO PTY LTD

J.-P. POGGI
Managing Director

encl. 1

RECEIVED
2 OCT 1981
DEPT. OF MINES AND ENERGY
SECURITY
3777

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME E.L. 579 QUARTER 16.4.81 TO 15.7.81

PERSONNEL (Field work, evaluation, office work)		2 194.49
MATERIAL (Direct)		2.84
TRAVEL, ACCOMMODATION (Direct)		73.23
CONTRACTS, SUPPLIES		--
DRAFTING SERVICES, PREPARATION OF REPORTS & MISCELLANEOUS		1 277.04
MANAGEMENT/OVERHEADS		177.38
	$	3 724.98

MQ/pz 82-0129

January 11, 1982

The Director General
Department of Mines and Energy
PO Box 151
EASTWOOD SA 5063

Mining Act 1971 - 1978
Exploration Licence No 579
3rd Quarter Report, Year 2
Period 16.7.81 to 15.10.81

Dear Sir,

During the period covered by this report Afmeco Pty Ltd has carried out the following programme:-

1. Data Review

A review and re-evaluation of existing aeromagnetic and spectrometric survey data has been conducted preparatory to selecting sites for scout drilling.

2. Geophysical Programme

A ground magnetic survey covering a 0.4 sq. km area north-east of the Mulgathing Rocks locality was carried out during the period.

Results from this survey are currently being assessed by a consultant geophysicist.

Please find attached an expenditure statement covering the period of this report.

Yours faithfully,
AFMECO PTY LTD

J.-P. Poggi
Managing Director

Enc. 1

RECEIVED
8 FEB 1982
DEPT. OF MINES AND ENERGY
SECURITY
3777

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME EL 579 QUARTER 16.7.81 to 15.10.81

	Expenditure of Quarter 16.7.81 to 15.10.81
Personnel (Field work, evaluation, office work)	2,442.54
Material (Direct)	210.60
Travel, Accommodation (Direct)	991.93
Contracts, Supplies	693.36
Drafting Service, Preparation of Reports and Miscellaneous	1,426.74
Management/Overheads	288.26
	$6,053.43

017

AFMECO PTY. LTD.
11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

MQ/ds 82-0479

23rd February, 1982

The Director General,
Department of Mines & Energy,
P.O. Box 151,
EASTWOOD S.A. 5063

Dear Sir,

Mining Act 1971 to 1978
Exploration Licence No. 579
2nd Quarter, Year 1
Period 16/10/81 to 15/1/82

During the period covered by this report AFMECO Pty Ltd did not conduct any field operations in the area of this tenement.

Instead the quarter was devoted to an office review of the data collected in prior quarters.

Please find attached a statement of expenditure covering the period of this report.

Yours faithfully,
AFMECO PTY LTD

Po

J.-P. POGGI,
Managing Director

Attach:

RECEIVED
25 FEB 1982
DEPT. OF MINES AND ENERGY
SECURITY
3777

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME
E.L. 579 QUARTER 16/10/81 to 15/1/82

PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	910.52
MATERIAL (DIRECT)	-
TRAVEL, ACCOMMODATION (DIRECT)	-
CONTRACTS, SUPPLIES	222.39
DRAFTING SERVICE, PRE. OF REPORTS & MISCELLANEOUS	-
MANAGEMENT/OVERHEADS	56.64
	$ 1189.55

Permit Year ends: 15.1.82

Commitment: $35,000

AFMECO PTY. LTD.
11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

019

MQ/jg 82- 1954

23rd August, 1982

The Director General
Department of Mines and Energy
P.O. Box 151
EASTWOOD S.A. 5063

Attention: Mr.I.G. Faulks

Dear Sir,

Mining Act 1971 to 1982
Exploration Licence No. 974
Expenditure Report
Period 18.3.82 to 17.6.82

During the period covered by this report Afmeco Pty Ltd did not undertake any field work over the area of the subject exploration licence.

The period was devoted to office studies prior to detailed geochemical sampling due to commence in July 1982.

Please find attached for your information and retention a copy of the expenditure statement in respect of this report period.

Yours faithfully
AFMECO PTY LTD

Po

J.P. POGGI
Managing Director

RECEIVED
25 AUG 1982
DEPT. OF MINES AND ENERGY
SECURITY
1777

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME EL 974 QUARTER 18.3.82 TO 17.6.82

PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	160.23
MATERIAL (DIRECT)	128.93
TRAVEL, ACCOMMODATION (DIRECT)	45.82
CONTRACTS, SUPPLIES	NIL
DRAFTING SERVICE, PREP. OF REPORTS & MISCELLANEOUS	NIL
MANAGEMENT/OVERHEADS	16.75
	351.73

AFMECO PTY. LTD.
(Incorporated in South Australia)
11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9618, 321 9681
Telex: AFMECO 92077 Perth

MQ/ds 82-2385

17th November, 1982

The Director General,
Department of Mines and Energy,
P.O. Box 151,
EASTWOOD S.A. 5063

Attention: Mr. Ian Grant

Dear Sir,

Mining Act 1971 to 1981
Exploration Licence No. 974
2nd Quarter Report, Year 1
Period 18.6.82 to 17.9.82

During the period covered by this report the following work programme was carried out on the area of the above tenement on behalf of AFMECO Pty. Ltd.

Data Review

A review of all the magnetic data collected during previous terms was carried out. From the results five anomalous areas were identified.

These anomalies have been gridded in preparation for a geochemical sampling programme to be undertaken later this year. It is envisaged that some 370 samples will be collected for analysis.

Please find enclosed an expenditure statement for the period of this report.

Yours faithfully,
AFMECO PTY LTD

J.-P. POGGI,
Managing Director

RECEIVED
23 NOV 1982
DEPT. OF MINES AND ENERGY
SECURITY
3777

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME
E.L. 974 Period 18/6/82 to 17/9/82

		$
PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)		18,136.17
MATERIAL (DIRECT)		-
TRAVEL, ACCOMMODATION (DIRECT)		4,064.12
CONTRACTS, SUPPLIES		3,723.28
DRAFTING SERVICE, PREP. OF REPORTS & MISCELLANEOUS		(117,47)
MANAGEMENT/OVERHEADS		2,549.46
	TOTAL:	$ 28,355.56

AFMECO PTY. LTD.
(Incorporated in South Australia)

11-13 Lucknow Place, West Perth, Western Australia
P.O. Box 526, West Perth, Western Australia, 6005
Telephone: (09) 321 9681 Telex: 92077

MQ/ds 83-0135

17th February, 1983

The Director General,
Department of Mines and Energy,
P.O. Box 151,
EASTWOOD S.A. 5063

Dear Sir,

Mining Act 1971 to 1978
Exploration Licence No. 974
3rd Quarter Report, Year 1
Period 18.9.82 to 17.12.82

During the period covered by this report the following exploration programme was carried out over the area of E.L. 974.

(1) Geophysical

Interpretation of previously flown aeromagnetic surveys showed the existence of five anomalies, possibly due to kimberlites, on the tenement.

Localised ground magnetics were used to define more clearly these anomalies.

(2) Sampling

Soil samples were taken over the areas of interest, however results have proved negative.

The five aeromagnetic anomalies were drilled using rotary air blast techniques.

(3) Results

Samples collected from the drilling programme are visually unencouraging however confirmation or otherwise of this contention will only be possible following analysis of the drill cutting samples.

We enclose for your information and retention an expenditure statement detailing the work carried out during the report period.

RECEIVED
21 FEB 1983
DEPT. OF MINES AND ENERGY

Yours faithfully,
AFMECO PTY LTD

J.-P. POGGI,
Managing Director

STATEMENT OF EXPENSES RELATING TO EXPLORATION PROGRAMME
E.L. 974 Period 18/9/82 to 17/12/82

	$
PERSONNEL (FIELD WORK, EVALUATION, OFFICE WORK)	5,053-22
MATERIAL (DIRECT)	-
TRAVEL, ACCOMMODATION (DIRECT)	968-16
CONTRACTS, SUPPLIES	94-00
DRAFTING SERVICE, PREP. of REPORTS & MISCELLANEOUS	12-29
MANAGEMENT/OVERHEADS	305-73
	$6,415-40

EXPLORATION LICENCE 974

MULGATHING, SOUTH AUSTRALIA

BHP MINERALS

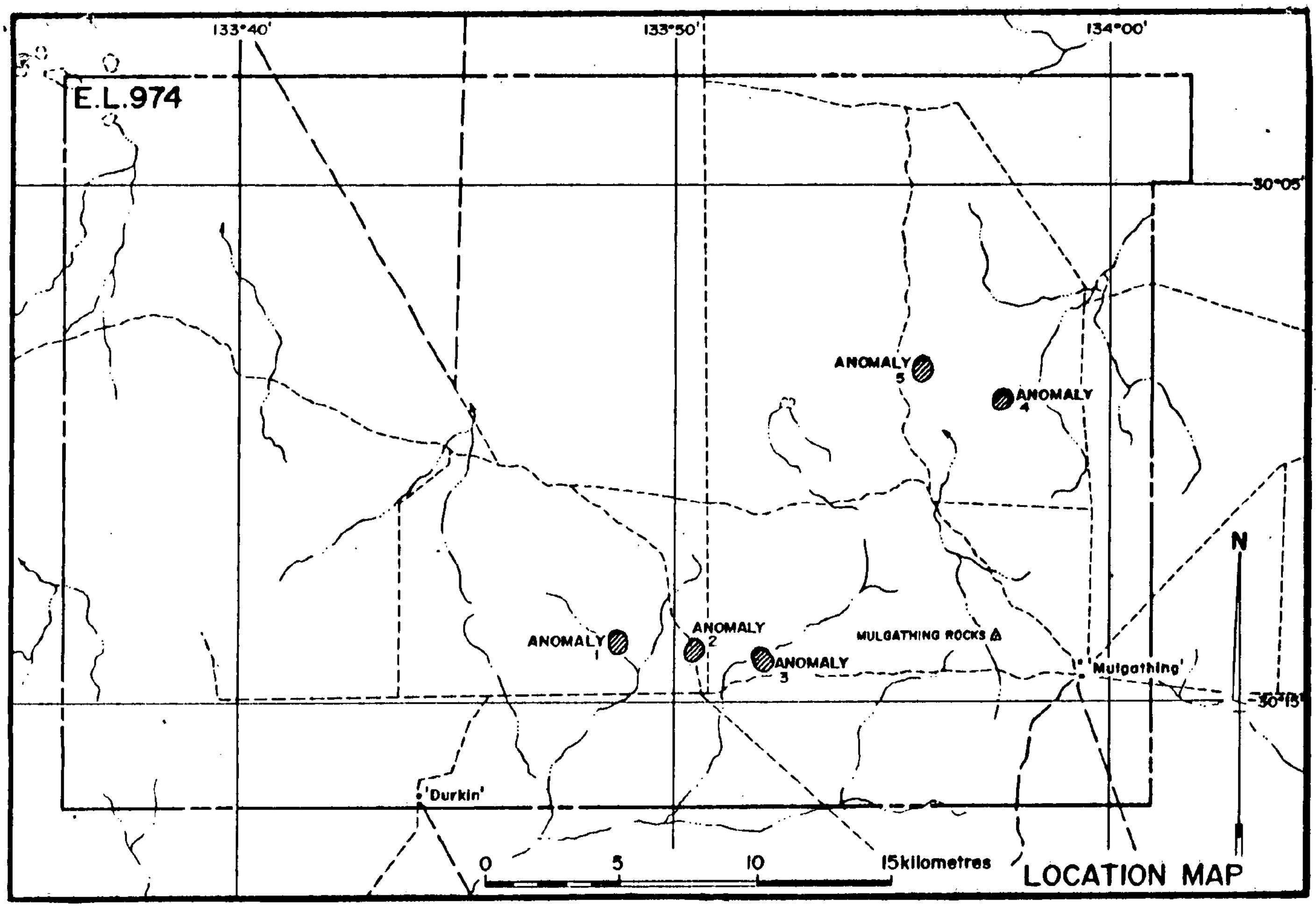
FINAL REPORT

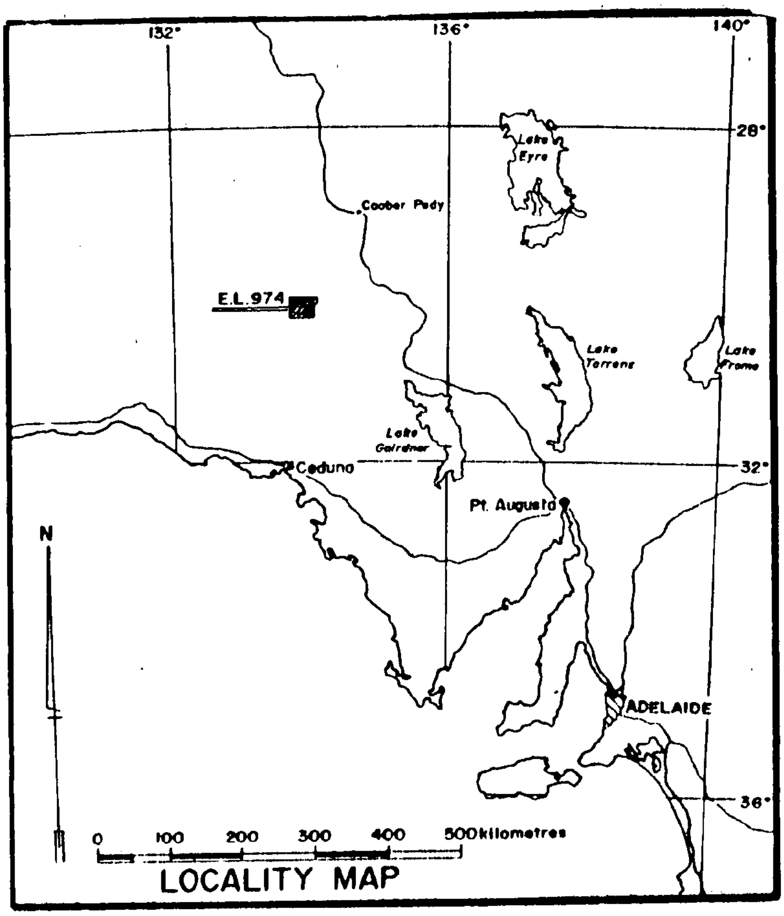
MARCH 1983

CONTENTS

FIGURES

FIG. 1


133°40'
133°50'
134°00'
30°05'
30°15'
E.L.974
ANOMALY 5
ANOMALY 4
ANOMALY 1
ANOMALY 2
ANOMALY 3
MULGATHING ROCKS
'Mulgathing'
'Durkin'
N
0
5
10
15kilometres
LOCATION MAP


132°
136°
140°
28°
32°
36°
Lake Eyre
Coober Pedy
E.L.974
Lake Torrens
Lake Frome
Lake Gairdner
Ceduna
Pt. Augusta
ADELAIDE
N
0
100
200
300
400
500kilometres
LOCALITY MAP

EXPLORATION LICENCE 974

MULGATHING, SOUTH AUSTRALIA

BHP MINERALS

FINAL REPORT

1. INTRODUCTION

BHP Minerals on behalf of AFMECO Pty Ltd completed an exploration programme for diamonds over E.L. 974 (Mulgathing) which expired on 17/3/83. A detailed loam sampling programme was carried out over the licence area. This was followed by the interpretation of AFMECO's aeromagnetic data, the selection of five anomalies for ground magnetic follow-up, and finally the drilling of these anomalies. Results of these programmes are presented below.

2. LOAM SAMPLING

A regional loam sampling programme totalling 379 samples was completed over the E.L. area. Samples were collected at one kilometre intervals along roads, tracks and fencelines (and occasionally on compass traverses). Each sample consisted of approximately 10 kg of - 4mm material gathered from the top few centimetres of a one metre square area. Each square was marked with a numbered wooden peg so that the location of the sample could be found again if necessary. Figure 4, shows the location of each sample site.

These samples were then processed in BHP's laboratory using standard techniques of washing, screening, concentration on a wilfley table, TBE concentration and magnetic separation. The weakly magnetic and non-magnetic fractions were then observed for diamonds and other kimberlitic indicators. Two samples (CA462 and CA 821) contained moissonite but since both these were collected close to fence lines no significance has been placed on these grains. No other kimberlitic indicators were found.

3. AEROMAGNETIC FOLLOW-UP

The aeromagnetic survey at Mulgathing was flown by Austirex Aerial Surveys Pty Ltd for AFMECO. The processed data was presented as contours at a 10 gamma interval and stacked profiles at a vertical scale of 500 gammas/cm. These scales are only suitable for picking relatively highly magnetic prospective anomalies, so the original flight analog charts were studies to locate lower intensity targets with an amplitude of less than 10 gammas. (See Figure 3).

Five anomalies were selected as possibly having kimberlitic sources. These were located on the ground and follow-up ground magnetics were completed over them.

cont./..

4. DRILLING

Thirteen percussion holes totalling 418 metres were drilled over the five anomalies.

Anomaly	Hole Number	Depth
1	PMU1	29 m
	PMU2	22 m
2	PMU3	26 m
	PMU4	25 m
3	PMU5	35 m
	PMU6	27 m
4	PMU7	42 m
	PMU8	38 m
	PMU9	34 m
	PMU10	40 m
5	PMU11	40 m
	PMU12	30 m
	PMU13	30 m

Location of the five anomalies and graphic logs of the thirteen drill holes are on Figure 2.

The magnetic source of three of these anomalies (anomalies 1, 2 and 3) was identified as magnetic volcanics or basic intrusives.

Non-magnetic basement was intersected on anomaly 4 and it is thought that local variations in the magnetic susceptability of the biotite schist may be the cause of this anomaly. Drilling difficulties were encountered in the clays overlying anomaly 5 and this prevented any positively identifiable basement being reached, although the basement appears to be weathered granitic material. (Figure 2).

Drill chips were collected over two metre intervals all the way down the holes and the bottom two samples from each hole were sent for analysis for arsenic, niobium, copper, lead, zinc, nickel, cobalt, chromium by Comlabs Pty Ltd of Adelaide. These results are in Table 1. None of the analysis results are indicative of a kimberlitic source. Atomic absorption techniques were used to analysis for copper, lead, zinc, nickel, cobalt and chromium and XRF methods were used for arsenic and niobium. The detection limit was 4 ppm for lead, nickel, cobalt and chromium and 2 ppm for copper, zinc, arsenic and niobium.

cont./..

5. SUMMARY

No kimberlitic indicators were found in the 379 loam samples collected over the E.L. Drilling of the five aeromagnetic anomalies (which were selected as possibly having a kimberlitic source) failed to locate any kimberlitic material.

6. EXPENDITURE

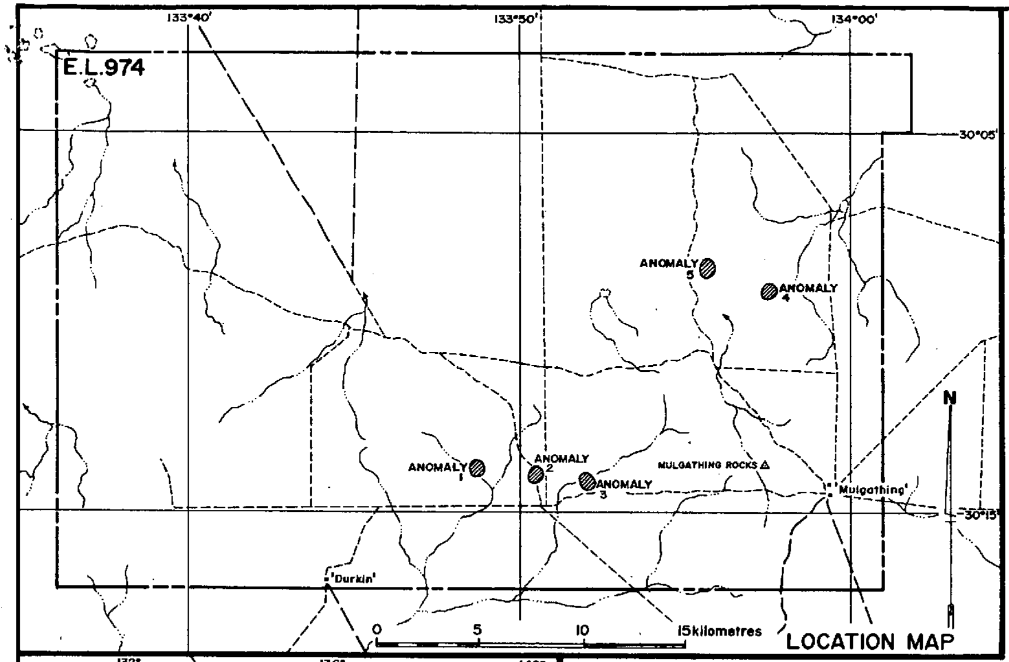
Expenditure debited to E.L. 974 by BHP was:

Wages and Salaries	$30,078
Messing and Accommodation	2,292
Fares and Mobilisation	38
Drilling	3,232
Transport	2,965
Surveying and Aerial Photographs	210
Mobilisation of Equipment	21
Sample Analysis	3,685
Occupancy and Location Expenses	30
Administration and Overheads	2,128
	$44,679

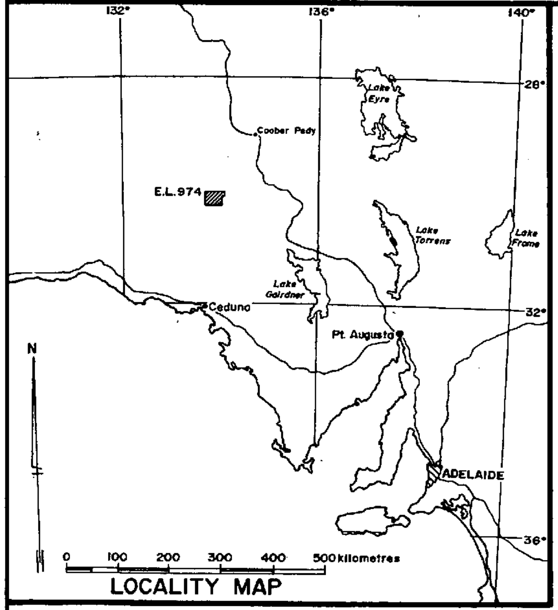
TABLE 1 ASSAY DATA

Anomaly No.	Hole No.	Sample (DEA)	Depth From	Depth To	As	Nb	Cu	Pb	Zn	Ni	Co	Cr	Rock Type
1	PMU 1	7025	26	28	2	6	44	<4	110	120	18	95	Volcanics
		7026	28	29	<2	12	55	<4	130	130	18	120	"
	PMU 2	7036	18	20	3	6	24	<4	110	115	18	26	"
		7037	20	22	<2	6	20	<4	80	85	18	22	"
2	PMU 3	7050	22	24	<2	8	95	<4	110	60	24	28	Intermediate intrusive
		7051	24	26	<2	10	48	8	110	90	26	55	" "
	PMU 4	7064	22	24	<2	10	40	<4	120	80	26	14	Dolerite (!)
		7065	24	25	<2	12	30	6	110	55	24	26	"
3	PMU 5	7083	32	34	<2	12	55	8	110	75	18	90	"
		7084	34	35	2	12	40	12	95	65	18	48	"
	PMU 6	7096	22	24	2	6	55	130	75	85	12	170	Clay
		7097	24	27	<2	6	110	150	145	240	26	530	"
4	PMU 7	7118	38	40	<2	14	46	16	150	100	34	240	Biotite schist
		7119	40	42	<2	14	44	10	110	75	22	46	" "
	PMU 8	7138	34	36	<2	16	34	34	150	60	26	42	Clay
		7139	36	38	2	18	18	20	75	32	10	24	"
	PMU 9	7156	30	32	<2	10	26	24	150	75	28	46	Weathered metamorphic
		7157	32	34	2	14	26	28	130	75	42	100	" "
	PMU10	7177	36	38	<2	16	8	<4	24	12	<4	8	Weathered granite(?)
		7178	38	40	<2	14	10	<4	26	16	6	12	" "
5	PMU11	7198	36	38	<2	18	50	14	180	110	36	65	Clay
		7199	38	40	<2	10	70	10	120	90	30	30	"
	PMU12	7214	26	28	3	16	46	10	100	145	38	28	"
		7215	28	30	<2	14	38	8	85	130	32	60	"
	PMU13	7230	26	28	10	10	95	<4	150	130	48	75	"
		7231	28	30	3	20	55	38	110	85	36	85	"

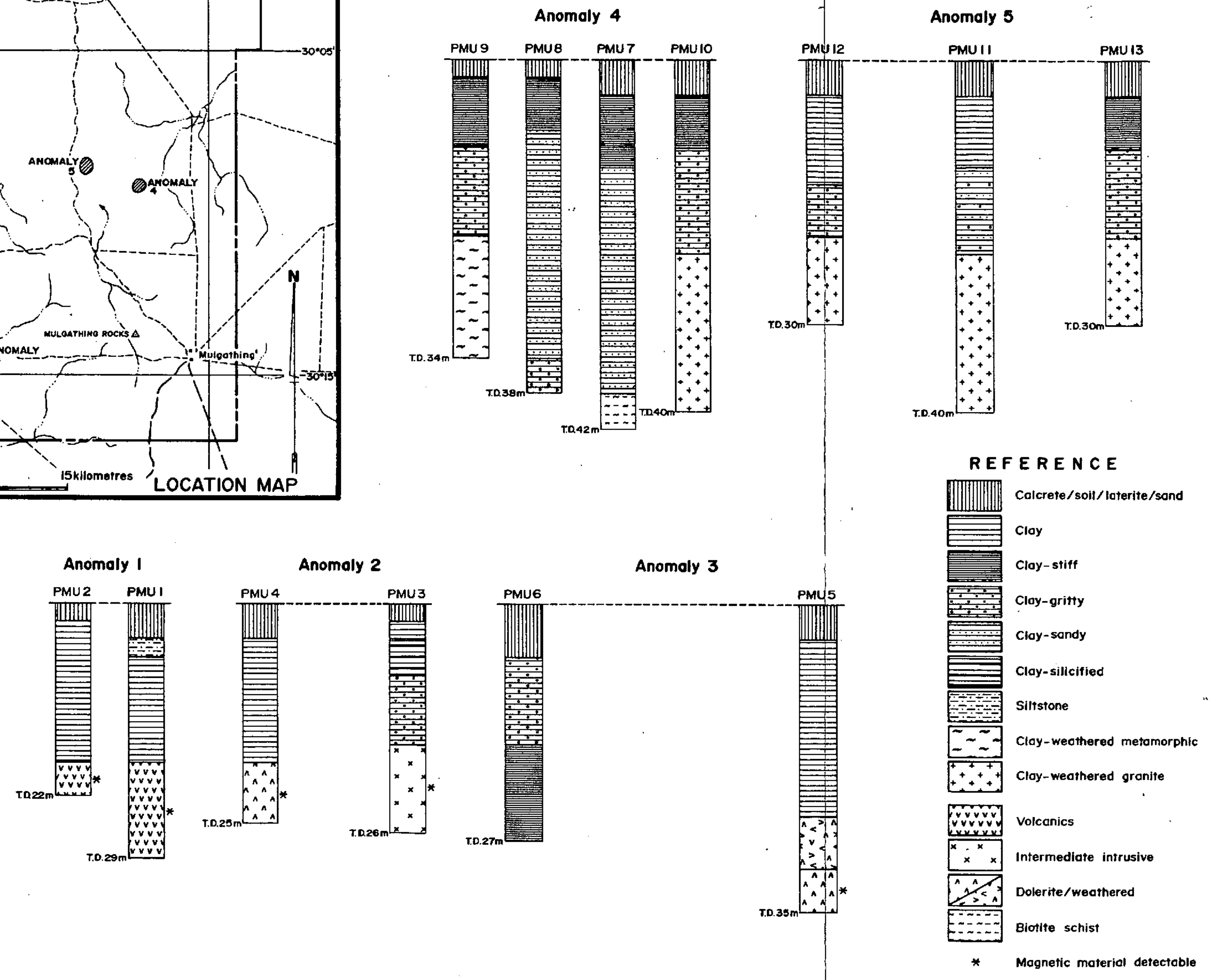
FIG. 2



LOCATION MAP



LOCALITY MAP



Vertical Scale 1:500
0 10 20 30 metres

Horizontal Scale 1:1,500
(between drillholes of each anomaly)
0 25 50 75 100 metres

THE BROKEN HILL PROPRIETARY CO. LTD.
EXPLORATION DEPARTMENT

E.L.974 MULGATHING ROCKS, S.A.
AFMECO J.V.
GRAPHIC LOGS

Prepared by: E.L.S.	Centre: Adelaide	
Date: 24-3-83	Project Nº 6-F660-3	Drawing Nº A3- 143
Drawn: A.R.V.		

Revisions:

032

Contents-Transparency Cylinder No: 3777/

Envelope No: 3777

State:- SOUTH AUSTRALIA

EL 974 (formerly 579)

Area Name	Scale	Data Type	International Map Reference	Map No	Microfilm		Mirco fiche	Sent to SADME
					S	R		
Mulgathing	1:25,000	Magnetic Intensity	SH53-10	GPM 2188	✓	8/9/80	✓	Roll 4
[AUSTIREX]				2187	✓	"	✓	"
29/2/80				2186	✓	"	✓	"
				2185	✓	"	✓	"
				2184	✓	"	✓	"
				2183	✓	"	✓	"
				2182	✓	"	✓	"
				2181	✓	"	✓	"
				2180	✓	"	✓	✓
				2219	✓	"	✓	"
				2217	✓	"	✓	"
				2218	✓	"	✓	"
Mulgathing	1:25,000	Flight Line	SH53-10	S 2088	✓	"	✓	"
[AUSTIREX]				2087	✓	"	✓	"
27/2/80				2086	✓	"	✓	"
				2085	✓	"	✓	"
				2084	✓	"	✓	"
				2083	✓	"	✓	"
				2082	✓	"	✓	"
				2081	✓	"	✓	"
				2089	✓	"	✓	"
				2195	✓	"	✓	"
				2194	✓	"	✓	"
				2193	✓	"	✓	"
Mulgathing	1:25,000	Uranium Channel	SH 53-10	GPR 2099	✓	"	✓	"
Austirex				2100	✓	"	✓	"
Plan Date				2101	✓	"	✓	"
2/5/80				2102	✓	"	✓	"
				2103	✓	"	✓	"
				2104	✓	"	✓	"
				2105 (31)	✓	"	✓	"

State:-

Area Name	Scale	Data Type	International Map Reference	Map No	Microfilm		Mirco fiche	Sent t. SADME
					S	R		
Mulgathing	1:25000	Uranium Channel	SH 53-10	GPR 2106	✓	8/8/83	✓	Roll A
(Austirex)				2107	✓	"	✓	"
PLAN DATE				2211	✓	"	✓	"
2/5/80				2212	✓	"	✓	"
				2213	✓	"	✓	"
Mulgathing	1:25,000	Total Count	SH 53-10	2153 GPR	✓	"	✓	"
Austirex				2154	✓	"	✓	"
Plan Date 6/3/80				2155	✓	"	✓	"
				2156	✓	"	✓	"
				2157	✓	"	✓	"
				2158	✓	"	✓	"
				2159	✓	"	✓	"
				2160	✓	"	✓	"
				2161	✓	"	✓	"
				2199	✓	"	✓	"
				2200	✓	"	✓	"
				2201	✓	"	✓	"
Mulgathing	1:25,000	Total Magnetic Field	SH 53-10	GPM 2135	✓	"	✓	"
(Austirex 79)				2136	✓	"	✓	"
Plan Date 17/2/80				2137	✓	"	✓	"
				2138	✓	"	✓	"
				2139	✓	"	✓	"
				2140	✓	"	✓	"
				2141	✓	"	✓	"
				2142	✓	"	✓	"
				2143	✓	"	✓	"
				2226	✓	"	✓	"
				2227	✓	"	✓	"
				2228 (29	✓	"	✓	"
			Total No 60					

2 of 2

Env. No. 3777
EL No. 579/974

033

Aerial Geophysical Surveys

~~Magnetic data tapes~~ covering: Tape 79 0004

✓ Magnetic -

✓ Radiometric -

~~VLF EM -~~

~~EM -~~

~~INPUT -~~

~~Other -~~

(Delete as necessary)

Surveys conducted by ...Austirex...............................

in ....Nov, 1979...

are held by Geophysics Section, South Australian Department of Mines and Energy.

- Magnetometer and spectrometer data. + lats + longs.
- Flight line films

AFMECO PTY LTD

WHYALLA BASE

Report No. WY 80.4

MULGATHING
SOUTH AUSTRALIA
(E.L. 579)

by

YG. BLADIER

11 OCT 1983
DEPT. OF MINES
AND ENERGY
SECURITY
3777

WHYALLA

JULY 1980

CONTENTS

FIGURES

APPENDICES

PLATES

SUMMARY

The Mulgathing area (E.L. 579) was selected for the study of the spectrometric signature of the older basement in an area where the sequence was believed to be comparable to that of the Tumby Bay area; the principal objectives were to test the signal from the basement and residual soils; to compare them with Tumby Bay; to attempt structural mapping by the use of the magnetic B.I.F. horizon; and to search for possible mineralisation.

The E.L. was flown in late November 1979 by Austirex Aerial Surveys Pty Ltd, and data was received during March and April. Area flown was 830 sq. km at 500 m line spacing. A description of the systems is given in Appendix I.

Maps received at 1:100 000 scale are:

Total magnetic intensity	contours plus	stacked profiles
Uranium channel	contours plus	stacked profiles
Thorium channel		stacked profiles
Potassium channel		stacked profiles
Total count		stacked profiles
U/K ratio	contours plus	stacked profiles
Th/K ratio		stacked profiles
U/Th ratio		stacked profiles
Flight lines		stacked profiles

Field reconnaissance was carried out from 18th June to 30th June with a two geologist team; two days were spent with S. Daly of the South Australian Department of Mines and Energy (SADME) to look at the most representative section of the Mulgathing Complex in the Mount Christie and South Lake areas, the latter being SE of Tarcoola.

Samples were collected as follows:-

7 for U and Th analysis
5 for base metal analysis
5 for petrographic and mineralogical examination

Three zones with radioactivity of more than 1000 c/s SPP2 were discovered.

CONCLUSIONS

The salient point of the Mulgathing area basement study is that spectrometry does not work except over outcrop. There is no difference in background levels between silcrete, calcrete, ferricrete, and sand dune that might reflect the underlying basement.

Airborne magnetics is high in contrast and an interpretative map can be constructed, but this needs to be checked by drilling to determine where it fits according to the Gawler Craton project concept.

Thorium anomalies with monazite and brannerite look prospective and the metallogenetic process has to be understood.

RECOMMENDATIONS

1. A detailed geological study should be made of the radioactive anomalies by mapping, radiometry, and costeaning, followed by 2 or 3 air core drill holes to obtain fresh rock for petrographic and metallogenetic study.

2. In order to optimise the results of the magnetic survey a shallow drilling programme above the main units should be carried out to check the geological interpretation. Eleven drill holes are proposed (Plate 1).

TENURE

The present study was undertaken on E.L. 579, of 1044 sq. km, which is held 100% by AFMECO.

The licence was granted on 16.1.80 for one year, the commitment is $35,000, and the E.L. is part of the Gawler Project basement study (Fig. 2).

Presently Cultus Pacific is searching for diamonds and other metals, and has made us an offer for a joint venture in uranium of its E.L.'s in the Mulgathing area (Fig. 2).

INTRODUCTION

The location of the Mulgathing Exploration Licence Area No. 579 is shown in Fig. 1. Mulgathing Station lies about 600 km NW of the Whyalla base. This area is 60 km north of the Trans Australia Railway and 102 km from Tarcoola, a small town which offers very little in the way of support services. The country is devoted to sheep farming. Access is easy by the main gravel road along the railway and thence by graded roads to the homestead and outstations.

About 95% of the basment rocks are thinly covered with sand, silcrete, and laterite. Low hills, generally of basement rocks, rarely rise above 40 m from the present plain level. Wide flat plains are blanketed with saltbush and bluebush, with sandy areas covered by moderately thick mulga and malleewood. Rainfall is low (150 mm) and falls in the winters. The summer is hot and dry.

The investigation which is the subject of this report consisted of a high resolution, low-level, aerial magnetic and spectrometric survey, conducted by Austirex Aerial Surveys Pty Ltd (App. 1), followed by ground follow-up, comprising geological reconnaissance, radiometry, and sampling.

PREVIOUS INVESTIGATION

In 1967 the South Australian Department of Mines and Energy (SADME) carried out mapping and drilling for banded iron formation (bif).

In 1971 Kennecott carried out an aeromagnetic survey with wide line spacing over the area, together with photography at 1:40 000 scale. Mapping, geochemical sampling, ground magnetics and drilling for nickel were conducted in 1973.

In 1972 Overland Enterprises made an examination of bore holes samples for rocks of kimberlitic affinity. IN 1973 Nissho Iwaii Co. worked on Tertiary and Permian sediments in the Mulgathing Trough. Carborne scintillometry and drilling were carried out, but with no encouraging results.

In 1975 Uranerz completed the Nissho survey with seismic and gravimetry surveys, and drilling, without positive results.

GEOLOGY

The Mulgathing area is part of the Gawler Craton. It is an area of crystalline basement stabilised in the Precambrian (1500 MA) and now partly covered by sediments of Permian to recent age. The oldest rocks are quartzo-feldspathic gneisses with interlayered quartzite and thin discontinuous banded iron formation. Foliated granitic gneiss occurs within the metasedimentary sequence. Basic and ultrabasic rocks also occur within the gneisses and may either be conformable or cross-cutting.

Basement outcrops are extremely poor within the licence area. Banded iron formation, with quartz-feldspar-amphibole-pyroxene gneiss, outcrops to the west of West Well. Magnetic features and field work suggest that the bif forms part of a series of anticlines and synclines. The core of one anticline is composed of very weathered acid gneisses, and at this locality counts of 3000 cps SPP2, and analyses of 30 ppm U and 2830 Th were obtained. There are other outcrops of acid gneisses to the south east of Top Bore Tank. Mulgathing Rocks present the best outcrop of fresh quartz-feldspar-biotite-amphibole orthogneiss.

The best cross sections of older basement are at Mount Christie, which occurs in an area adjacent to, and south of, E.L. 579. At this locality two fully cored holes have been drilled through the iron formation. The iron formation, approximately 50 m thick, is a quartz-magnetite-diopside-hypersthene-amphibole gneiss. It retains a predominantly granoblastic texture even when there is evidence of a later phase of metamorphism accompanied by recrystallisation and partial replacement of pyroxene by amphibole (Whitten, 1965, in Daly et al, 1973). A coarse-grained pinkish-grey poorly-layered to massive quartz-plagioclase-microcline-cordierite-garnet-gneiss underlies the banded iron formation, and could be correlated with the gneiss with thorium anomalies that has been found south of West Well.

Outside the E.L., and to the east of it, there is an outcrop of post-tectonic Hiltaba type granite.

Permian sediments were discovered by Nissho Iwaii in drilling an inferred Tertiary channel between Durkins' and Charcott Bore. They were deposited in a graben formed by normal faulting which succeeded the Kimban Orogeny. The effect of stress relaxation after an orogeny is very small in this area, but it continued for a long time and it is probably still active. Tertiary sand and clay is extensive and generally fills old lake depressions.

Silcrete or siliceous duricrust occurs as a bouldery layer capping extensively kaolinised rocks.

Laminated, slabby, and nodular calcrete is found on weathered rocks of all ages. Ferricrete generally caps bif. Laterite and brown sandy soils are also extensive.

AIRBORNE GEOPHYSICAL DATA

The aerial magnetic and spectrometric data are given in Plates 2 to 12.

The following comments are appropriate.

Total count, stacked profiles

The anomalies are very small over foliated granites and laterite but it is impossible to differentiate one from the other, and unfortunately there is also foliated granitic outcrop that does not give a spectrometric response. Total count in this case is of little use.

Uranium contours and stacked profiles

The contours show uranium highs over laterite, but the laterites are very poorly defined on the stacked profiles. This data is of no use for mapping.

Thorium stacked profiles

There is only one response, over laterite. There is no response over thorium anomalies which give 1000 SPP2 on the surface and 3000 c/s after digging to 30 cm, but the flight may have passed too far away. The anomaly covers an area of 500 to 1000 sq. m and is 2 or 3 times background. Thorium is not useful for mapping but it is very surprising that this one big anomaly was not registered.

Potassium stacked profiles

The potassium channel gives a response over foliated granite, which can be differentiated from laterite when the interpretation is associated with the total count and the uranium channel. Photogeology can be used more successfully to distinguish granite from laterite.

U/K ratio contours and stacked profiles

The ratio contours give only low value over laterite. Stacked profiles are not useful. U/K ratio contours and stacked profiles are not useful for mapping.

Th/K ratio stacked profiles

Th/K ratios also indicate the laterite and are not useful for mapping.

U/Th ratio stacked profiles

No features of geological significance are evident.

Magnetic total field contours and stacked profiles

Examination of the total magnetic field contours enables an interpretative geological map (Plates 14 and 15) to be constructed with limited factual data in this area of poor outcrop (Plate 1). In the eastern part, the structure of bif is easily distinguished. It forms a series of flat anticlines and synclines.

Stacked profiles show mainly the bif structures but in the western part of the map, one zone could be interpreted as a ultramafic body, kimberlite or carbonatite. The magnetic data is by far the best tool for mapping.

Conclusions

The spectrometric results are very disappointing on E.L. 579. The reason is probably the very poor outcrop conditions (5%) and the lack of diversity of lithologies. Banded iron formation and acid gneiss have not the same response but are the only basement rocks which outcrop in the area. Occasionally the laterite shows a small anomaly.

Total magnetic intensity data are the most useful for mapping but due to the lack of outcrop, interpretations are not always easy. Magnetic anomalies in the western part of the are could be interesting. Geophysical interpretations by the author and Consultant B. Dockery are shown in Plates 14 and 15.

RADIOMETRIC ANOMALIES

Uranium

Small uranium anomalies (3 x background) exist over laterite. The average reading on laterite is 70 c/s SPP2, but readings of up to 300 cps at the surface, and 450 cps (SPP2) at 20 cm depth, were obtained.

Thorium

A thorium anomaly was discovered in conglomerate overlying basement (quaternary?) and in the basement. The conglomerate gave a count of 1000 to 1500 SPP2 (Th - 910 ppm; U - 30 ppm) and is described by W. Fander as a kaolinitised breccia with granitic, pegmatitic, and greisen fragments. There are crystals of monazite up to 1 mm in size, tourmaline crystals, and black metamict brannerite. Other components include metaquartzite, tourmalinised quartz-mica-schist, quartz grains, and kaolinitic masses or pellets with occasional andalusite fragments. They are embedded in fine kaolinite and cemented by quartz.

The conglomerate forms a small cliff above sand cover on an outcrop of very weathered basement. Some of the basement has been identified as quartz-feldspar gneiss of sedimentary origin, containing small flakes of graphite. Sand over the basement is generally radioactive with 200 to 300 SPP2 and after digging 20 cm, very weathered basement gave readings of 3000 SPP2, and samples yielded 2830 ppm Th and 30 ppm U. The presence of brannerite is noteworthy. Weathered outcrop shows very intense kaolinitisation and shearing. Small sheared quartz veins are abundant.

Most Mulgathing Complex rocks that outcrop are very fresh, which could be because the extensive silcrete and laterite in the area covers deeply weathered Mulgathing Complex. When the cover is removed the fresh rock is exposed. An alternative explanation is that the rocks have been hydrothermally altered and oxidised by waters introduced along shear zones.

The exposures at the thorium anomaly and at a small mesa to the north, appear to be topographically unique in the area. They may be the result of movement along a shear zone, which means that the movement took place after the formation of the quaternary silcrete.

To the south west of Mount Christie two other radiometric thorium anomalies were discovered (U 10 ppm; Th 180 ppm) which gave 1200 c/s SPP2 in a quartz-feldspar-biotite gneiss of probable lower amphibolite facies. The rock consists mainly of large, shapeless, interlocking patches of microcline and oligoclase with subordinate stressed quartz. There are random flakes of dark brown biotite, with associated accessory minerals, which include rutile, ilmenite (partly altered to leucoxene), well-rounded zircon grains up to 0.75 mm (i.e. exceptionally large), and subhedral crystals of fresh monazite up to 15 mm in size. The status of the monazite is not certain, but it is probably detrital. The presence of detrital heavy minerals shows that the rock is of sedimentary origin.

DISCUSSION

The uranium anomalies in laterite may lie along a NNE-SSW trend, parallel to a prominent magnetic feature, which could mean that an underlying fault or a continuous linear geological unit may contain uranium mineralisation, and the concentration in laterite would reflect this. One of these anomalies should be tested by aircore drilling.

The thorium anomalies on EL 579 are in an area of easy access and their significance can be tested rapidly. Two possible solutions are envisaged:

- The rocks are metasediments, in which case the thorium is only a sedimentary concentration without corresponding uranium deposition. On the other hand, the uranium could have been present in the brannerite (as in Blind River) but due to strong metamorphism and later weathering has been removed so that only the thorium remains.

- Granitisation effects are not very far from the surface (outcropping of quartz veins). Uranium and thorium could have been mobilised together but due to weathering the uranium has migrated first and we are in the lower part of the mineralised body where only thorium remains. Mapping and costeaning, aircore drilling in the weathered zone, followed by diamond coring, will be necessary to obtain evidence to test this hypothesis.

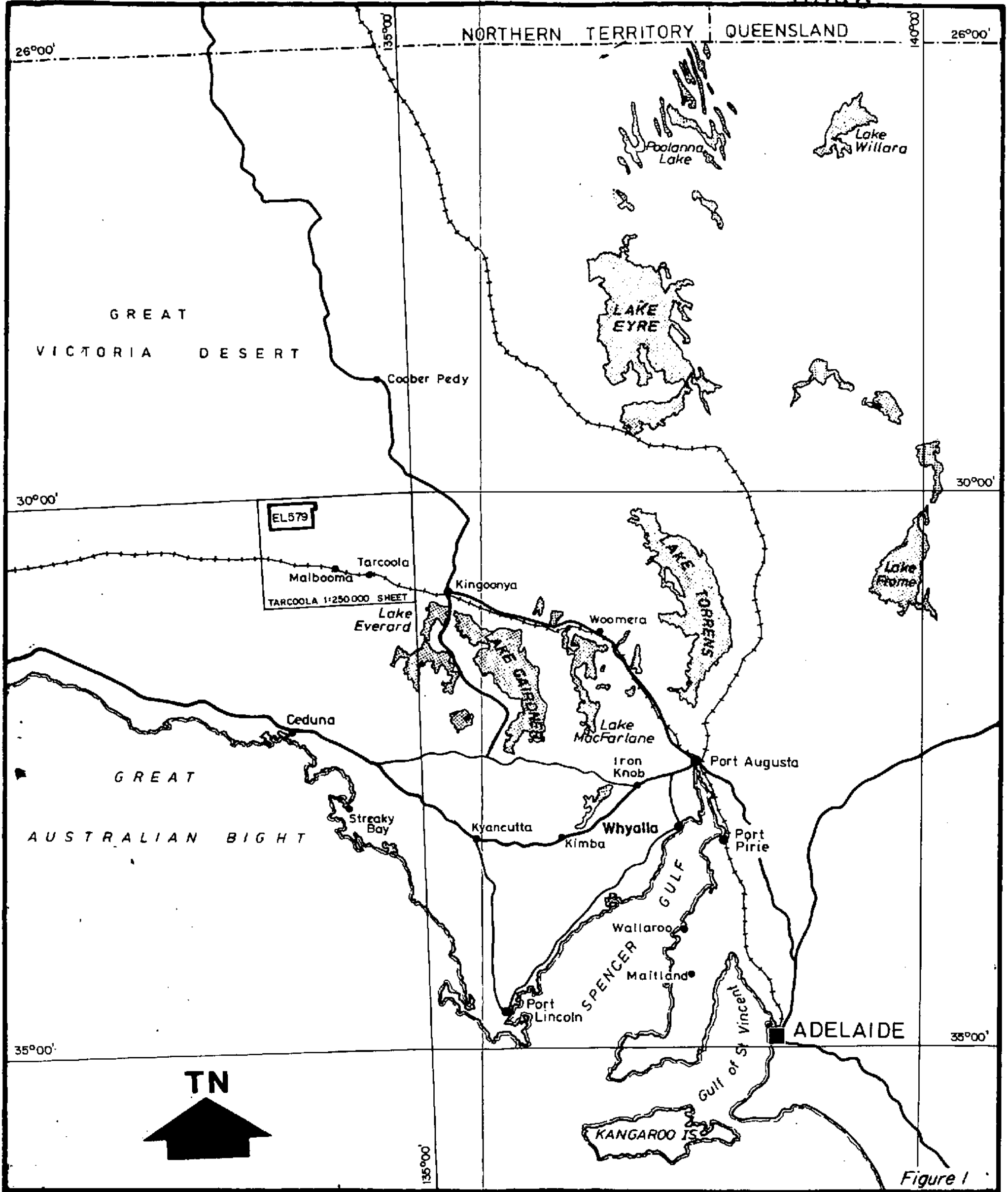


Figure I

Compiled from Plate 12 of the TIMES ATLAS OF THE WORLD (Comprehensive Edition), Fourth Edition, 1972.

To accompany Report No. WY.80.4.

DRAWN
R.P.S.

DATE
September, 1980

GEOLOGY
Y. Bladier

APPROVED

DWG. No
AFMAP 2761

REV No
0

AFMECO PTY. LTD.

SCALE
1:5 000 000
0 50 100 150 200 250 Kms

MULGATHING PROJECT

LOCATION AND TENURE MAP

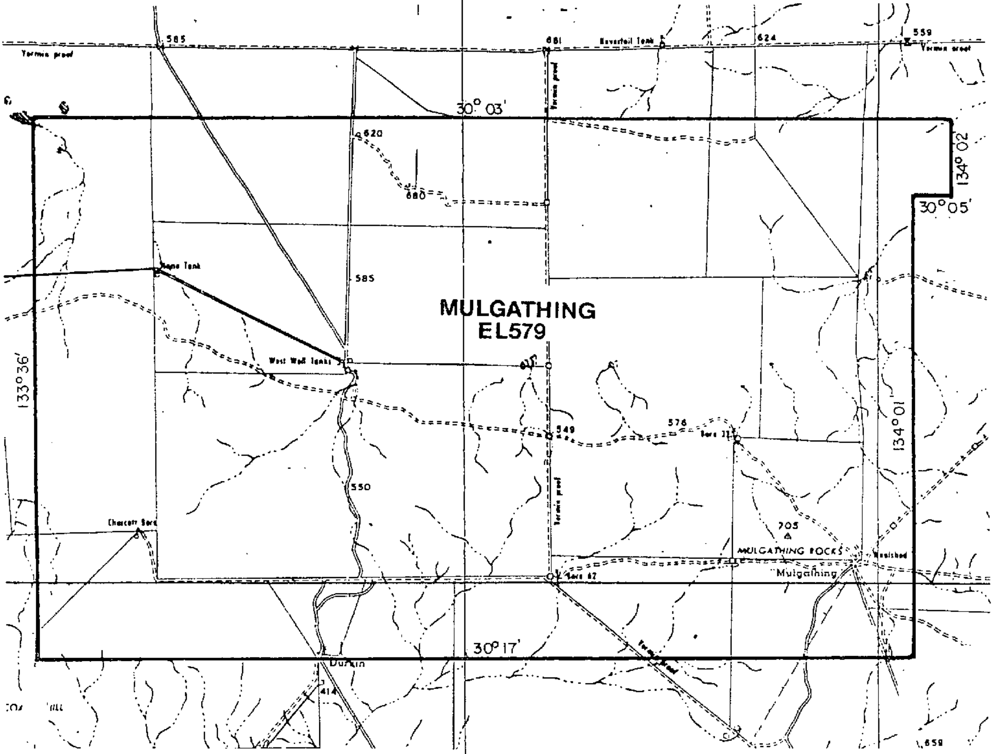


Figure 2

TN

Compiled from Tenure map issued by SADME.

To accompany Report No. WY.80.4

DRAWN	SADME
DATE	16-1-80
GEOLOGY	G.R. Ryan
APPROVED	
DWG No	SH 53-10.T.1990
REV No	0

AFMECO PTY. LTD.

SCALE
1:250000
2 0 2 4 6 8 10km

GAWLER BLOCK

EXPLORATION LICENCE

579

APPENDIX 1

AUSTIREX AERIAL SURVEYS AIRBORNE SYSTEM

1. Survey aircraft: Government Aircraft Factories NOMAD, Model 22B, Registration number VH-FZP.

2. Airborne Proton Magnetometer: Varian Model 49-595N Sensor and Aldetec magnetometer.

3. Ground Station Proton Magnetometer: Geometrics 826A magnetometer with a sensitivity of 1.0nT.

4. Airborne Gamma-ray Spectrometer: Geometrics Model GR-800 with multi-channels of 256 and 128 channels for main and upwards crystal arrays. Energy windows set for potassium at 1.37 to 1.57 Mev, uranium at 1.66 to 1.86 Mev, thorium at 2.40 to 2.80 Mev, Total Count at 0.4-3.0 Mev, and cosmic background 3.0 to 6.0 Mev.

5. Crystal Detectors: Geometrics Model 3072/512R with sodium iodide (thallium-activated) crystals with the main detector containing 50.34 litres and the upwards-looking detector containing 8.39 litres. All crystals are optically coupled to matched photo-multiplier tubes.

6. Radar Altimeter: Collins ALT.50 altimeter, measuring vertical distances from surface to aircraft with range 0 to 610 metres and accuracy ±2%.

7. Doppler Navigation System. Sperry-Decca type 72 with TANS Computer 94420. Navigation in latitude-longitude, grid, or range and bearing.

8. Aerial Tracking Camera: Vinten Mk3 scientific 16 mm frame camera with wide-angle lens.

9. Digital Data Acquisition System: Sonotek Model IGSS, which is a software-controlled mini computer with 4K core memory and 2 Digi-Data 9 track tape decks.

10. Analogue Recorder: Geometrics Model GAR-6 with 6 channels of data provision.

78-81

AFMECO PTY LTD

WHYALLA BASE

Report No.WY.81.3

E.L. 579

MULGATHING BASEMENT STUDY

FIRST REPORT ON DRILLING

NOVEMBER/DECEMBER, 1980

by

G.R. STYLES

WHYALLA
GRS/pg/206

RECEIVED
26 SEP 1983
DEPT. OF MINES AND ENERGY
SECURITY
3777

APRIL, 1981

CONTENTS

FIGURES

TABLE

APPENDICES

PLATES

SUMMARY

The programme was designed to test the basement rocks following an interpretation of an aeromagnetic survey of the area. An additional 2 holes were sited to investigate a thorium anomaly in weathered basement rocks. Between 12.11.80 and 9.12.80. twenty holes totalling 1134m were drilled.

An assemblage comprised dominantly of quartz-feldspars ± biotite ± garnet gneiss but also including sheared felsic rocks and a basic schist, granulite and amphibolite has been returned. Drilling of the thorium anomaly produced only small gamma peaks within quartz-feldspars filled fault breccias.

CONCLUSIONS

The magnetic interpretation of metasediments and felsic metamorphics was largely successful but the interpretation of mafic metamorphic domains was less so. This may be due to the lack of estimates of depth to source or because the mafic rocks are thin interbeds within largely felsic terrain. Interpretation failed to recognise the large amount of mylonite (= faults) in the area.

Except for one, a contact metamorphosed metadiorite, the rocks are amphibolite to granulite facies grade metamorphic rocks belonging to the Mulgathing Complex; the metadiorite may be related to the Gawler Range Volcanics.

The importance of the strong surface thorium anomaly remains unresolved with no corresponding anomalies at depth. The overlying conglomerate retains interest both as a pointer to as yet unknown basement rocks and to possibly significant recent sedimentary environments.

The water bore survey returned some apparently high U, Cu and Zn values but their significance on a regional or local scale is not yet clear.

RECOMMENDATIONS

The usefulness of the current silicate analysis scheme would be greatly enhanced if both FeO and Fe_2O_3 were determined. This would allow the use of triangular diagrams which are standard for the comparison of metamorphic rocks.

The water samples require, at the very least, resampling and analysis in a single batch. Comparison with as many other Gawler Craton waters as possible is recommended but this may entail an extensive water sampling programme over the whole craton by AFMECO.

TENURE

E.L. 579 "Mulgathing", covering $1044km^2$, is current for the 12 months ending on 15.1.82 and carries a commitment of $35,000. AFMECO has 100% interest in the E.L.

LIST OF ABBREVIATIONS USED IN TEXT AND DRILL LOGS

all	allanite	vfg	very fine grained
ap	apatite	fg	fine grained
bt	biotite	mg	medium grained
chl	chlorite	cg	coarse grained
cord	cordierite	f-cg	fine to coarse grained
ep	epidote	m-cg	medium to coarse grained
gn	garnet	A	angular
hb	hornblende	SA	sub angular
ksp	k-feldspar	SR	sub rounded
ky	kyanite	ab	abundant
mag	magnetite	carb	carbonate
mv	muscovite	dissem	disseminated
plag	plagioclase	dom	dominant
py	pyrite	lim	limonite
qtz	quartz	H	light
sill	sillimanite	mod	moderate
sph	sphene	org	organic
staur	staurolite	sst	sandstone
zr	zircon	tr	trace

1. INTRODUCTION

1.1. Aim

An interpretive geological map was prepared from an airborne magnetometer survey (reported in WY 80.4) by the consultant B. Dockery and the drilling programme was designed to test the differing magnetic domains. Additionally two holes were sited to test a thorium anomaly in weathered basement rocks.

1.2 Location and access

The E.L. lies within the TARCOOLA 1:250 000 sheet area about 550km by road from Whyalla and about 80km from the railway town of Tarcoola (Fig.1). In addition to the railway and telephone, food and fuel can be obtained here but no other support facilities are available.

1.3 Previous work

The E.L. was selectively flown for spectrometry and magnetometry in November, 1979 by Austirex Aerial Surveys Pty. Ltd., and a field reconnaissance was undertaken in June, 1980.

Ground scintillometry located a small anomalous area (WY 80.4) in which weathered basement rocks are exposed in and around a small (max. 4-5m) cliff in which a ~ 1m thick sedimentary breccia is capped by ~1m of silcrete. The anomalous radioactivity was shown to be due solely to thorium.

The basement rocks are now quartz-kaolin rock with relict gneissic textures containing, in one instance, graphite. They range from 50-200 c/s SPP2 but one spot in a limonitic clay rock, gave 3000 c/s SPP2 and 1750 to 2880 ppm Th. A 0.5m wide zone of sheared quartz-kaolin rock was interpreted as a fault. The breccia contains monazite and brannerite and gave up to 2000 c/s SPP2 and 910ppm Th. (Fig. 2, App. 2 & 3).

The breccia was considered to be unique in the area and possibly equivalent to the pleistocene Talus of Daly (1981). Transport distance was thought to be very short and two drill holes were planned to test the nature of the basement rocks and the fault.

2. WORK COMPLETED

2.1. Drill programme

A total of 1134m was drilled by the contractor Wallis Geochemical Drilling Co. Pty. Ltd., between 12.11.80 and 9.12.80. The aircore system was used in eighteen holes and followed by 1 to 3m of diamond drilling to obtain samples of fresh basement rock (total 840m aircore, 34.5m diamond). The two holes on the thorium anomaly were precollared using aircore; it was followed by diamond drilling (total 97m aircore, 162.5 diamond). (See App. 1 for drilling record).

2.2 Probing of drill holes

The holes were logged through the drill stems from a truck mounted unit supplied by Geoscience Assoc. (Aust.) Pty. Ltd. Gamma and neutron logs were taken and presented in analogue form together on a single chart. A digital record was also made with a reading every 20cm.

2.3 Sampling and analysis of drill holes

Aircore samples were taken every metre and a fraction was stored in clear plastic vials for retention as a permanent record. The basement core is stored in core trays with a representative sample being sent for thin section description and analysis.

2.4. Water survey

Sixteen water bores were sampled and analysed for uranium and pathfinder elements.

3. RESULTS OF DRILL PROGRAMME

Gneisses and granitoids of probable sedimentary origin are the dominant rock types. The criteria for sedimentary origin are the common presence of rounded zircons and the high alumina content as indicated by sillimanite and the high Al_2O_3 to $Na_2O + K_2O + CaO$ ratio. The mineralogy of these rocks suggests an uppermost greenschist to amphibolite facies metamorphic grade.

Differing from these felsic metasediments are the 4 mafic rocks. MUL 16 and MUL 15 (115.2m) went across granulite facies rocks of probable basic origin whilst MUL 1 was drilled in contact metamorphosed diorite. MUL 14 (117.4m) is unique showing a basic sequence containing graphite and being in the amphibolite facies.

The two holes testing the thorium anomaly (MUL 14 and 15) encountered gneisses and minor basic granulites with extensive zones of shearing expressed as mylonites and breccias. Several small gamma anomalies were located within quartz-feldspar breccias. (Plate 2 <u>et seq</u>. App. 2 & 3).

4. RESULTS OF WATER SURVEY

The water samples revealed a large range in uranium content from below detection limit to 65 ppb in bore number 62. Charcott bore returned a high Zn value and Mailgate bore is high in both Cu and Zn. (App. 4).

5. DISCUSSION

5.1. Basement study

A prime concern of this report is to determine if the geology as interpreted from the magnetics, with very little background knowledge, is backed up by the samples obtained from the drilling programme. Table 1 shows that the areas interpreted as metasediments and felsic metamorphics produced either dynamically deformed granitoids or quartz-feldspars + garnet + biotite gneissic metasediments.

The one possible exception is to be found in MUL 19 with distinctive blebby aggregates similar to those encountered in MUL 6. Both petrologists consulted consider these rocks to be of unusual origin and the biotite patches to (possibly) be xenoliths. An unusual acid rock with metamorphosed xenoliths is more compatible with the interpretation for MUL 6 (kimberlite) than with MUL 19 which is situated in metasediments close to BIF.

The interpretation of mafic metamorphics seems to be less accurate with three holes producing felsic gneisses. The two deep diamond holes, MUL 14 and 15 were drilled in interpreted mafic metamorphics but encountered only small volumes of basic material within more felsic, acidic material. This can be interpreted as basic metavolcanic interbeds within a largely pelitic metasedimentary sequence. Such a relationship may become apparent with a more detailed analysis of the magnetic data rather than the blanket interpretation used here (ditto MUL 11, 17). Also an estimate of depth to magnetic source would be useful, especially for a feature such as that at MUL 6.

The interpretation seems to have the most problems in the recognition of mylonite shear zones. The extent of dynamic deformation (MUL 4,8,9,11,17 and much of 14 and 15) that was found was not expected from the interpretation and referring back to the magnetic map (WY 80.4) and the regional magnetics, only MUL 9 is readily explained. This sample comes from a long linear magnetic domain which is probably a regional shear zone with lenses of low stress material e.g. MUL 2.

On petrographic evidence, all the rocks encountered (except those in MUL 1) in this programme are likely to be part of the Archean Mulgathing Complex as defined and described by Daly (1981).

According to Daly (1981) the Mulgathing Complex has undergone granulite facies metamorphism around 2300-2490 My with retrograde metamorphism during the Kimban Orogeny at 1600-1800 My. The evidence from this programme is confusing. Firstly, the felsic metasediments contain no cordierite or orthopyroxene either as relicts or their retrograde products which suggests that the granulite facies was not reached. Secondly the two basic rocks, in MUL 16 and in MUL 15 at 115.2m have reached the granulite facies but the MUL 15 sample has felsic metasediments of only amphibolite facies on either side (i.e. MUL 15 85.2m). The other basic rock (MUL 14 117.4m) is compatible with the surrounding metasediments being in the amphibolite facies.

Overall then, the presence of the two granulite facies rocks indicate that the area reached this grade of metamorphism. The biotite rich felsic metasediments are compositionally capable of developing cordierite orthopyroxene so the absence of these indicator minerals is surprising.

The diorite encountered in MUL 1 has not undergone regional metamorphism. It corresponds to the "un-named diorite" of Daly (1981) and may be related to the carpentarian Gawler Range Volcanics.

The group of rocks found in MUL 4, 8, 9, 11 and 17 differ from the other felsic rocks in that they are strongly deformed, tending towards mylonites and that they are granitic rather than gneissic in character. MUL 8 lies in the same magnetic domain as the "Mulgathing Rocks" outcrop of foliated granitoid, which is considered by Daly (1981) to be syntectonic Kimban granite due to the 1580-1700 Ma age orogenic event.

An alternative to the Daly classification is that the granitoids are older archean members of the Mulgathing Complex with the deformation occurring anytime up until the Kimban with a subsequent resetting of the dates. Minor deformation in the form of stressed quartz or other minerals is common throughout the area and the compositional similarity suggests that the now deformed granitoids are derived from the gneissic metasediments.*

5.2 Thorium anomaly

The investigation of the thorium anomaly at West Well is inconclusive. The surface anomaly (sample 3682) is a limonite clay rock with abundant decomposed mica which is quite unlike the anomalous quartz-feldspar breccias in the core. However, this material may be similar to the Mt.Christie anomaly (WY 80.4) where, by this authors observation, the anomaly occurs in a coarse grained monazite bearing biotite-quartz-feldspar rock which is apparently a metamorphic pegmatite conformable with the surrounding gneisses - although nothing of this type is present in the core.

A radioactive sedimentary breccia similar to the one outcropping at West Well was intersected at 8m in MUL 12 and its stratigraphic position, at the top of the tertiary sequence confirms the young age of the formation.

The presence of this breccia in sites 10km apart is at odds with the paleogeography deducted from the programme in the tertiary sediments around Tarcoola. It was deduced that the basement rocks were covered and contributed little, if any, to the tertiary sedimentation. Additional points are:

- The size, angularity and sorting suggest transport has been very short and by the same measure, MUL 12 is further from the source than the outcrop.

- The abundance and size of the monazite and brannerite also points to a nearby source rock rich in these minerals, but the only known basement rock containing these minerals is the strange rock in MUL 6.

- The lithic fragments at the outcrop comprise rock types so far unencountered in the region.

---

*The standard methods of comparison such as ACF diagrams are not possible without Fe^{2+} and Fe^{3+} in the analyses and the comparison gained from App. 3 is rather qualitative.

All in all this breccia is interesting, firstly because it points to the existence of previously unknown basement rocks which may be important stratigraphically (e.g. tourmaline-quartz-mica schist) or economically (e.g. greisen, monazite-brannerite rich rock) and secondly because of the new economic possibilities it opens up in the post tertiary sedimentation of the area.

5.3 Water survey

We have at present only a small data base for comparison of water bore samples on the Gawler Craton. The only other analyses known to the author are the 28 bores sampled on E.L. 621 Wirrida (Report WY.81.4). Most of the water bores and wells sampled appear to be sunk through the overburden and weathered material to fresh basement and this is supported by our drilling where small water supplies were frequently encountered near the fresh rock.

Comparison of the two groups of water samples reveals two outstanding differences, namely, an increase in both Cu and U in the Mulgathing samples. Whether this difference is real or not is open to question. If real, this may reflect a fundamental geological difference between the two areas. A. Giblin of CSIRO has found similar low U values in the Wirrida samples (P. Walker, pers.com.) but when the U detection limit changes from 10 to 5 ppb for U and from 100 to 10 ppb for As some doubt must arise as to the validity of comparing the two batches.

6. REFERENCES

Daly. S.J., 1981: The Stratigraphy of the TARCOOLA 1:250 000 map sheet area. SADME R.B. 81/5

TABLE. 1. Comparison of actual and interpreted rock types.

	$Al_2O_3/(Na_2O + K_2O + CaO)$	Rock type	
		Interpreted	Actual
Mul 1	1.99	mafic metamorphic	metadiorite
Mul 2	2.0	metasediment	gneiss, rounded zircon and rutile
Mul 3	1.6	felsic metamorphic	gneiss, stressed, rounded zircon
Mul 4	1.32	felsic metamorphic	crushed granite
Mul 5	2.0	metasediment	gneiss, stressed
Mul 6	2.35	ultramafic/kimberlite	gneiss, blebby bt, rounded zircon, monazite, brannerite
Mul 7	2.2	mafic metamorphic	gneiss, strongly feldspathic
Mul 8	1.36	granite	gneiss-mylonite
Mul 9	1.54	metasediment	gneiss-mylonite
Mul 10	1.96	felsic metamorphic	gneiss, stressed, rounded apatite, zircon
Mul 11	1.85	mafic metamorphic	gneiss-mylonite, rounded zircon
Mul 12	1.88	felsic metamorphic	gneiss, stressed, rounded apatite, zircon
Mul 13	3.43	BIF	gneiss, cg, well rounded zircon
Mul 14 93.2m	2.18	mafic metamorphic	gneiss, sheared, sillimanite
Mul 14 117.4m	2.05	mafic metamorphic	schist, basic, graphite
Mul 15 85.2m	2.47	mafic metamorphic	gneiss, 2^{o} foliation, rounded zircon, sillimanite
Mul 15 115.2m	0.65	mafic metamorphic	granulite, basic
Mul 16	0.91	mafic metamorphic	amphibolite, basic
Mul 17	1.73	mafic metamorphic	gneiss-mylonite
Mul 18	1.86	BIF	gneiss, cg, sillimanite-andalusite
Mul 19	2.26	metasediment	gneiss, blebby bt, andalusite

APPENDIX 1

Drilling Record

Appendix 1

HOLE	AMG COORDS	TD	AC	DD
MUL 1	9 70 E 7 36 N	16.4	14.9	1.5
MUL 2	0 30 E 7 11 N	19.5	18.3	1.2
MUL 3	9 62 E 6 77 N	9.9	8.4	1.5
MUL 4	0 29 E 6 70 N	73	71.5	1.5
MUL 5	0 29 E 6 35 N	56.8	55.3	1.5
MUL 6	0 30 E 5 78 N	63.8	62.4	1.4
MUL 7	0 03 E 5 05 N	25.4	18.2 20-23.4	1.8 2.0
MUL 8	9 44 E 5 31 N	44.6	43	1.6
MUL 9	8 84 E 5 52 N	15	12	3
MUL 10	8 57 E 5 92N	26.4	24.1	2.3
MUL 11	7 80 E 5 78 N	26.7	24.9	1.8
MUL 12	6 86 E 6 76 N	136.9	133.4 134.6-135.7	1.2 1.2
MUL 13	7 14 E 6 23 N	76.9	75.3	1.6
MUL 14	7 70 E 6 15 N	119.5	37	82.5
MUL 15	7 70 E 6 14 N	140	60	80
MUL 16	8 38 E 6 05 N	19.9	18.9	1
MUL 17	7 80 E 6 00 N	20.6	20	0.6
MUL 18	7 97 E 6 20 N	47.8	46.4	1.4
MUL 19	7 83 E 6 39 N	36.7	35.4	1.3
MUL 20	7 08 E 6 77 N	158	118.5 121.8-156.3	3.3 1.7

APPENDIX 2

Petrographic Reports

by

H.W. Fander

Five samples were received for mineralogical and petrological examination; thin sections were prepared and examined and other tests were also carried out to determine various minerals found. The descriptions are set out below.

3678 (T.S. 32550)

The rock, which is kaolinised breccia with granitic, pegmatitic and greisen fragments, contains crystals of monazite up to 1mm in size. Tourmaline crystals and black opaque fragments also occur. The black material was x-rayed and gave a weak, rutile type pattern typical of metamict brannerite.

Other components include metaquartzites, tourmalinised quartz-mica schists, quartz grains, kaolinitic masses or pellets and occasional andalusite fragments; they are embedded in fine kaolinite and cemented by quartz. The rock may be a tectonic breccia or a fault-filling, or even a sedimentary breccia; the relationship is obscured by the kaolinisation.

3680 (T.S. 32551)

This rock is a kaolinised quartz-feldspar gneiss, of sedimentary origin, containing small flakes of graphite.

The main constituents are large and small irregular patches of quartz, stressed and fractured, and aggregates of ultrafine kaolinite: there are no relict feldspar textures but occasional relict mica textures are seen. Accessory minerals include rutile (perhaps formed from the kaolinisation of biotite), well-rounded detrital grains of zircon and small shreds of graphite. Some of the black, 'metallic' material was removed from the rock and was tested and confirmed as graphite.

REPORT CMS 80/10/32

Project 124 Rock Samples

Seven rock samples were received for thin-section preparation and petrological examination; they are described in the accompanying table.

Summary

All the rocks are strongly kaolinised and their interpretation is therefore tentative, particularly in regard to their origin. Interpretations are based, inevitably, to a large extent on relict textures and structures, which in these rocks are especially poorly preserved. There is some evidence to suggest (e.g. in 2475) that the kaolinite was not a weathering-product, but rather a hydrothermal alteration-product, perhaps succeeded by some shearing, which would have destroyed any pseudomorphous textures; there is evidence in several samples that the kaolinite was deformed.

Generally, in such altered rocks, interpretations are partly based on the nature of any zircon present (whether rounded or euhedral), but no zircon was detected in any of these rocks.

SAMPLE NO.	ROCK TYPE - COMPOSITION	FABRIC	MINOR MINERALS	COMMENTS
2475	Kaolinised Microgranite. Irregular, corroded grains of weakly stressed quartz, evenly distributed in massive fine kaolinite; coarser kaolinite veins.	Medium-grained uniform, of igneous appearance.	Small hematite flakes, brown leucoxene grains.	Classified as a microgranite mainly on textural evidence, but origin not known (i.e. whether igneous, metamorphic).
2477	Kaolinised Gneiss. Thin parallel streaks of granular/tabular quartz, alternating with thicker bands of massive fine kaolinite (?feldspar).	Strong preferred orientation and fine banding; no relict textures.	Traces of fine leucoxene and hematite.	Presumably a fine quartz-feldspar gneiss before kaolinisation: may have been an acid volcanic rock, but this is speculation.
2479	Quartz-Kaolinite Rock (?Granite). Irregular patches of stressed mosaic quartz, and of fine kaolinite, with small muscovite flakes in patches.	Coarse, formless fabric, not gneissic but with some shearing.	Patches of Fe-staining.	Could be a sheared, kaolinised granite or related rock. Fabric is igneous rather than metamorphic.
2480	Kaolinised Gneiss. Mostly fine kaolinite, as parallel bands and lenses, with streaks of fine quartz, lenses of quartz-muscovite.	Gneissic fabric, with later shearing, folding minor brecciation.	Patchy ferruginisation	Originally a quartz-feldspar-muscovite gneiss, possibly of igneous origin, perhaps related to 2477.
2484	Quartz-Kaolinite Rock (Gneiss). Mainly shapeless masses of fine kaolinite, patches and angular fragments of stressed quartz.	Fabric is brecciated; kaolinite masses are deformed. No relict textures.	Fragments of coarse tremolite; apatite grains. Sericite patches.	Presence of tremolite suggests metasedimentary rock, but origin is obscured by kaolinisation.
2486 (T.S. 4351)	Quartz-Kaolinite Gneiss. Dominantly fine, semi-schistose kaolinite, with embedded lenses and angular fragments of quartz.	Good preferred orientation, partly due to later shearing	Ultrafine leucoxene, rutile; sericite patches.	Featureless rock, possibly related to 2484; origin not known, thought to be metasedimentary.

REPORT CMS 80/12/44

Rock Samples 80/1455 - 80/1468

Fourteen rock samples were received for thin-section preparation and petrological examination; each rock is briefly described in the accompanying table.

Summary

All the rocks are metamorphic and most are believed to be metasediments, with a few meta-igneous rocks. Most are fairly featureless, especially in terms of composition, which makes it difficult to precisely define their metamorphic facies, because of the lack of metamorphic indicator minerals; it is believed that they can be assigned to the upper greenschist to amphibolite facies of regional metamorphism. Several show two phases of metamorphism, the first regional and the second essentially dynamic, ranging from strain effects in mineral components, through mild shearing to intense crushing and even mylonisation (1457, 1461) in the strict sense.

The two meta-igneous rocks are 1457 and 1468; 1460 and 1461 may also be igneous, based mainly on the absence of detrital heavy minerals and therefore not reliable. 1457 is not definitely igneous and in such rocks the petrological evidence alone is insufficient. Thus, the only definitely igneous rock is 1468, a metadiorite formed by contact-metamorphism and thus out of context with all the other rocks, clearly younger (i.e. unaffected by regional or dynamic metamorphism).

Sample 1467 was found to have very low radioactivity and no discreet U/Th minerals were identified; their distribution may be erratic and more detailed investigations could be carried out if warranted.

SAMPLE NO.	ROCK TYPE - COMPOSITION	FABRIC	MINOR MINERALS	COMMENTS
1455 (I.G. 55504) MUL 3	Quartz-Feldspar Gneiss. Poikiloblastic, ragged crystals of orthoclase-microperthite; patches of stressed granular quartz; fine mosaics of oligoclase.	Medium to coarse gneissic fabric; uniform. All minerals stressed.	Shreds of biotite throughout; leucoxenised opaques. Rounded metamict zircon.	Simple composition, featureless rock; upper greenschist/lower amphibolite facies, believed of sedimentary origin.
1456 MUL 2	Quartz-Feldspar-Biotite Microgneiss. Medium grained interlocking oligoclase, orthoclase and quartz; thin bands of fine biotite flakes.	Fairly even-grained; faint compositional banding.	Rounded zircon and rutile grains.	Featureless metasediment, probably upper greenschist facies but lacking indicator minerals.
1457 MUL 4	Crushed ?Granite. Originally coarse quartz and K-feldspar, now highly stressed, brecciated; finely crushed, mylonitised in zones.	Thoroughly dynamically metamorphosed. Induced twinning in feldspar.	Patches of fine sericite and chlorite veinlets.	Nature of original rock unknown, because of strong crushing; could have been pegmatite, granite or gneiss.
1458 MUL 6	Quartz-Feldspar-Mica Gneiss. Patchy oligoclase quartz, K-feldspar, fine to coarse; biotite- and muscovite-rich patches intergrown with quartz.	Confused, chaotic fabric. Minerals weakly stressed.	Small detrital metamict zircon, ?monazite, ?brannerite. Magnetite.	Rock may be metamorphosed conglomerate or hybrid rock with metamorphosed xenoliths.
1459 MUL 5	Garnet-Biotite Gneiss. Scattered subhedral garnets in quartz-oligoclase mosaic, coarse orthoclase; bands of coarse biotite flakes, marginally recrystallized.	Good coarse gneissic fabric; marked biotite banding. Stressed textures.	Pleochroic haloes in biotite around minute inclusions. Trace pyrite.	Upper greenschist/lower amphibolite facies metasediment, with later weak stress, but no retrogression.
1460 MUL 7	Quartz-Oligoclase-Biotite Gneiss. Subhedral to rounded, partly argillised oligoclase, interstitial subparallel degraded biotite flakes; clear quartz patches.	Coarsely granular rather than typically gneissic fabric. Medium/coarse.	Leucoxene. Oxidised magnetite. Orthoclase patches. Appatite, tourmaline.	Strongly feldspathic rock. Could be of igneous origin, in which case it was a granodiorite.
1461 MUL 9	Crushed Quartz-Feldspar Gneiss. Fine and coarse splinters, jagged fragments of quartz, oligoclase and orthoclase in fine, partly recrystallized matrix.	Fine breccia fabric, strongly stressed, with shear zones.	Quartz veins with fine hematite. Fe-staining.	A well defined crush breccia, not far removed from a mylonite; could be related to 1457.
1462 MUL 10	Quartz-Feldspar Gneiss. Mostly medium to coarse-grained, stressed, interlocking oligoclase and quartz; minor orthoclase, biotite, fibrous actinolite.	Good gneissic fabric, weak compositional banding; stressed.	Rounded apatite, zircon. Granular magnetite.	Amphibolite facies gneiss of sedimentary origin; later stress, but no retrograde metamorphism.
1463 MUL 8	Sheared Microgneiss. Small, stressed, angular grains of quartz, orthoclase, albite, in a streaky matrix of the same minerals; a few coarser lenses.	Strong preferred orientation due to recrystallization/shearing. Medium/fine grained.	None, except for thin goethite films, streaks.	Not unlike 1461, but less severely crushed. Simple, featureless composition, probably metasedimentary.

SAMPLE NO.	ROCK TYPE - COMPOSITION	FABRIC	MINOR MINERALS	COMMENTS
1464 MUL 11	Sheared Gneiss. Interlocking large and small, stressed grains of orthoclase-microcline, oligoclase, quartz; microgranular matrix of the same minerals.	Gneissic fabric modified by shearing, some recrystallization.	Rounded zircon. Small sporadic biotite flakes. Magnetite (trace).	Clear evidence of granulation, partial recrystallization; originally coarser sedimentary origin.
1465 MUL 12	Garnet-Biotite Gneiss. Large garnets, partly replaced by green biotite; in pods with brown biotite: coarse, stressed, interlocking orthoclase, oligoclase, quartz.	Very coarse gneissic fabric, stressed minerals; fractured garnet.	Conspicuous rounded apatite and zircon, granular magnetite. Muscovite.	Minor retrograde metamorphism of garnet; amphibolite-facies metasediment.
1466 MUL 13	Garnet-Biotite Gneiss. Bands or lenses of coarse garnet-quartz-microcline, and of finer garnet-biotite-microcline-oligoclase-quartz.	Garnite porphyroblasts up to 10mm; large-scale banding, contrasting grain sizes	Small, well-rounded zircons. Partly leucoxenised magnetite.	Amphibolite-facies metasediment, very coarse and well-defined. Fresh, only very weakly stressed.
1467 MUL 14 93.2m	Sheared Sillimanite Gneiss. Small and large lenses, patches or matted sillimanite needles; granulated quartz, oligoclase and orthoclase. Biotite flakes.	Gneissic fabric, superimposed shearing with change of orientation.	Siderite veins, with fine pyrite, cutting fabric. Magnetite in biotite.	No radioactive minerals as such detected and radioactivity very low (Geiger). Amphibolite-facies metasediment.
1468 (T.S. 35516) MUL 1	Metadiorite (Hornblende-Hornfels). Small patches of matted amphibole (hastingsite) needles, set in coarse andesine plates, marginally recrystallized.	Relict coarse, intrusive igneous fabric; superimposed hornfels textures.	Shreds of biotite; a few crystals of primary hornblende.	Contact-metamorphism of intermediate intrusive; medium-grade, little change in mineralogy.

MINERAL INVESTIGATORS REPORT 82/81 - R. TOWNEND

Petrographic description of seven cores (80/1484 - 80/1490) and the mineragraphic description of two cores (80/1484 - 80/1486).

INTRODUCTION

Two polished sections were made in addition to the requested thin sections, for 80/1484 because of the interest in radioactivity and for 80/1486, because of the considerable opaque content.

The C.S.I.R.O. scanning electron microscope was used to check for radioactive elements in the polished section of 80/1484.

This SEM operates under back scattered electron/low vacuum conditions and is excellent for rapid appraisal of high atomic number element distributions, in a semi-quantitative approach. It is recommended for routine checking of radioactive samples. The more sophisticated electron probe microanalyser is only necessary when accurate spot analyses are required.

80/1484 MUL 14 117.35m

Macroscopic
A grey green ? basic schist in which an intense veining of carbonate etc. parallel to this fabric tends to obscure the primary texture.

Microscopic (One thin and polished section)
Anthophyllite biotite plagioclase quartz schist

Primary 60%		Secondary 40%
Anthophyllite	70%	Talc
Biotite	10%	Sericite
Plagioclase	10%	Chlorite
Quartz	5%	Vein
Apatite	Trace	Siderite
Rutile	1%	
Ilmenite	1%	
Pyrite	-1%	
Chalcopyrite	-1%	
Graphite	-1%	

The section is dominated by orientation of the colourless orhtoamphibole fibrous laths, which often exceed a millimetre in length. The granular feldspar, plus quartz tend to have a limited distribution leaving extensive areas to be dominated by the amphibole and accompanying biotite and a resulting strong lineation. Both minerals are extensively altered, the amphibole to talc and the biotite less so, to chlorite.

This regular texture is very much interrupted by a network of fine iron carbonate veins running parallel to it, or at high angles. The biotite is particularly associated with fine rutile and opaques. The calcic plagioclase, showing partial sericitization occurs as a single equant 0.1 - 0.2mm grains scattered through this fabric, or in millimetre felsic clusters, with minor quartz.

Rutile is sporadically distributed in 0.5mm well crystallized composites but is most common as fine associations with relict ilmenite, and secondary leucoxene. Pyrite is present in semi-skeletal aggregates, or in the carbonate veins, where it may be quite extensive, with a marked zoning. This takes the form of a clear medium zone and a darker mottled rim, which may include marcasite.

There is an irregular dissemination of low reflectively micaceous opaque forming semispherulitic clusters up to 30 microns across, identified as 'graphite'.

The C.S.I.R.O. electron scanner was used to look for concentrations of uranium or thorium, without success.

The scanner did locate several spots high in lead (? radiogenic). Galena was not seen in polished section and it is not possible to confirm sulphur in the presence of lead because of an overlap of x-ray peaks.

This analysis also found a trace of sphalerite and a cobalt nickel arsenic sulphide.

80/1485 MUL 15 85.2m

Macroscopic
Well banded biotite quartz-feldspathic gneiss, lacking a schistocity in the mica layers.

Microscopic (One thin section)
Quartz biotite muscovite plagioclase gneiss

Quartz	50%
Biotite	20%
Muscovite	15%
Plagioclase	10%
Sillimanite)	5%
Zircon)	
Opaques)	

A well banded gneissose rock in which there is a marked oriented fabric at approximately right angles to this banding. This is partially reflected by the micas, but also by the quartz which is slightly elongated across the banding but its strain extinction bands are particularly developed in this direction. This 'new'quartz may have produced the very irregular sutured contacts. The plagioclase appears to be 'old', usually clouded by sericite spotting, with a composition in the oligoclase-andesine range.

The micas, the yellow to orange brown pleochroic biotite and the muscovite, form rather irregular associations, bunches of poorly oriented 0.2mm average long dimension flakes. Directly associated with the biotite are clusters of very fine colourless needles of a mineral considered to be sillimanite.

The rounded zircons, when included in mica, produce a marked halo. The rocks regional metamorphic grade has reached amphibolite as shown by the development of sillimanite but it has clearly undergone a polymetamorphic history. Compositionally, it seems to be of sedimentary origin.

<u>80/1486</u> MUL 15 115.2m

<u>Macroscopic</u>
Fine grained granulite textured basic rock, containing disseminated sulphides.

<u>Microscopic</u> (One thin and polished section)
Clinopyroxene - plagioclase - garnet - amphibole granolite

<u>Prograde</u> 95%		<u>Retrograde</u> 5%
Clinopyroxene	40 - 45%	Hornblende (gn)
Plagioclase	40 - 45%	
Garnet	5%	
Hornblende (bn)	2%	
Quartz	- 1%	
Apatite	- 1%	
Ilmenite Pyrite Chalcopyrite Pyrrhotite Marcasite	5%	

This high grade metamorphic assemblage can be defined as a granolite, in the sense of Winkler (Petrogenesis of Metamorphic Rocks. 3rd Edition). It has a granoblastic inequigranular texture, with clinopyroxene (Diopside ser.) and plagioclase (andesine) tending to form monomineralic polygonal clusters with grain sizes varying between 0.1 and 0.5mm. Locally coarse garnet (? almandine) or brown hornblende may be intergrown with the pyroxene. These ferromagnesium associations are rimmed by green hornblende, clearly representing an incipient hydrous retrogressive metamorphism.

The plagioclase is well twinned, the twin lamellae often 'veeing' and also curving, typical of high grade metamorphic rocks.

The principal opaques are ilmenite and pyrite. The ilmenite is evenly disseminated in rather irregular single grains or clusters, averaging about 0.1mm. Invariably it is surrounded by a rim of sphene, although internally it always appears fresh. The pyrite is present in several habits. Firstly, it appears as 'normal' fresh subhedral to anhedral grains, 0.1 - 0.2mm diameter, often containing inclusions of chalcopyrite, pyrrhotite and sometimes marcasite. Secondly, it is less commonly skeletal, or showing oxidation with a resulting oxidised 'semi-birdseye' appearance. This latter variety develops an incipient cleavage, indicating deviation from pyrrhotite.

<u>80/1487</u> MUL 16

<u>Macroscopic</u>
A granular medium grained amphibolitic rock.

<u>Microscopic</u> (one thin section)
Hornblende plagioclase orthopyroxene granolite

		<u>Retrograde</u>
Hornblende	~45%	Actinolite
Plagioclase	40%	Biotite
Orthopyroxene	10%	
Clinopyroxene	5%	
Opaques	- 1%	

This high grade metamorphic clearly has affinities with 80/1486. Its 'granolite' classification is shown by its orthopyroxene (? bronzite). This pyroxene together with a diopside is enclosed within a polygenal aggregate of hornblende, with a yellow to olive brown pleochroism, considered prograde. The pyroxenes have a relict coarser texture, to 0.5mm length, compared with the enveloping equidimensional 0.1 - 0.3mm amphibole. As in 80/1486, the feldspar occurs in slightly lensoid aggregates, of similar texture to the amphibole, broad twinning and smooth grain boundaries. There is some minor retrogressive reaction, producing green semi-fibrous actinolite and biotite.

The opaques, which include sulphides and non-magnetic oxides, may occur in fine concentrations within the pyroxenes or are in coarser euhedra (0.2mm) in hornblende (? ilmenite).

The composition of the rock, as with 80/1486 is basic.

<u>80/1488</u> MUL 17

<u>Macroscopic</u>
A strongly foliated feldspathic gneiss, white plagioclase exceeding pink K feldspar and clear quartz lenses.

<u>Microscopic</u> (One thin section)
Plagioclase quartz K feldspar gneiss

Plagioclase	35 - 45%	<u>Secondary</u>
Quartz	30 - 40%	Sericite
Microcline-Perthite	30 - 40%	(Titania
Biotite	2%	(Rutile
Muscovite	- 1%	
Zircon	Trace	
Opaques		

The texture is composed of three distinct elements porphyroblastic microcline 0.5 - 3mm, ribbons or lenses of quartz, strongly oriented and a fine grained polygenal textured plagioclase (0.1 - 0.2mm). The minor mafic components yellow biotite forms occasional oriented intergrowths within the plagioclase matrix; and is associated with secondary titanium oxides, including rutile, and relict ?ilmenite opaques. Some muscovite and sericite is associated with this biotite. Zircon is the only accessory as subeuhedral prisms to 0.15mm maximum lengths. The potash feldspar is coarsely perthitic, the smaller blasts have shapes, flat edges, dictated by the strong quartz lineation. The plagioclase, like the potash feldspar, quite fresh, is apparently oligoclase, twinning is poorly developed and the equant grains show little evidence of a preferred fabric.

The distinct ribbons or layers of quartz indicate that the rock has experienced considerable deformation. The grade of metamorphism is difficult to assess. If the muscovite is not prograde, then the gneiss could form part of a granulite or charnockite suite. The origin of these 'granitic' gneisses is always equivocal.

80/1489 MUL 18 0080

Macroscopic
A poorly foliated garnetiferous porphyroblastic quartzofeldspathic biotite gneiss.

Microscopic (One thin section)
Quartz feldspar garnet biotite sillimanite gneiss

K feldspar	35 - 40%	Secondary
Plagioclase	30 - 35%	Chlorite
Quartz	25 - 30%	
Biotite	3 - 5%	
Garnet	2 - 3%	
Sillimanite	1%	
Zircon	- 1%	
Andalusite	- 1%	

Microcline, oligoclase and quartz all form coarse grains and are the dominant element, the matrix being relatively subordinate. This dominance of 'blasts' results in a poor preferred fabric, only evidenced by the continuous biotite layers wrapped around the macrosilicates but following a modest orientation overall.

The centimetric garnet in section is irregular in outline, partly altered to chlorite etc. and contains a few rounded inclusions of quartz. Around its perimeter it appears to be breaking down to a mixture of mica and aluminium silicates. Stubby fibres of sillimanite are scattered irregularly through the biotite-rich zones and there is also the rare andalusite, in juxtaposition. Quartz is predominant as matrix to the foregoing, normally in medium to fine grained xenoblastic (0.1 - 0.2mm) mosaics with sutured contacts. Locally there is evidence of re-crystallization, particularly of quartz in the matrix, which becomes very fine and is the site of sillimanite concentrations.

The development of sillimanite shows that an upper amphibolite grade of metamorphism has been achieved, although this appears to be a late, possible retrograde event. Comments as genesis are as for the previous sample.

80/1490 Mul 19

Macroscopic

A quartz feldspar gneiss containing centimetric finely crystalline biotite - rich masses.

Microscopic (one thin section)

Host		"Inclusion"	
Plagioclase)	Major	Biotite)	Major
Quartz)		Quartz)	
Andalusite)	Minor	Plagioclase)	
Muscovite)		Zircon	Accessory
Biotite)			
K feldspar	Accessory		

The "host" rock consists of a porphyroblastic plagioclase (1 - 2mm) of rather irregular outline enclosed with a quartzite matrix. The quartz grains are extremely xenoblastic with corrugated contacts and in the slide show little preferred orientation. Also present are occasional euhedral andalusites, up to a millimetre in length and invariably partly replaced by an enveloping muscovite.

Strongly coloured biotite is also associated with these latter and may be porphyroblastic. Minor myrmekitic textures are seen with K feldspar and quartz.

Biotite is the principal mineral of the "inclusions", in fine grained (50 microns) non oriented intergrowths with quartz and ?untwinned plagioclase. This mica has a distinctly weaker pleochroic scheme than the biotite from the host.

There is evidence for the breakdown of the host fabric, with veining and incipient recrystallization of the plagioclase, probably correlated with the alteration of the andalusite. Perhaps some of the quartz is secondary.

The fine biotite-rich associations do not represent recrystallized host and must be considered xenoliths, but meaningful interpretation of an obviously heterogeneous rock like this is only possible with a knowledge of the environment.

APPENDIX 3

Rock Analyses

	METADIORITE MUL 1	GNEISS MUL 2	GNEISS MUL 3	CRUSHED GRANITE MUL 4	GNEISS MUL 5	GNEISS MUL 6	GNEISS MUL 7	SHEARED GNEISS MUL 8	CRUSHED GNEISS MUL 9	GNEISS MUL 10	SHEARED GNEISS MUL 11	GNEISS MUL 12	GNEISS MUL 13	SHEARED GNEISS MUL 14 93.2m
SiO_2	52.1	75.0	66.5	76.2	61.1	70.1	59.6	77.3	74.6	63.1	69.8	56.9	66.0	54.4
TiO_2	0.09	0.20	0.23	0.11	1.31	0.45	1.26	0.08	0.17	1.75	0.17	1.79	0.56	0.43
Al_2O_3	25.9	14.5	12.0	11.9	15.0	16.2	16.4	12.1	13.3	13.9	17.0	16.4	12.4	18.0
Total Fe	4.9	1.98	11.1	0.94	9.90	9.67	9.2	1.17	1.90	9.34	2.51	11.7	14.6	10.7
MnO	0.06	0.01	0.06	<0.01	0.04	0.03	0.07	<0.01	<0.01	0.15	0.01	0.13	0.11	0.11
MgO	3.13	0.45	0.12	0.27	4.23	1.00	2.3	0.08	0.26	3.1	0.54	3.23	2.60	3.1
CaO	9.78	2.00	0.48	0.08	1.33	2.18	1.05	0.15	0.12	3.01	1.72	3.2	0.79	5.97
Na_2O	3.10	4.38	2.9	0.40	2.43	3.44	3.98	3.64	3.1	3.57	4.99	2.9	0.80	3.64
K_2O	0.09	0.93	4.1	8.53	3.72	1.26	2.40	5.09	5.37	0.49	2.44	2.58	2.02	1.5
P_2O_5	0.06	0.04	0.18	0.05	0.13	0.08	0.42	0.03	0.06	0.3	0.04	0.44	0.07	0.23
LOI	0.65	0.54	2.74	1.54	0.77	1.66	3.3	0.37	1.11	1.29	0.83	0.73	0.09	1.97

MUL 1 - 14 ACS Combined gravimetry, AAS and XRF
MUL 14 - 19 ANALABS XRF

	SCHIST MUL 14 117.35m	GNEISS MUL 15 85.2m	GRANULITE MUL 15 115.2m	AMPHIBOITE MUL 16	GNEISS MUL 17	GNEISS MUL 18	GNEISS MUL 19
SiO_2	51.6	69.3	49.4	49.8	72.6	71.7	69.5
TiO_2	0.75	0.60	2.40	1.35	0.26	0.12	0.5
Al_2O_3	13.4	15.2	13.3	10.7	14.9	15.4	15.7
Fe	11.6	3.95	12.6	15.2	0.67	2.75	3.25
MnO	0.26	0.06	0.4	0.24	0.04	0.05	0.05
MgO	12.2	2.5	5.5	10.4	0.6	1.6	2.2
CaO	3.3	0.7	13.1	9.1	1.6	1.35	1.8
Na_2O	1.07	1.49	1.76	1.97	2.73	3.31	2.64
K_2O	2.15	3.95	0.5	0.6	4.25	3.6	2.5
P_2O_5	0.09	0.02	0.18	0.38	0.02	0.02	0.02

Appendix [illegible]

Sample Description	U U ppm	Th Th ppm	Ba Ba ppm	Sr Sr ppm	V V ppm	Y Y ppm	Sn Sn ppm	Mo ppm	As ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni Ni ppm	Co Co ppm	Cr Cr ppm
MUL 1 1	0.20	< 5	50	30	20	< 10	< 1	< 3	< 5	15	< 10	30	< 2	80	< 10	130
2	0.10	10	300	50	< 10	< 10	< 1	< 3	< 5	100	< 10	30	< 2	< 10	< 10	50
3 3	0.25	20	300	100	10	30	3	< 3	10	290	50	50	< 2	< 10	< 10	50
4	0.45	10	1000	30	< 10	< 10	< 1	< 3	< 5	85	< 10	25	< 2	< 10	< 10	50
5 5	0.32	< 5	300	30	50	< 10	3	3	10	40	< 10	100	< 2	100	10	280
6	< 0.05	< 5	300	30	10	< 10	3	< 3	< 5	70	< 10	45	< 2	30	< 10	130
7 7	< 0.05	5	300	10	50	< 10	3	3	< 5	35	< 10	65	< 2	< 10	< 10	50
8	3.20	60	100	30	< 10	< 10	< 1	< 3	< 5	30	< 10	35	< 2	< 10	< 10	30
9 9	0.18	10	1000	30	< 10	< 10	< 1	< 3	< 5	65	< 10	15	< 2	< 10	< 10	60
10	< 0.05	< 5	300	30	50	< 10	3	3	10	30	< 10	60	< 2	50	< 10	110
11	< 0.05	< 5	1000	30	< 10	10	3	< 3	40	60	< 10	40	< 2	25	< 10	40
12	0.88	< 5	1000	30	100	< 10	< 1	10	< 5	55	< 10	110	< 2	60	15	150
13 13	1.02	< 5	500	50	50	< 10	3	10	10	45	< 10	40	< 2	75	< 10	190
14 [illegible]m	4.00	260	1000	50	50	30	3	3	< 5	50	25	50	< 2	170	< 10	640
14 117.35m	1.0	x	730	340	220	9	4	x	20	40	20	125	x	285	65	1450
15 35.2m	3.8	15	850	180	100	7	x	x	x	15	20	70	0.5	65	30	250
15 115.2m	1.5	4	180	250	250	35	x	x	5	180	30	155	x	65	65	80
16	1.5	6	150	320	240	35	x	x	5	125	30	130	x	355	95	840
17	2.2	6	1350	420	10	x	x	x	x	15	30	20	x	20	20	120
18	1.2	35	770	260	70	10	x	x	5	40	35	70	x	60	30	210
MUL 19	1.8	10	1150	390	110	x	3	x	x	25	25	65	x	45	30	210

ACS Batch No: A1795 (O/N 5594) MUL 1 - 14 Cr(10), Th(5), XRF Ba(30), Mo(3), Sn(1), Sr(30), V(1), Y(10), Emission Spect. Ag(2), Co(5), Cu(5), Ni(10), Pb(20), U(1), Zn(5), AAS, AS, Gutzeit

ANALABS (O/N 5625) MUL 14 - 19 Ag(5), Co(5), Cu(5), Ni(5), Pb(5), U(1), Zn(5), AAS. AS(3), Ba(20),Cr(5), Mo(5), Sn(3), Sr(5), Th(4), V(5), Y(4), XRF

Appendix 3

U ppm	Th ppm	Ba ppm	Sr ppm	V ppm	Y ppm	Sn ppm	Mo ppm	As ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	Co ppm	Cr ppm	Ce ppm	La ppm	Nb ppm	Zr ppm	Au ppm	Ti ppm	[illegible]	[illegible]
0.455	10	200	30	< 10	< 10	< 1	< 3	< 5	10	< 10	10	< 2	10	< 10	110	40	20	5	150	< 3			
0.060	10	400	< 30	< 10	< 10	< 1	< 3	< 5	< 10	< 10	100	2	10	< 10	80	< 20	30	20	400	< 3			
0.055	5	500	< 30	10	< 10	< 1	< 3	10	10	< 10	10	< 2	15	< 10	300	30	30	10	265	< 3			
0.138	< 5	500	< 30	< 10	< 10	1	3	< 5	15	10	15	2	< 10	< 10	145	30	40	< 5	215	< 3			
0.120	20	1000	30	100	< 10	5	< 3	30	110	50	140	< 2	25	10	430	20	40	5	200	< 3			
0.13	10	1000	< 30	20	< 10	< 1	< 3		25	15	25	< 2	20	10	285	50	30	< 5	305		2000		
0.017	5	500	< 30	< 10	< 10	< 1	< 3		65	< 10	25	< 2	30	10	530	20	30	< 5	200		500		
.100	30	500	< 30	100	10	< 1	< 3		20	10	75	< 2	40	10	525	30	20	10	320		2000		
0.001	10	500	< 30	< 10	< 10	< 1	< 3		< 10	< 10	15	< 2	30	< 10	265	20	50	10	225		1000		
0.002	[illegible]	500	< 30	< 10	< 10	< 1	< 3		10	< 10	< 10	< 2	< 30	< 10	295	20	10	< 5	275		300		
.02	50	1000	< 30	10	< 10	< 1	< 3		10	< 10	< 10	< 2	< 10	< 10	490	100	70	15	190		200		
0.002	40	1000	30	< 10	< 10	< 1	< 3		10	< 10	10	< 2	30	< 10	1260	60	110	30	350		300		
0.025	10	400	< 30	< 10	< 10	< 1	< 3		< 10	< 10	< 10	< 2	< 10	15	340	50	50	5	265		100		
	[illegible]	< 30	30	< 10	< 10	< 1	< 3	< 50	50		200	< 0.1	< 3	< 5	< 20		< 100	< 20	< 100	< 3		< 1	30
30	1750 2880	50	50	< 10	55	30	< 3	< 50	30		300	< 0.1	< 3	< 5	< 20	1670	650	< 20	100	< 3		1	50
20	680	< 30	30	< 10	30	< 1	< 3	< 50	50		300	< 0.1	< 3	< 5	30		< 100	< 20	< 100	< 3		< 1	30
30	910	< 30	30	10	45	< 1	< 3	< 50	50		300	< 0.1	< 3	< 5	30	1650	800	< 20	100	< 3		< 1	30

	Cd ppm	Ga ppm	Ir ppm	Mn ppm	Nd ppm	Sb ppm	W ppm
1	< 3	1	< 2	20		< 30	< 50
2	< 3	1	< 2	300	400	< 30	< 50
[illegible]	< 3	< 1	< 2	200		< 30	< 50
[illegible]	< 3	< 1	< 2	100	460	< 30	< 50

.75 - 2687 U by Fluorimetry; Mo, V, Au, Sn, Ba, Sr, Ti, Y by emission spect.
Cu, Pb, Zn, Ag, Ni, Co by AAS; Th, Cr, Ce, La, Nb, Zr by XRF
[illegible] - 3682 Emission spect. Ce, Nd, La, Y by XRF

Appendix 3

	2475	2476	2477	2478	2479
SiO_2	70.36	88.21	70.55	68.61	61.39
TiO_2	0.34	0.13	0.73	0.3	0.63
Al_2O_3	12.92	5.63	16.55	16.01	13.03
Total Fe	1.99	1.06	1.88	2.23	15.49
MnO	<0.01	<0.01	<0.01	<0.01	<0.01
MgO	0.25	0.08	0.11	0.23	0.24
CaO	3.44	0.97	0.53	2.23	0.53
Na_2O	0.33	0.16	0.28	0.15	0.16
K_2O	0.22	0.97	0.18	1.18	0.39
P_2O_5	0.02	0.02	0.02	0.05	0.01
LOI	10.13	3.27	9.17	9.00	8.13

ACS: Na, Mg by AAS rest by XRF

APPENDIX 4

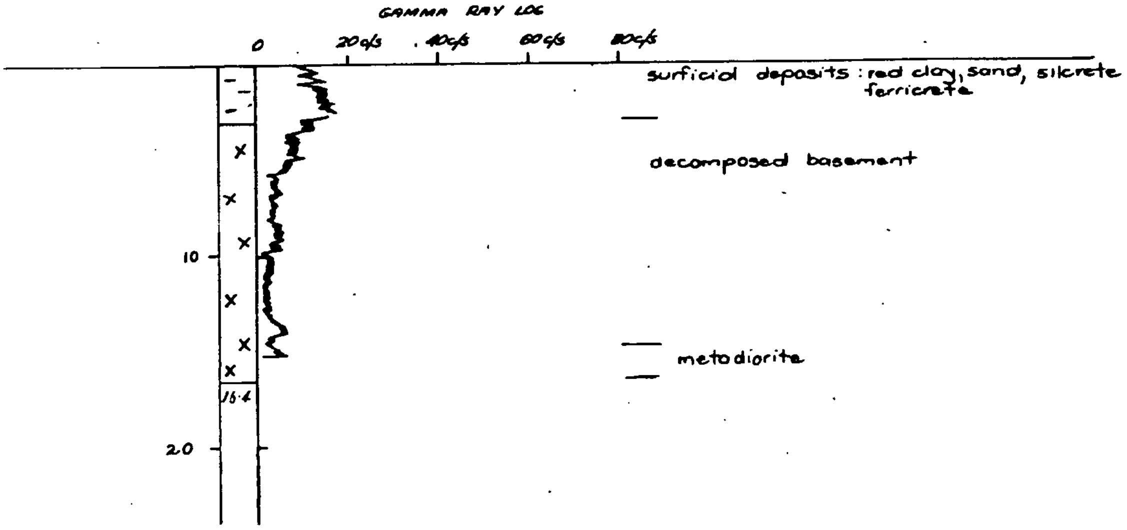
Water Analyses

APPENDIX 4

Sample Description	U ppb	SO_4ppm	As ppb	Cu ppb	Co ppb	Zu ppb
Charcott 1183	6	282	<10	12	<5	2500
No 62 4	65	267	<10	40	<5	250
Snake Rocks 5	30	200	<10	30	<5	350
Dingo Well 6	<5	18	<10	58	<5	250
Muckanippie 7	<5	118	<10	10	<5	240
Nardoo Well 8	38	552	<10	13	<5	950
Bunyip 9	26	854	<10	8	<5	100
No 30 90	53	595	<10	20	<5	270
Top 1	45	877	<10	18	<5	950
Neverfail 2	<5	618	<10	6	<5	420
Irria 3	14	167	<10	38	<5	625
West Well 4	18	125	<10	21	<5	100
Victory 5	<5	30	<10	30	<5	550
Homestead 6	26	55	<10	5	<5	100
Homestead 7	18	57	<10	5	<5	100
Mailgate 1198	14	887	<10	125	<5	1600

NALYTICAL METHODS: SO_4 determined by Gravimetry. U by Fluorimetry. Cu,Co, Zn by Solvent Ext/ASS.
As by modified Gutzeit method.

MUL 1.

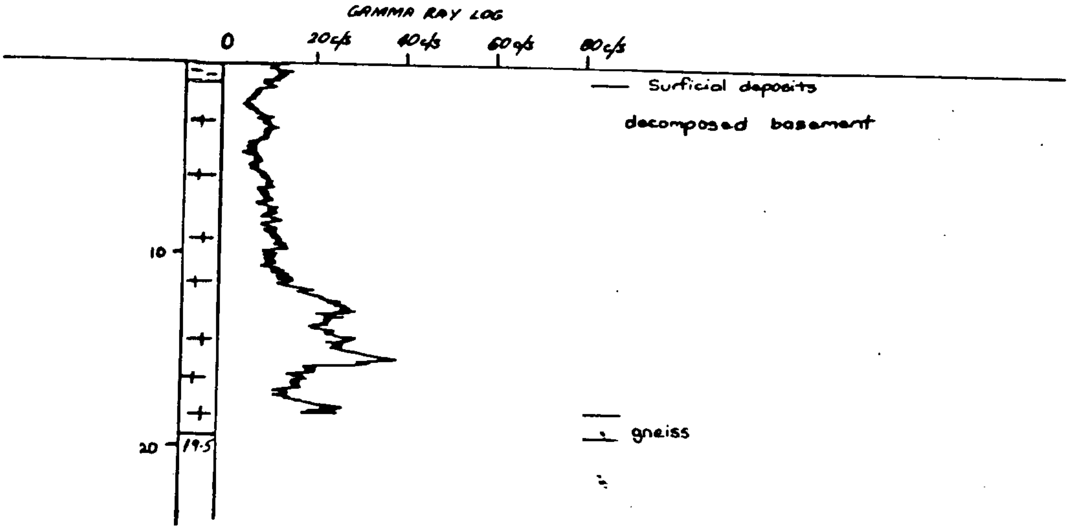


To Accompany Report WY. 81.3.

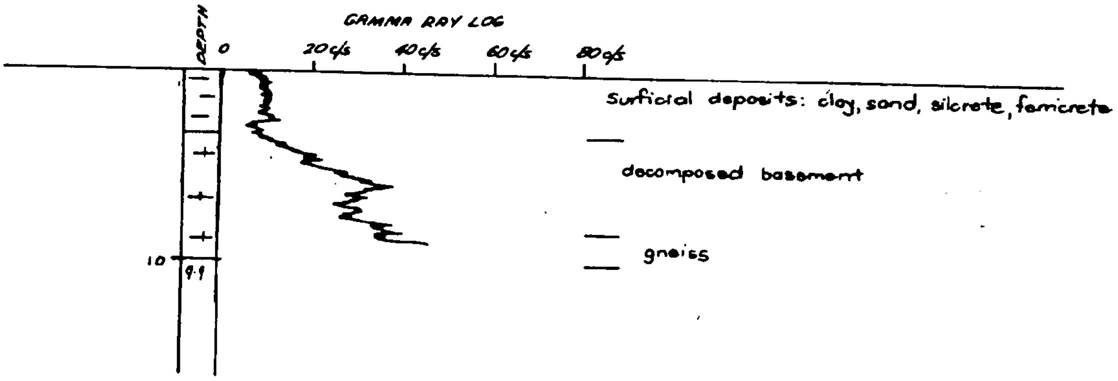
Plate : 2

DRAWN G.R.S.	**AFMECO PTY. LTD.**	
DATE NOV. '80	**SCALE**	1 : 400 (1cm = 4 m)
GEOLOGY G.R.S.	MULGATHING - S.AUST.	
APPROVED		
DWG. No. SH53-10.124.3524.	DRILL HOLE LOG - MUL 1	
REV. No.		

MUL 2.



MUL 3.



To Accompany Report WY.81.3.

Plate : 3

DRAWN G.R.S.
DATE NOV. '80
GEOLOGY G.R.S.
APPROVED
DWG. No. SH53-10.124.3525
REV. No.

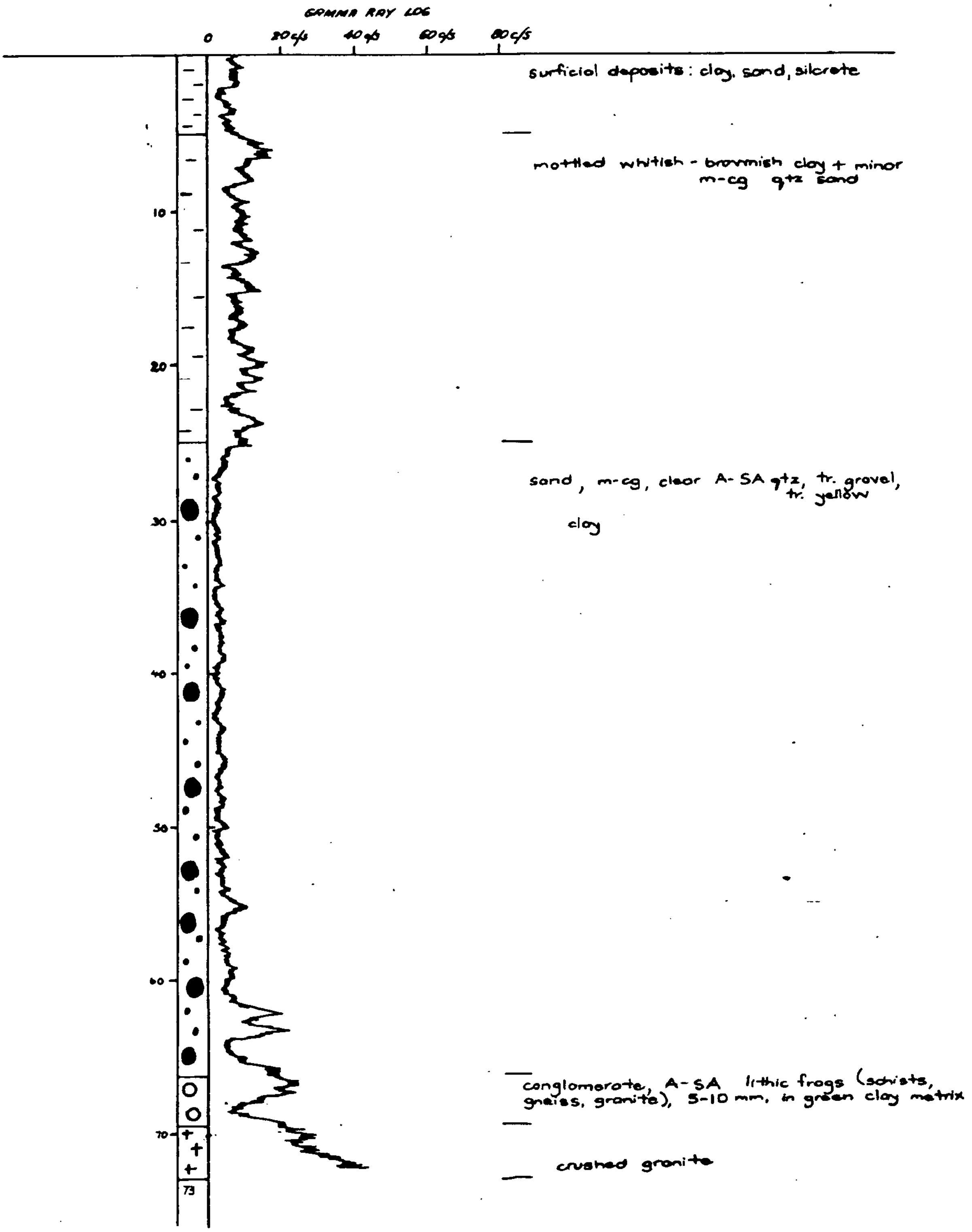
AFMECO PTY. LTD.

SCALE 1:400 (1cm = 4m)

MULGATHING - S.AUST.

DRILL HOLE LOGS - MUL 2 & 3

MUL 4.



To Accompany Report WY.81.3.

Plate : 4

DRAWN G.R.S.
DATE NOV '80
GEOLOGY G.R.S.
APPROVED
DWG. No. SH53-10.124.3526.
REV. No.

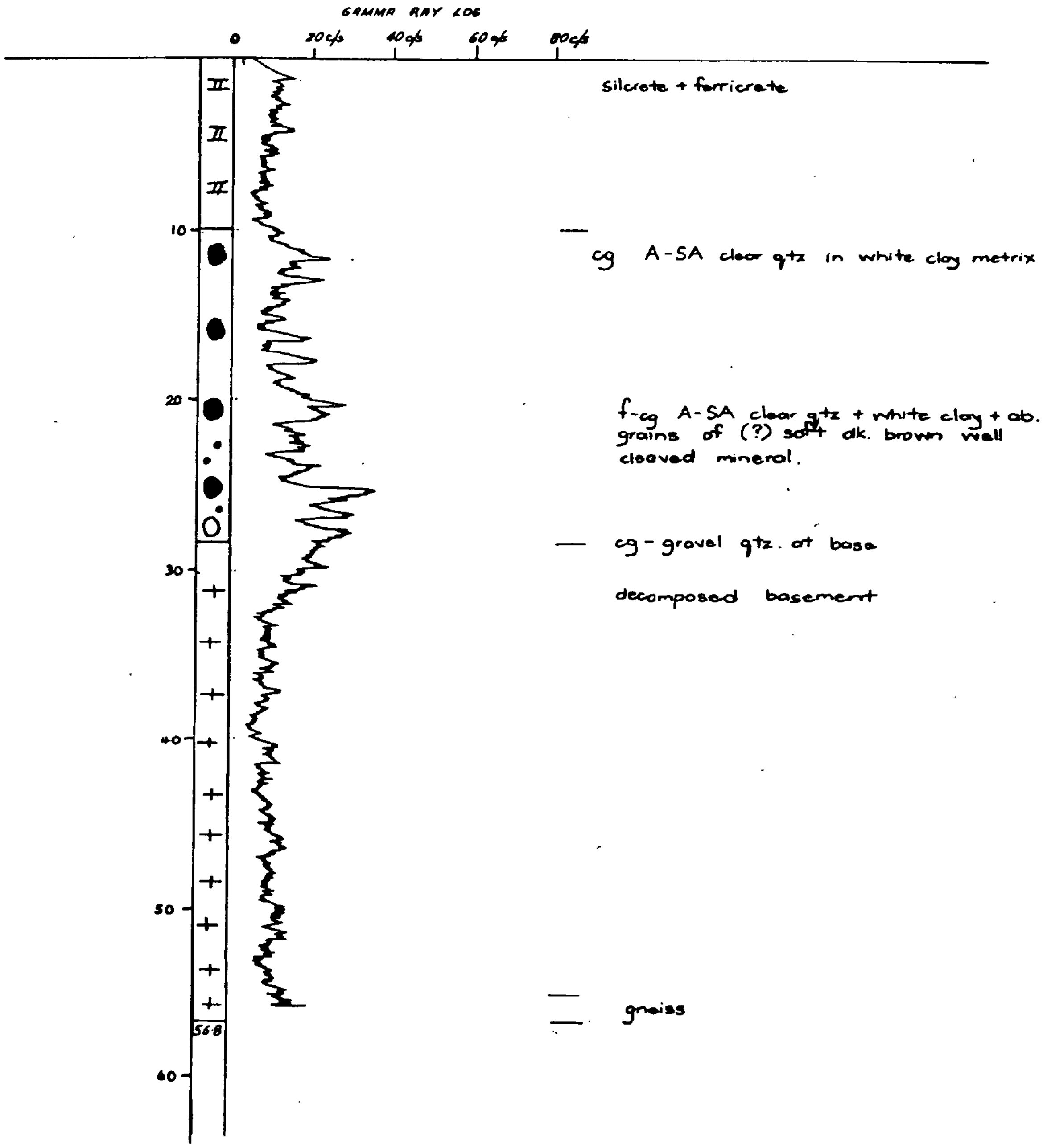
AFMECO PTY. LTD.

SCALE 1: 400 (1cm = 4 m)

MULGATHING - S.AUST.

DRILL HOLE LOG - MUL 4

MUL 5.



To Accompany Report WY. 81.3. *Plate: 5*

DRAWN G.R.S.
DATE NOV '80
GEOLOGY G.R.S.
APPROVED
DWG NO SH53-10.124.3527.
REV NO

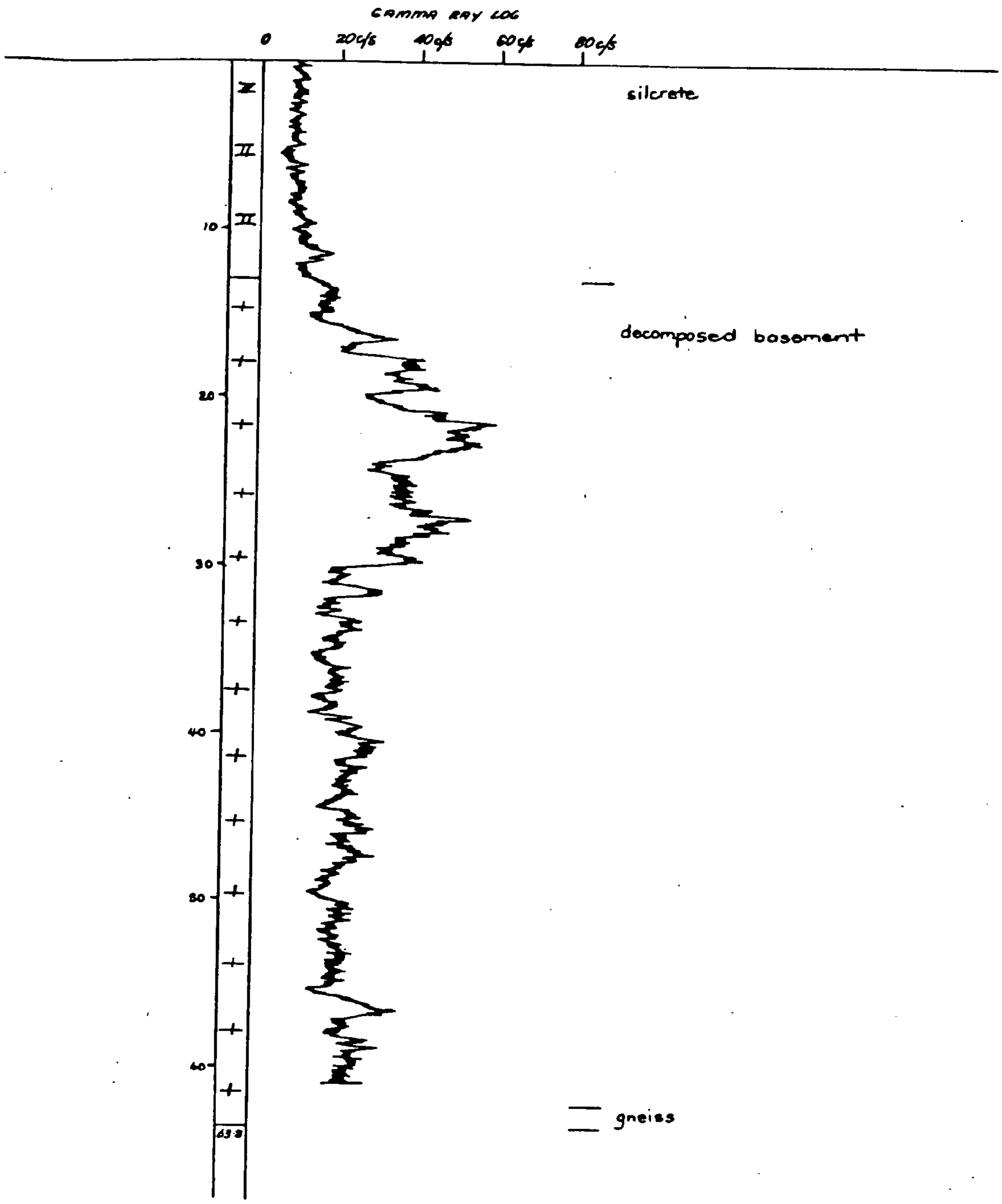
AFMECO PTY. LTD.

SCALE 1 : 400 (1cm = 4m)

MULGATHING - S. AUST.

DRILL HOLE LOG - MUL 5

MUL 6.



To Accompany Report WY. 81.3.

Plate : 6

DRAWN
G.R.S.
DATE
NOV '80
GEOLOGY
G.R.S.
APPROVED
DWG. No.
SH53-10.124.3528.
REV. No.

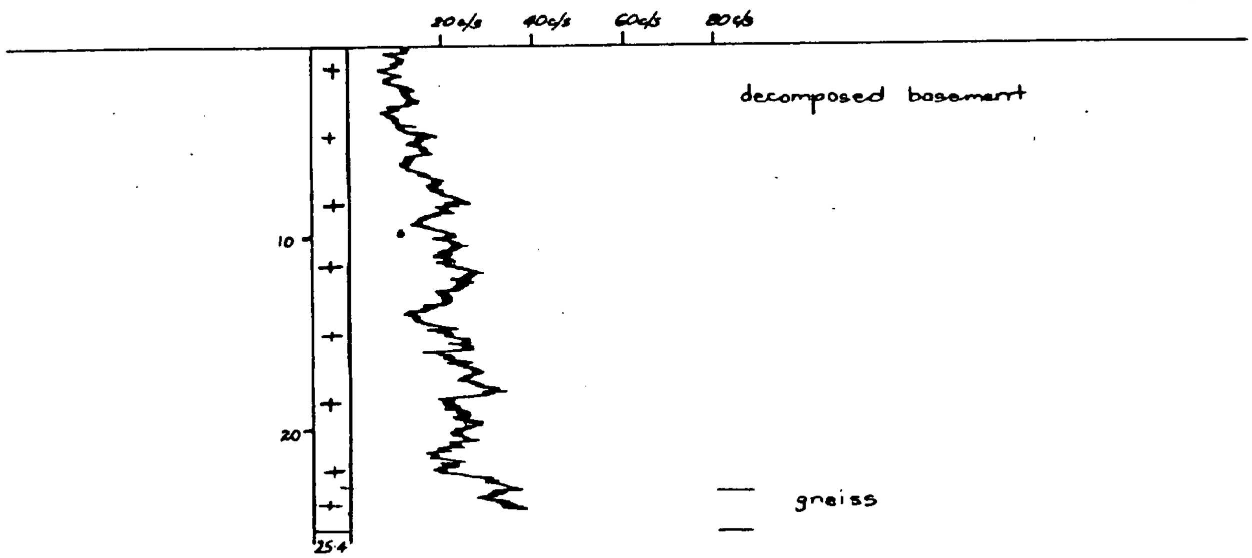
AFMECO PTY. LTD.

SCALE
1:400 (1cm = 4 m)

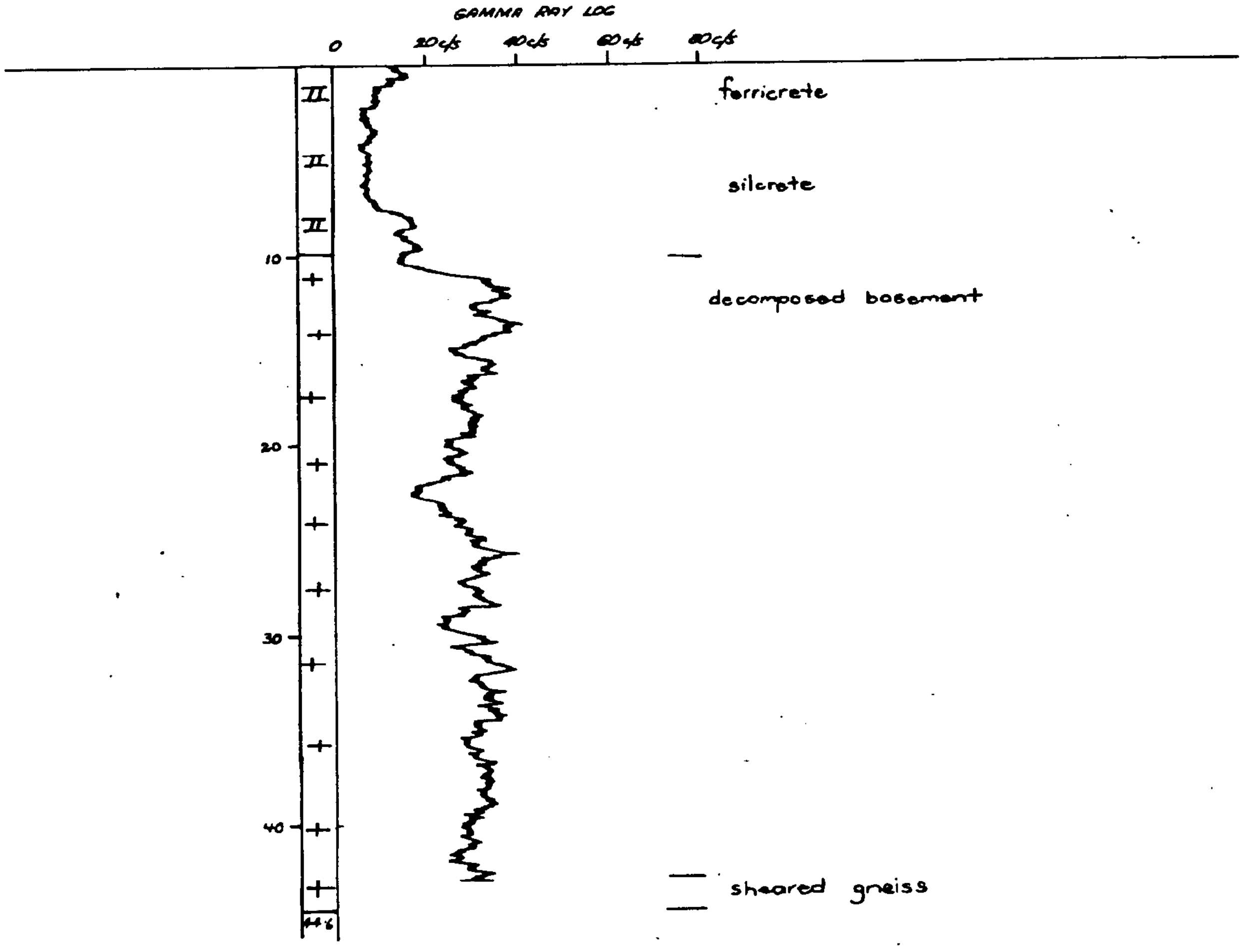
MULGATHING - S.AUST.

DRILL HOLE LOG - MUL 6

MUL 7.



MUL 8.



To Accompany Report WY.81.3.

Plate : 7

DRAWN G.R.S.
DATE NOV '80
GEOLOGY G.R.S.
APPROVED
DWG. NO. SH53-10.124.3529
REV. NO.

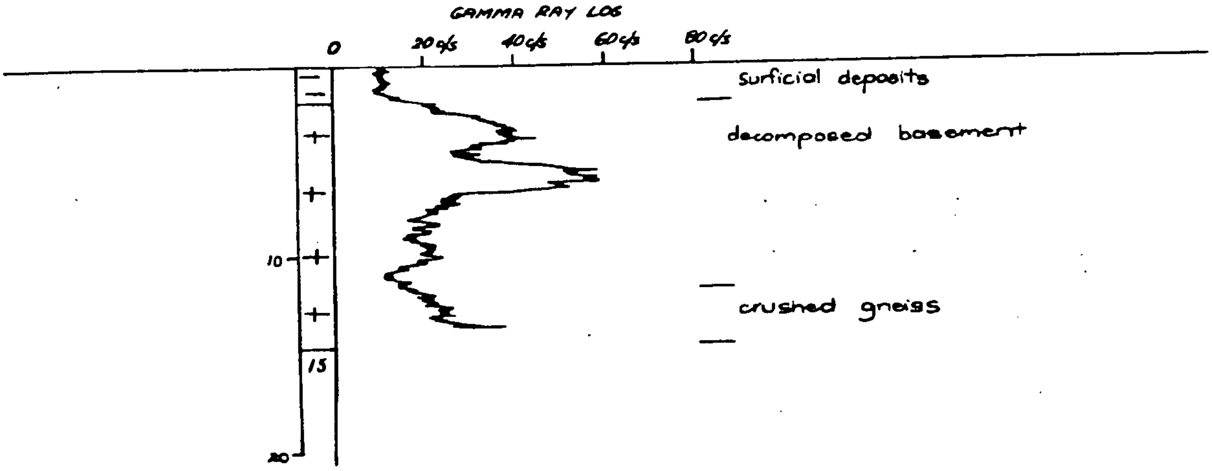
AFMECO PTY. LTD.

SCALE 1:400 (1cm = 4m)

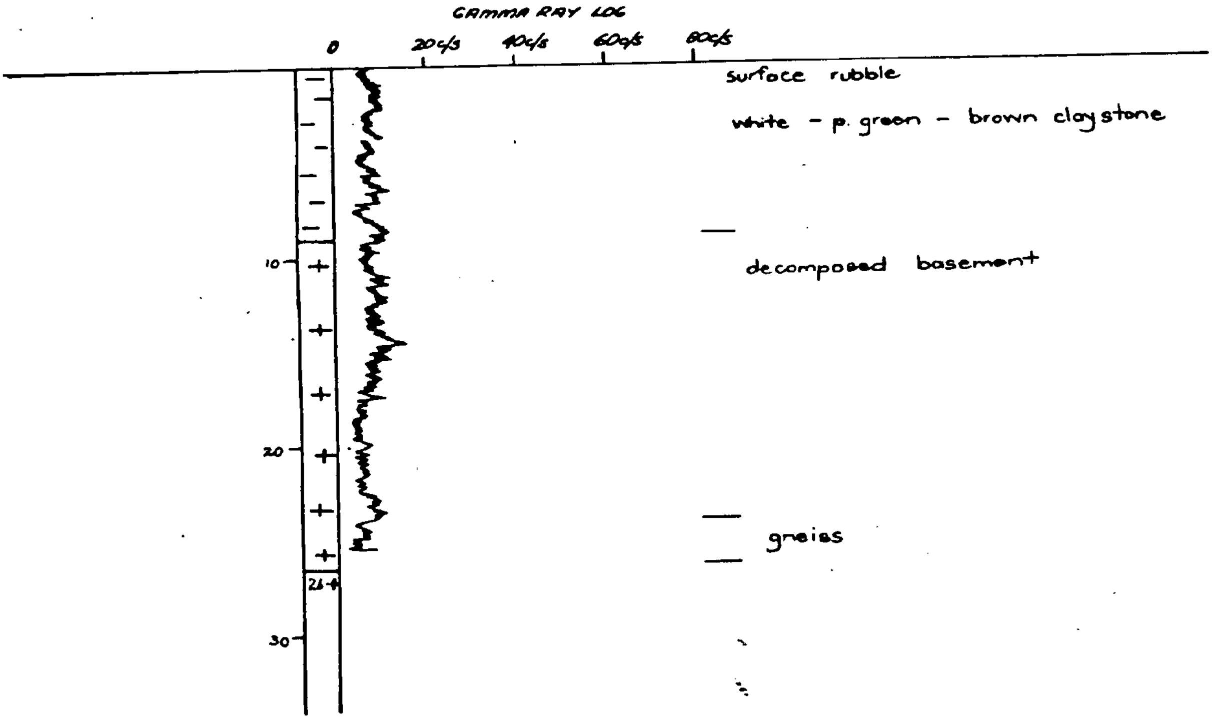
MULGATHING - S.AUST.

DRILL HOLE LOGS - MUL 7 & 8

MUL 9.



MUL 10.

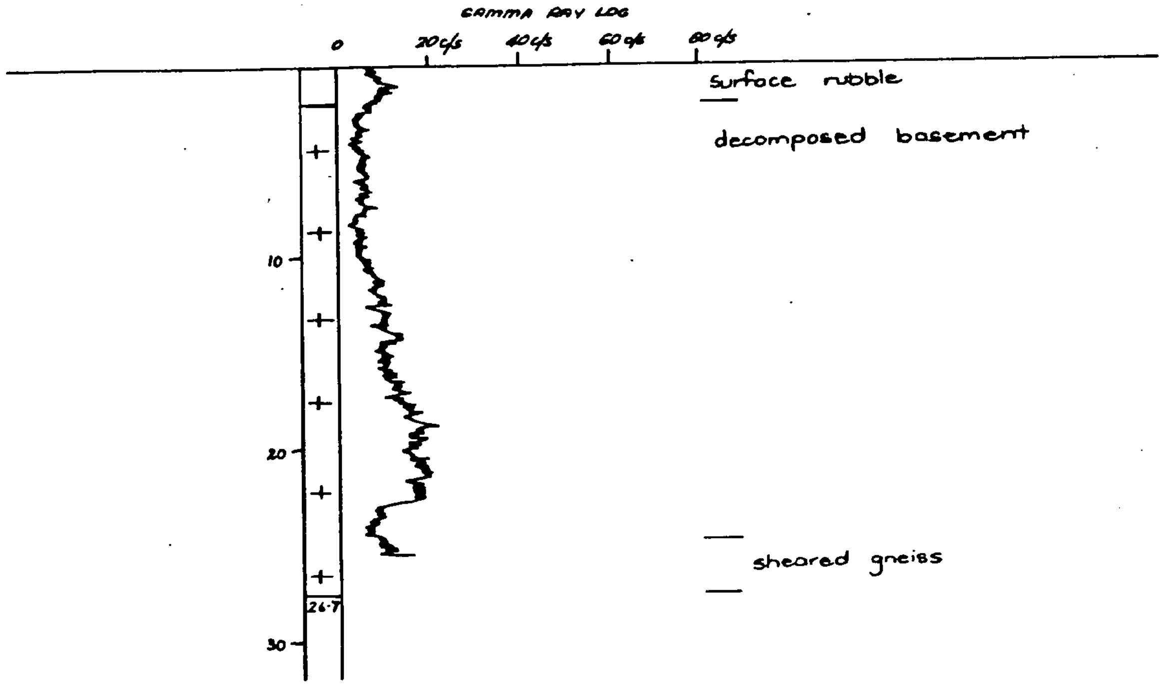


To Accompany Report WY. 81.3.

Plate : 8

DRAWN G.R.S.	AFMECO PTY. LTD.
DATE NOV '80	SCALE 1:400 (1cm = 4m)
GEOLOGY G.R.S.	MULGATHING - S.AUST.
APPROVED	
DWG. No. SH53-10.124.3530	DRILL HOLE LOGS - MUL 9 & 10
REV. No.	

MUL 11.



To Accompany Report WY. 81.3.

Plate : 9

DRAWN
G.R.S.

DATE
NOV '80

GEOLOGY
G.R.S.

APPROVED

DWG. Nº.
SH53-10.124.3531

REV. Nº.

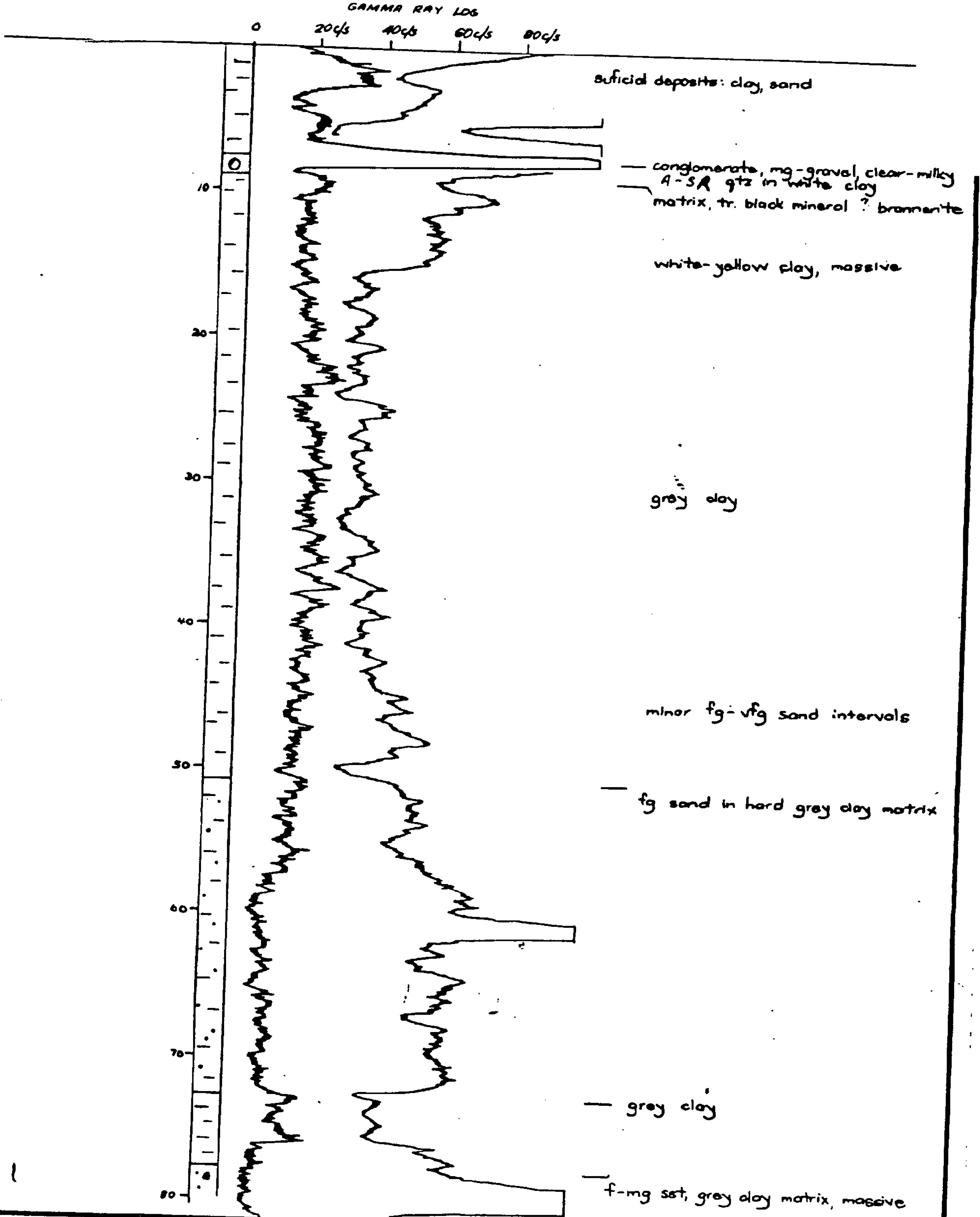
AFMECO PTY. LTD.

SCALE
1 : 400 (1cm = 4 m)

MULGATHING - S. AUST.

DRILL HOLE LOG - MUL 11

MUL 12.



To Accompany Report WY. 81.3.

DRAWN G.R.S.
DATE NOV '80
GEOLOGY G.R.S.
APPROVED
DWG. No SH53-10 124.3532 (a)
REV. No.

AFMECO PTY. LTD.

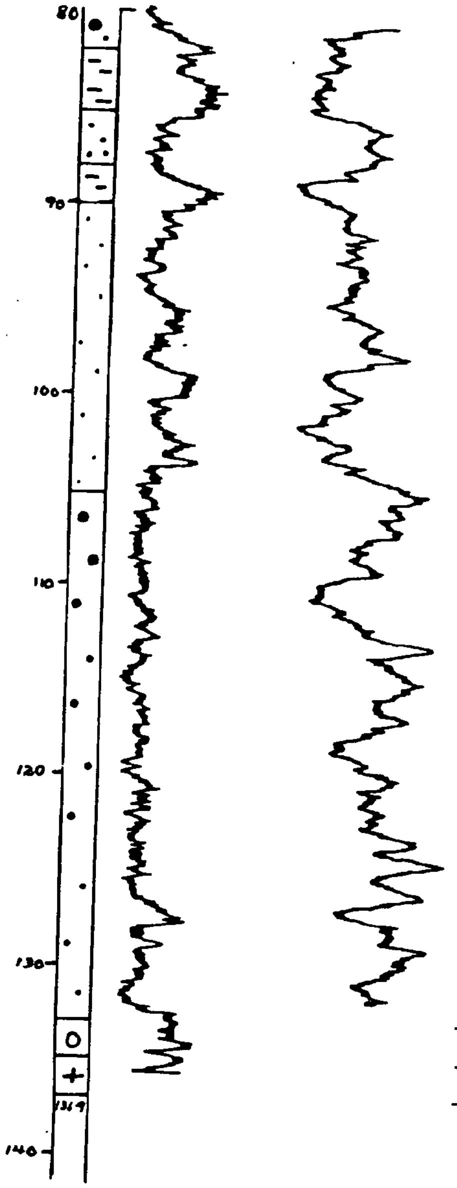
SCALE 1:400 (1cm = 4 m)

MULGATHING - S.AUST.

DRILL HOLE LOG - MUL 12 (1 of 2)

Plate : 10

MUL 12 (continued)



— grey clay, massive, tr fg sand, fissile ⊥ to core

— fg sand + grey clay matrix

— grey fissile clay

—

fg sand + grey clay matrix, few thin sandy intervals often slumped

— mg sand, gen. clean, clear > orange qtz, SR

— boulder conglomerate, boulders of basement in sandy or clay matrix

—

— gneiss

To Accompany Report WY.81.3.

Plate : 11

DRAWN G.R.S.
DATE NOV '80
GEOLOGY G.R.S.
APPROVED
DWG. No SH53-10 124.3532 (b)
REV. No.

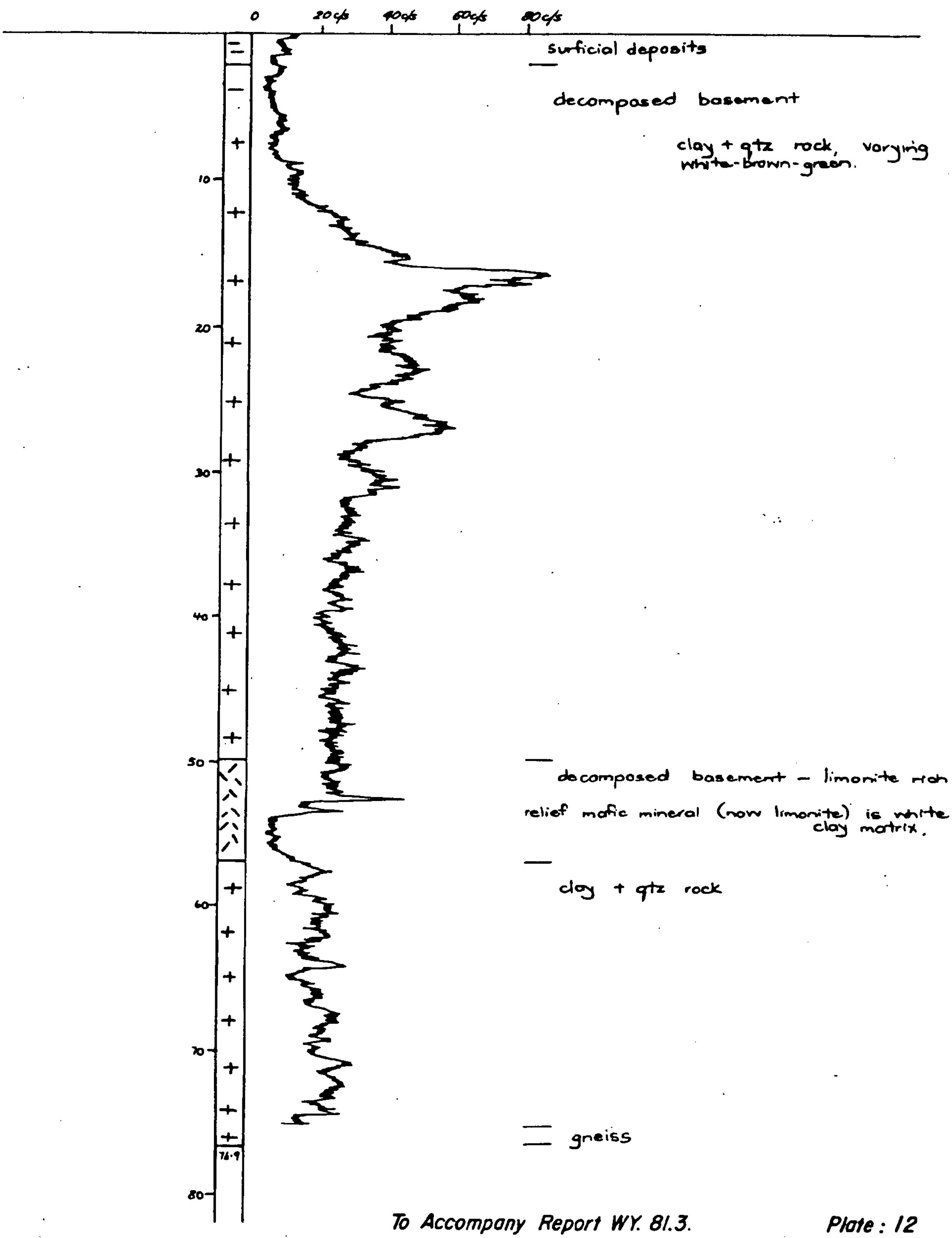
AFMECO PTY. LTD.

SCALE 1:400 (1cm = 4m)

MULGATHING - S. AUST.

DRILL HOLE LOGS - MUL 12 (2 of 2)

MUL 13.

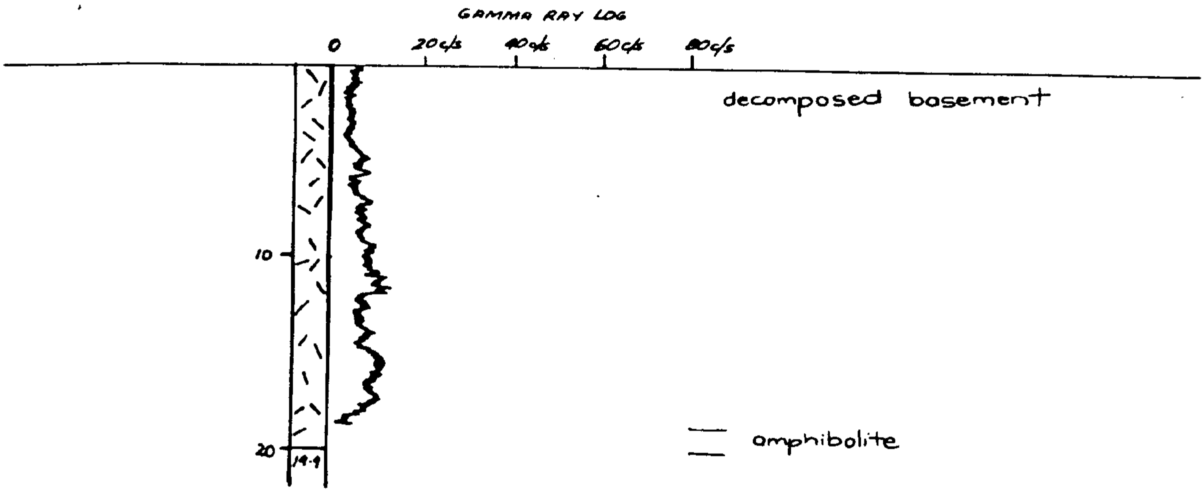


To Accompany Report WY. 81.3.

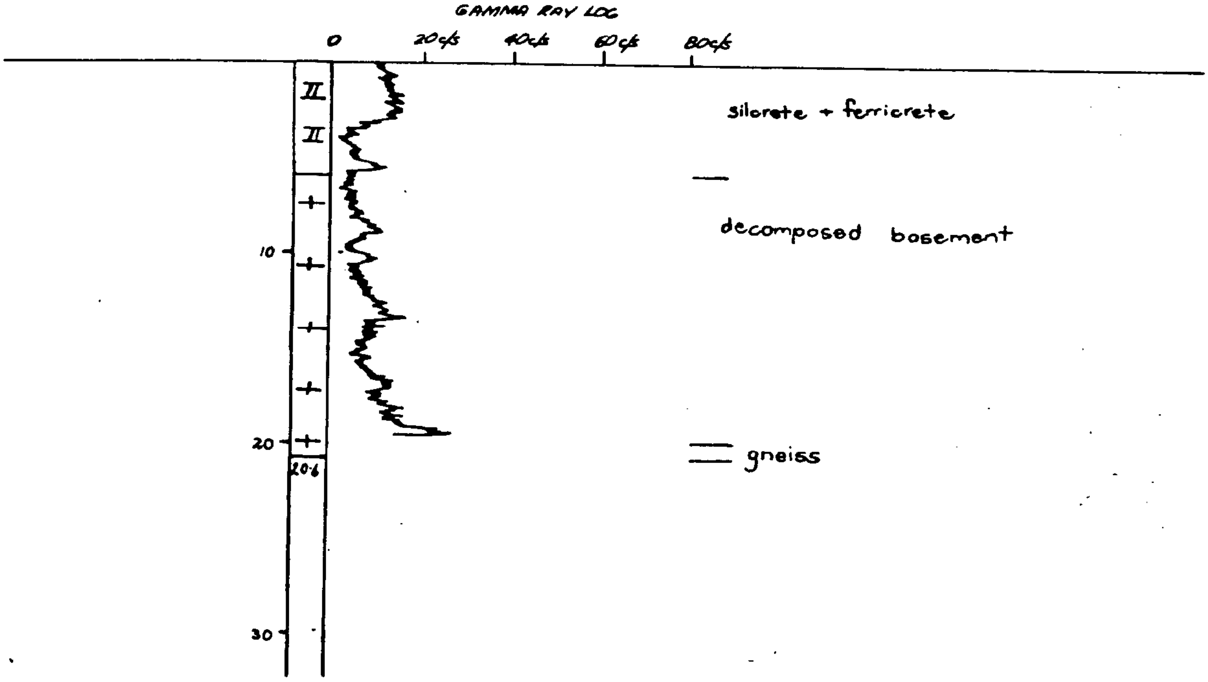
Plate : 12

DRAWN G.R.S.	**AFMECO PTY. LTD.**	
DATE NOV 80	SCALE 1:400 (1cm = 4 m)	
GEOLOGY G.R.S.		
APPROVED	MULGATHING - S.AUST.	
DWG. No. SH53-10.124.3533.	DRILL · HOLE LOG – MUL 13	
REV. No.		

MUL 16.



MUL 17.



To Accompany Report WY. 81. 3.

Plate : 15

DRAWN GRS.

DATE NOV '80

GEOLOGY GRS.

APPROVED

DWG. NO. SH53.-10.124.3536.

REV. NO.

AFMECO PTY. LTD.

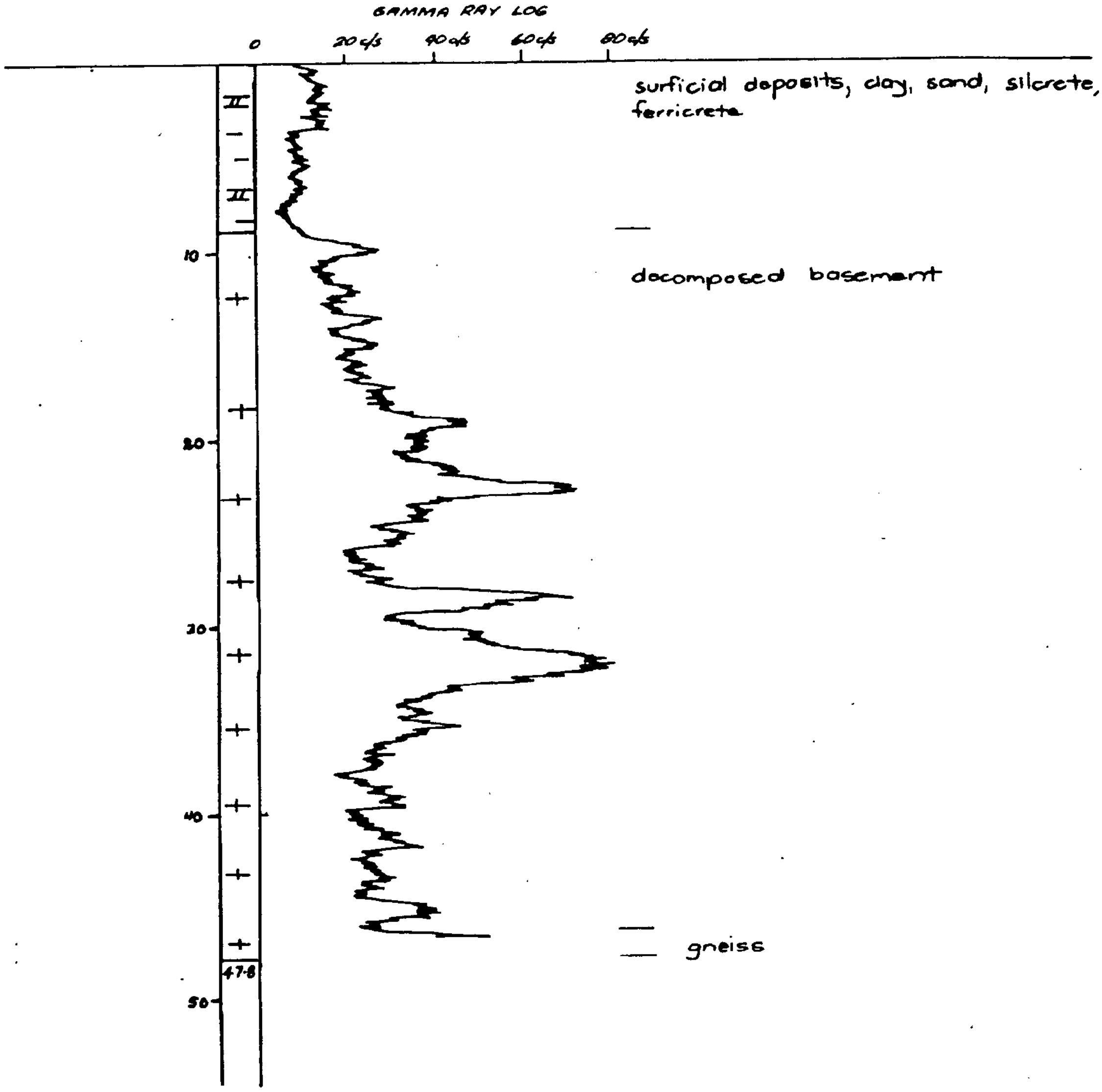
SCALE 1:400 (1cm = 4m)

MULGATHING - S. AUST.

DRILL HOLE LOGS - MUL 16 & 17

MUL 18.

0101

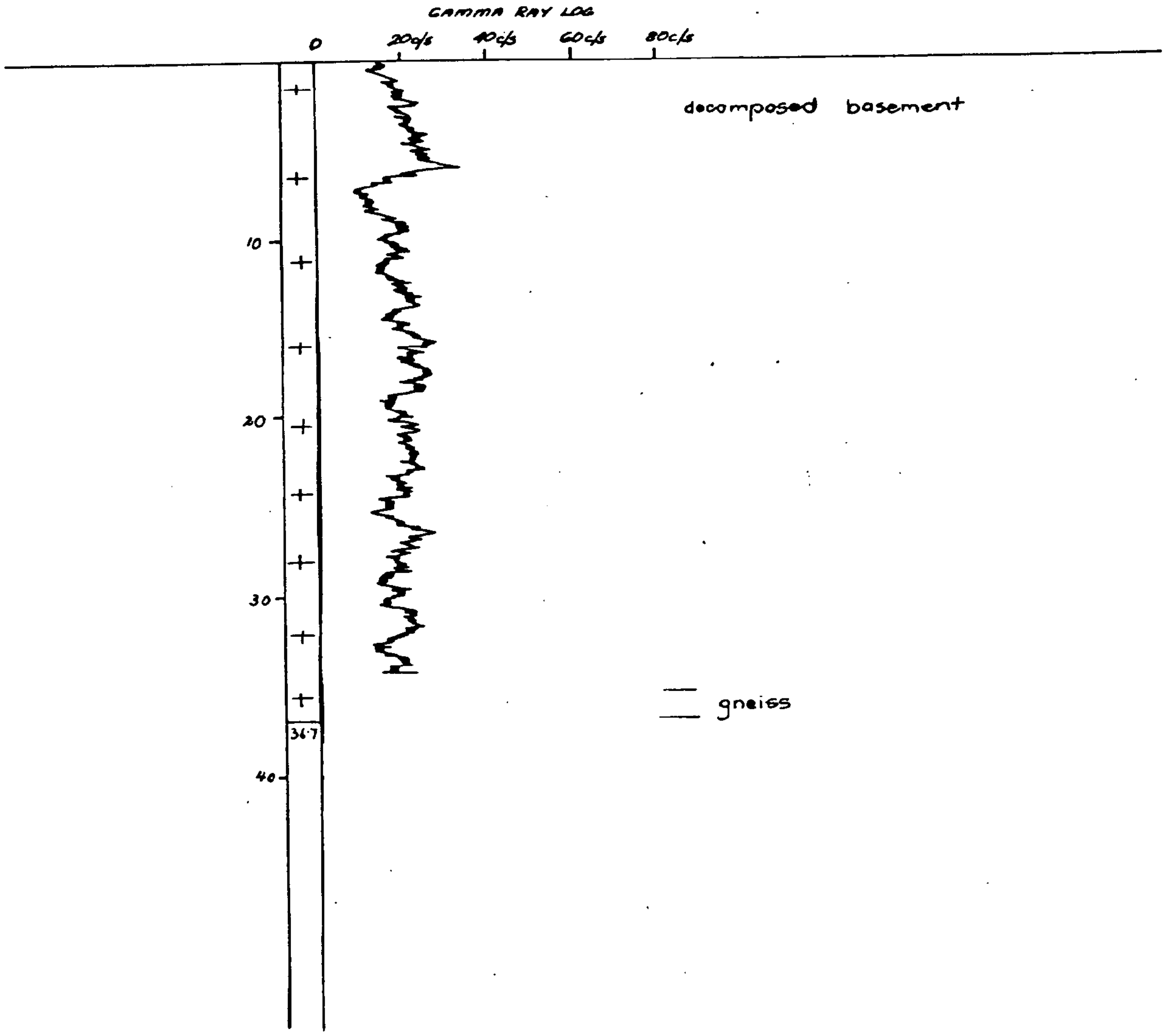


To Accompany Report WY. 81.3. *Plate : 16*

DRAWN G.R.S.	**AFMECO PTY. LTD.**
DATE NOV '80	**SCALE** 1:400 (1cm = 4m)
GEOLOGY G.R.S.	MULGATHING - S.AUST. DRILL HOLE LOG - MUL 18
APPROVED	
DWG. No. SH53-10.124.3537.	
REV. No.	

0102

MUL 19.



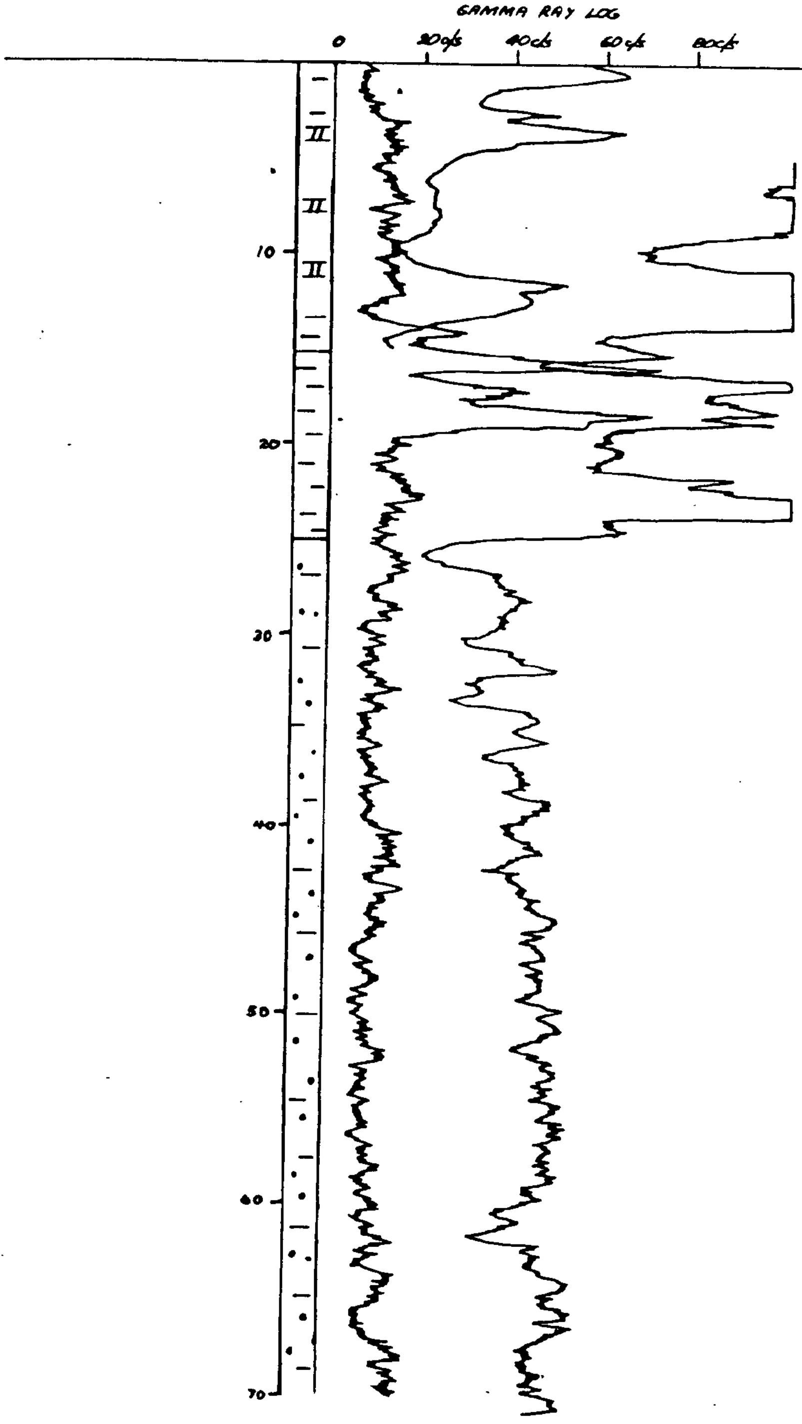
To Accompany Report WY. 81.3.

Plate : 17

DRAWN G.R.S.	**AFMECO PTY. LTD.**
DATE NOV '80	SCALE 1:400 (1cm = 4m)
GEOLOGY G.R.S.	MULGATHING - S. AUST.
APPROVED	
DWG. No. SH53.-10.124.3538	DRILL HOLE LOG - MUL 19
REV. No.	

MUL 20.

0103



surficial deposits: clay, ferricrete,
Silcrete

— white + lt yellow clay

— f-mg sand + clay matrix, grey
> yellow, brown, green.
clear >> red stained qtz, SA-SR,
few clay platelets probably
sequence of cm interbeds
clayey sand (as above) and
clay.

sand is now dom. fg.

To Accompany Report WY. 81.3.

Plate : 18

DRAWN G.R.S.

DATE NOV '81

GEOLOGY G.R.S.

APPROVED

DWG. No SH53-10 124.3539 (a)

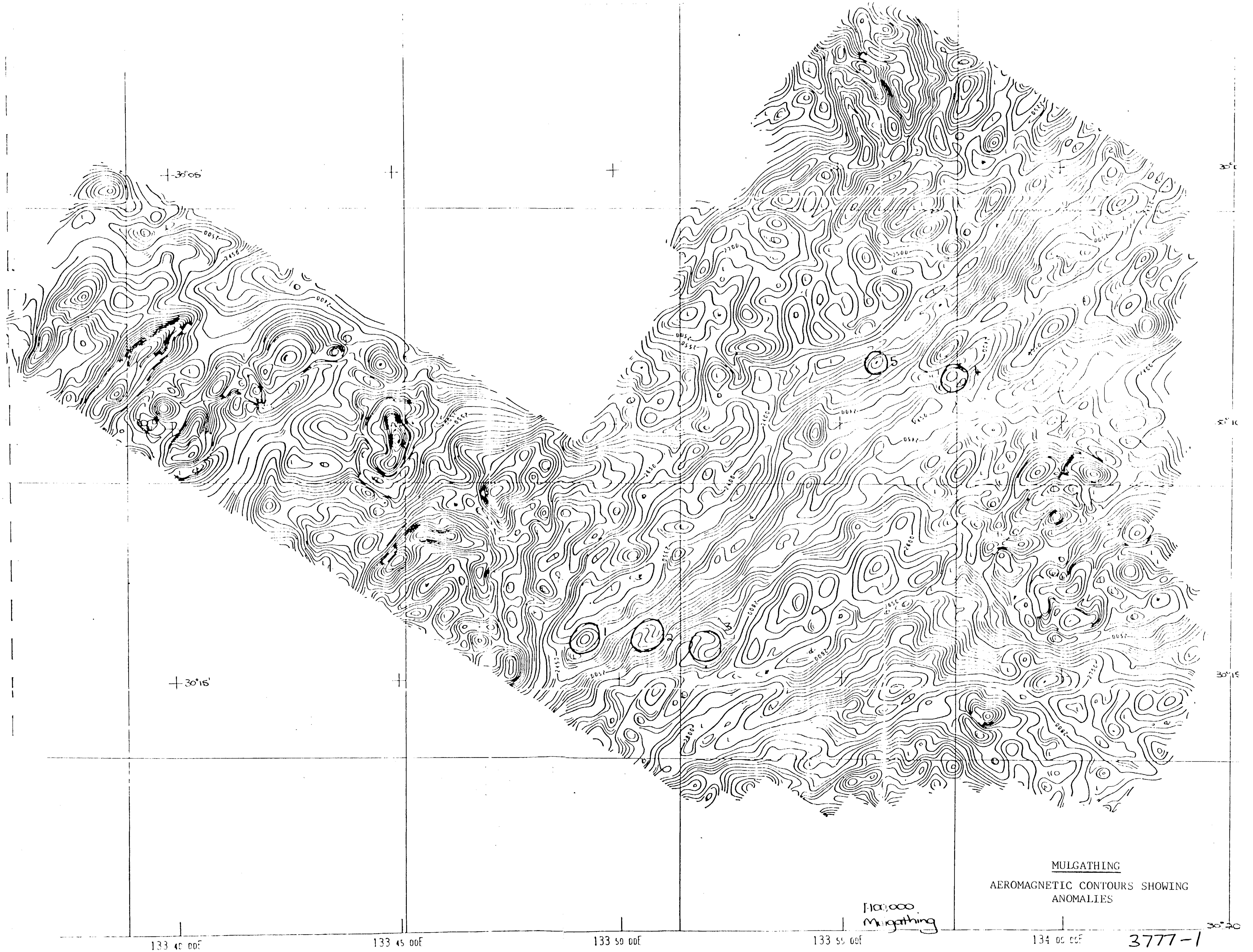
REV. No.

AFMECO PTY. LTD.

SCALE 1:400 (1cm = 4m)

MULGATHING - S. AUST.

DRILL HOLE LOG - MUL 20 (1 of 2)



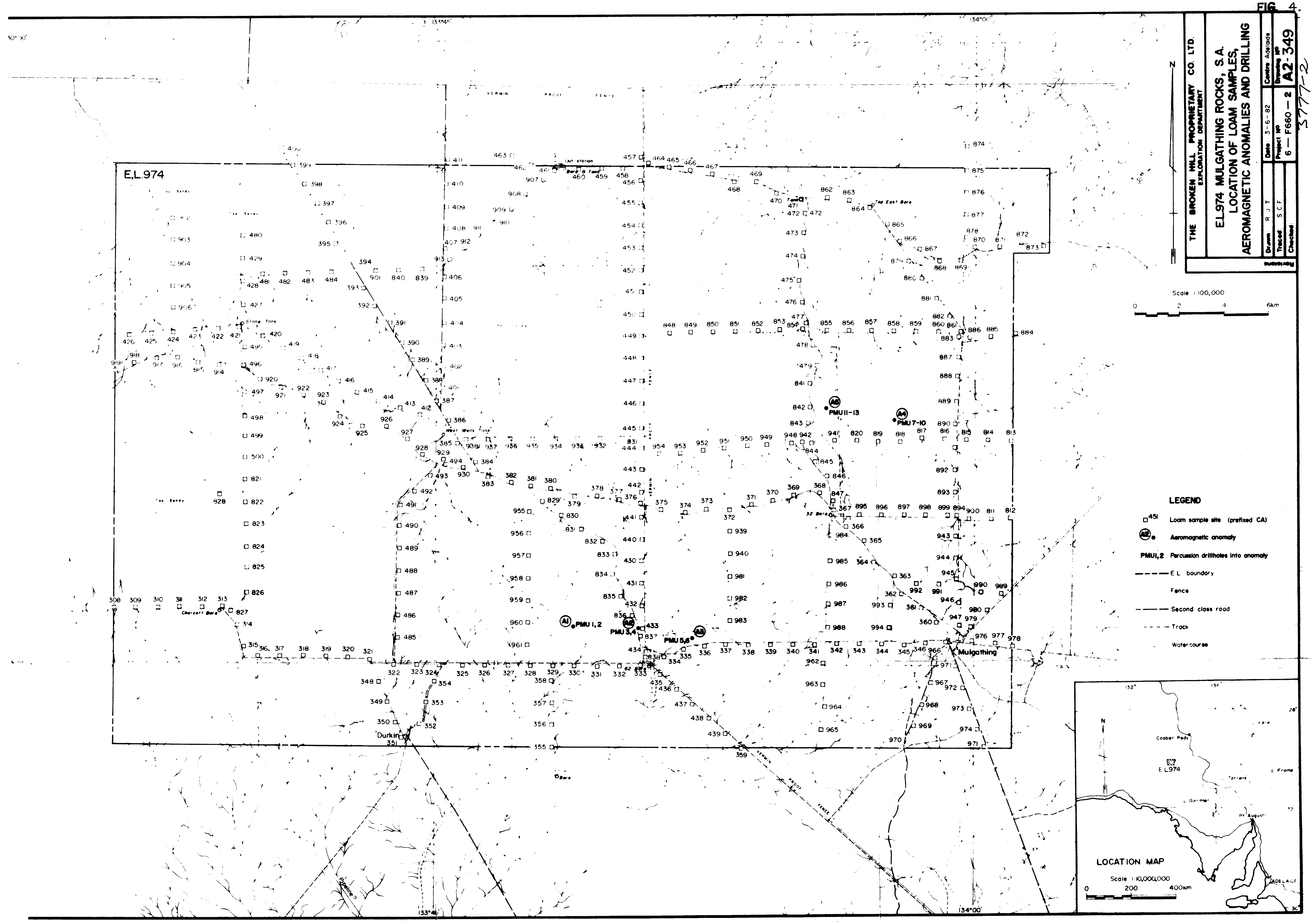
MULGATHING

AEROMAGNETIC CONTOURS SHOWING
ANOMALIES

1:100,000
Mulgathing

3777-1

FIG. 4.



THE BROKEN HILL PROPRIETARY CO. LTD.

EXPLORATION DEPARTMENT

E.L.974 MULGATHING ROCKS, S.A. LOCATION OF LOAM SAMPLES, AEROMAGNETIC ANOMALIES AND DRILLING

Drawn: R J T
Traced: S C F
Checked:
Date: 3-6-82
Project No 6 — F660 — 2
Centre Adelaide
Drawing No A2-349

3777-2

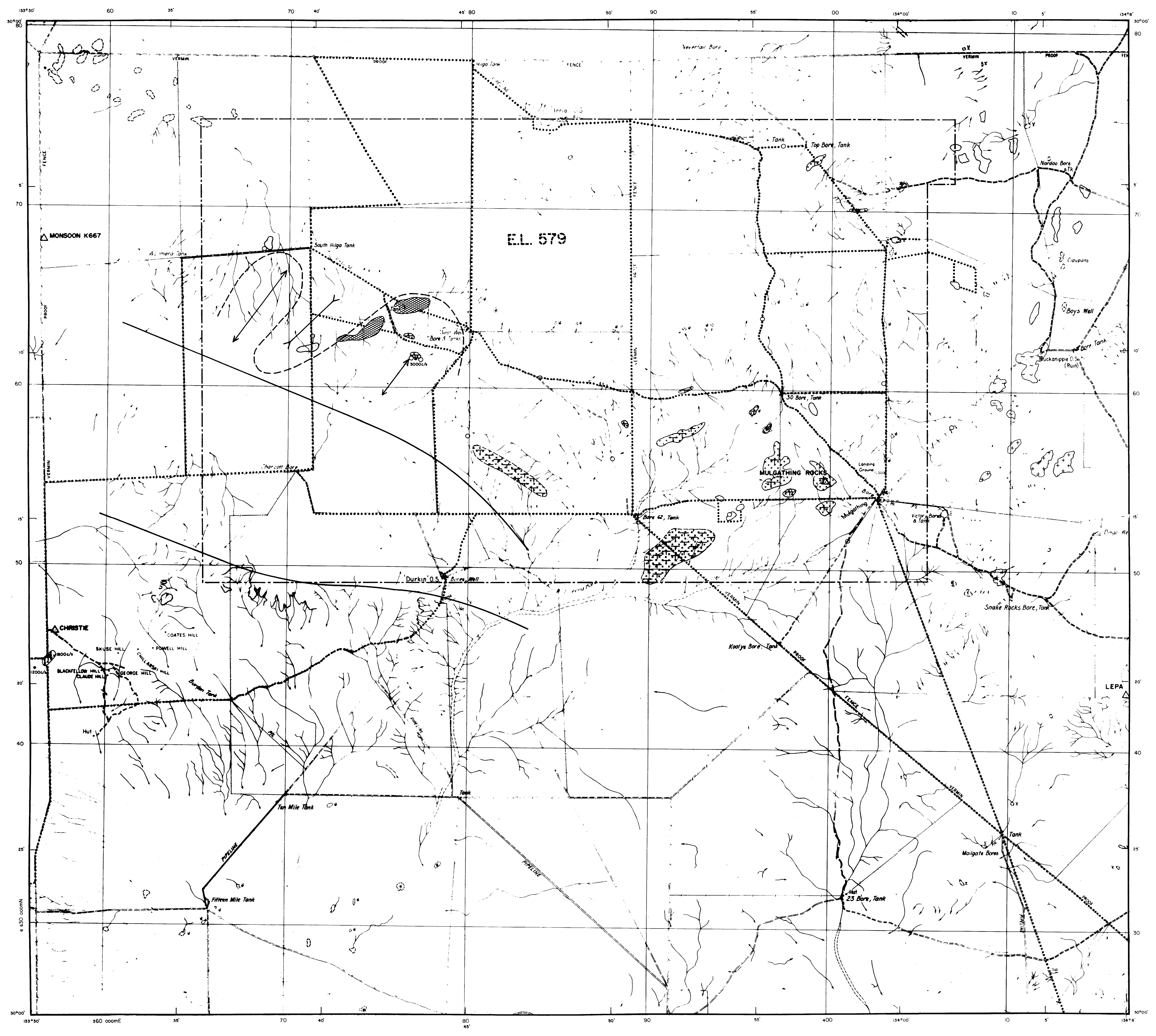
Revisions

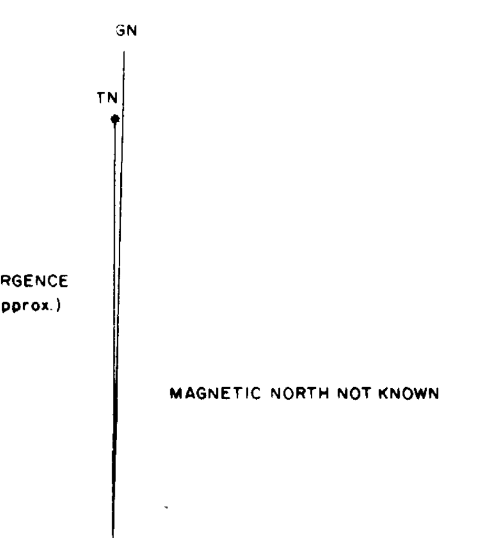
Scale 1:100,000

0 2 4 6km

LEGEND

□451	Loam sample site (prefixed CA)
(A2)●	Aeromagnetic anomaly
PMU1,2	Percussion drillholes into anomaly
— — —	E.L. boundary
	Fence
———	Second class road
- - -	Track
	Watercourse





TRUE NORTH AND GRID NORTH ARE SHOWN DIAGRAMMATICALLY FOR THE CENTRE OF THIS MAP

LEGEND

	☐	Laterite and Ferricrete
	+	Younger Granite, Hitalba type
Mulgathing complex	×	Orthogneiss
	⊤	Acid Gneiss
	▩	Banded Iron Formation
	~	Undifferentiated

REFERENCE

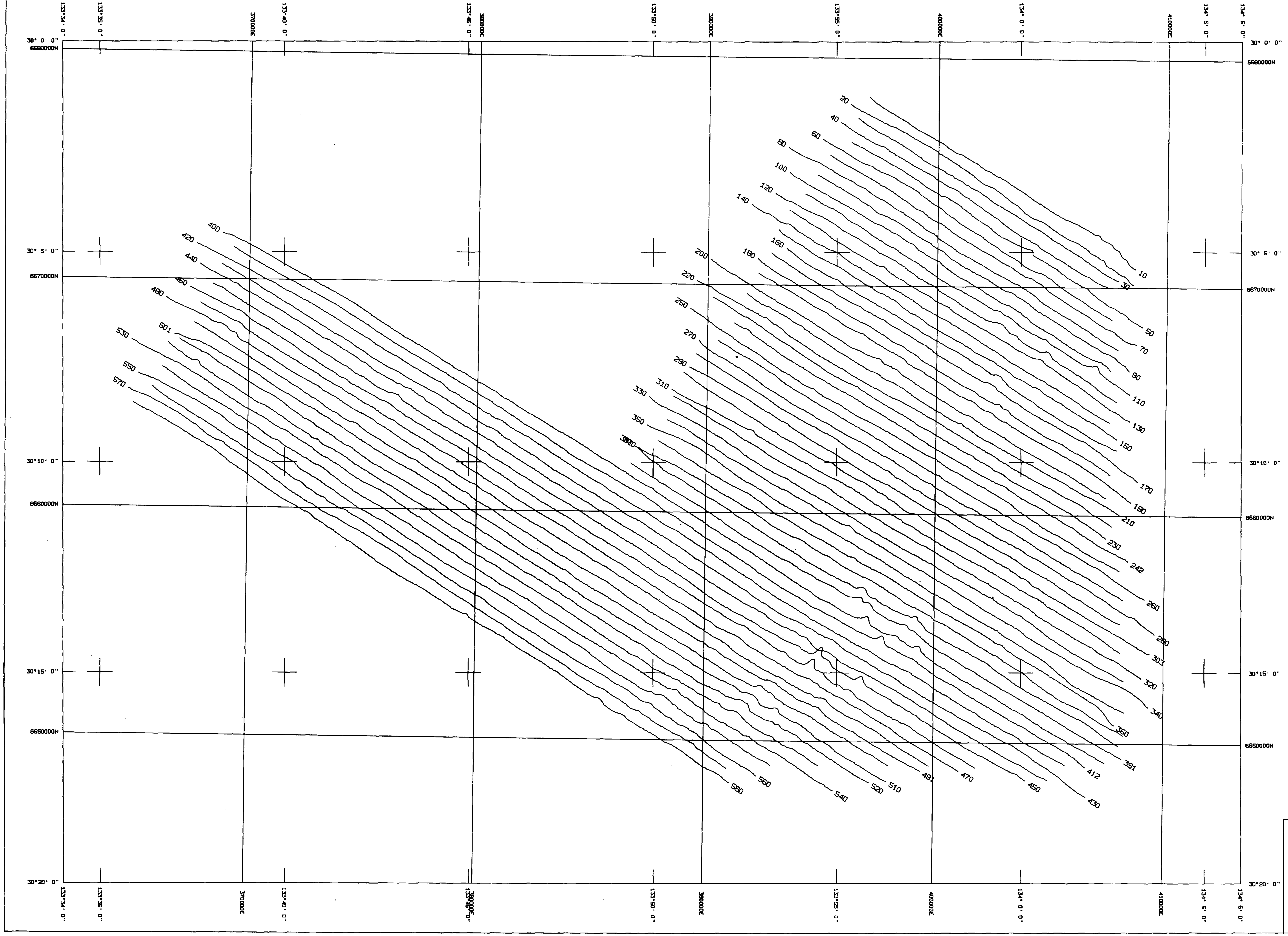
•••••••••••	Car Radiometry
⟷	Anticline
>—<	Syncline
——	Normal Fault
1800c/s ●	Radiometric Anomaly
○	Proposed Drill Hole
—-—	Exploration Licence Boundary

Planimetric information compiled from 1:100 000 maps, Mulgathing (5637) and Carnding (5737), prepared by SADME

To accompany Report No. WY. 80. 4.

PLATE 1

REVISION	DATE		**AFMECO PTY. LTD.**
		REV. No. 0	**SCALE** 1:100 000 — 2 0 2 4 Km
		DRAWN Tracey	MULGATHING PROJECT
		DATE August 1980	EXPLORATION LICENCE 579
		GEOLOGY Y. G. Bladier	OUTCROP GEOLOGY
DWG. No. SH 53-10.124.2669		**APPROVED**	3777-3



3777-4

PLATE 2

MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 8000 COUNTS/CM

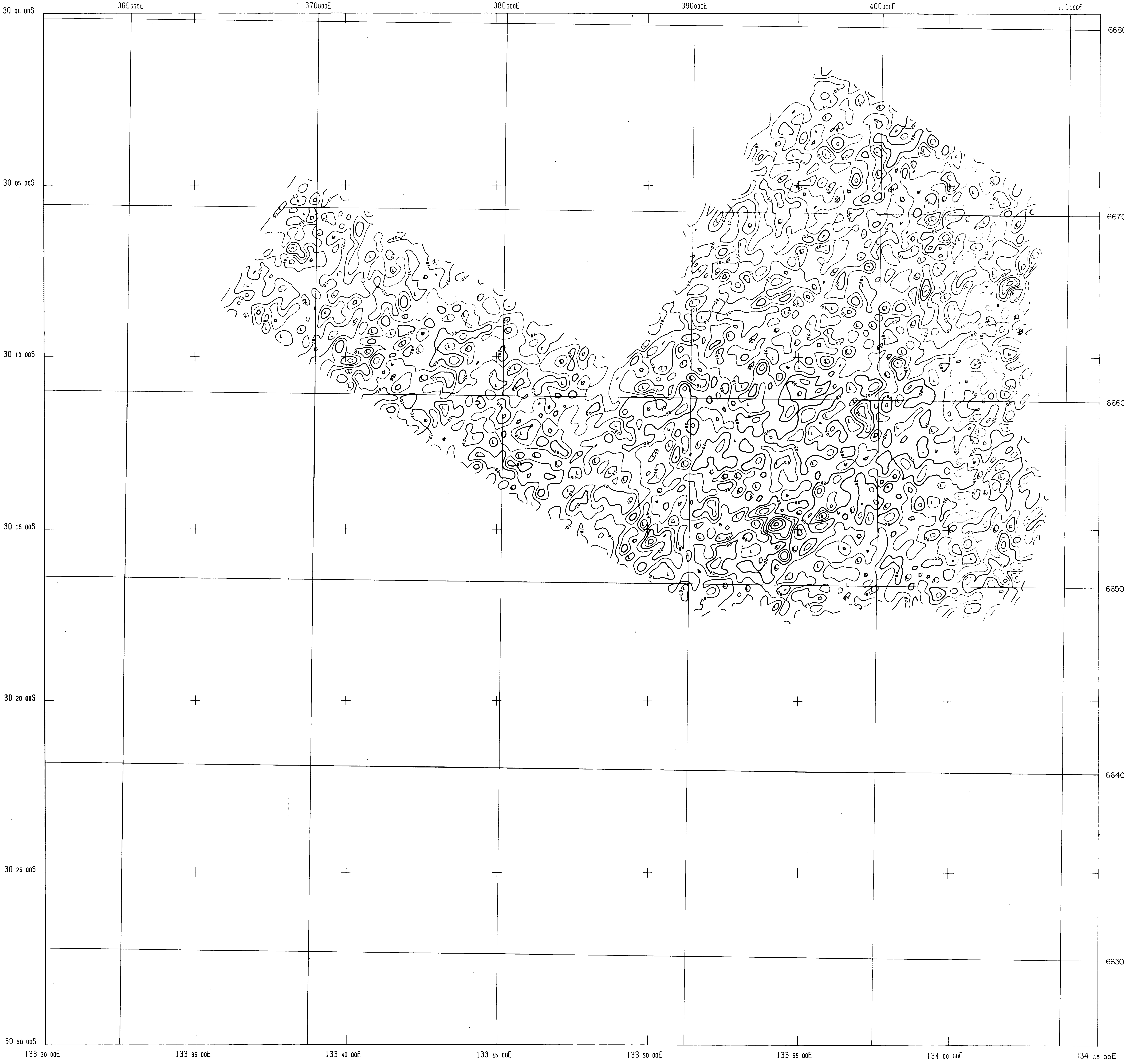
1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD.

22/MAY/80

DWG.No.SH53-10 GPR 2074



N

0 1 2 3 4 5 6 7 8 9 10 Km

SCALE 1:100000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

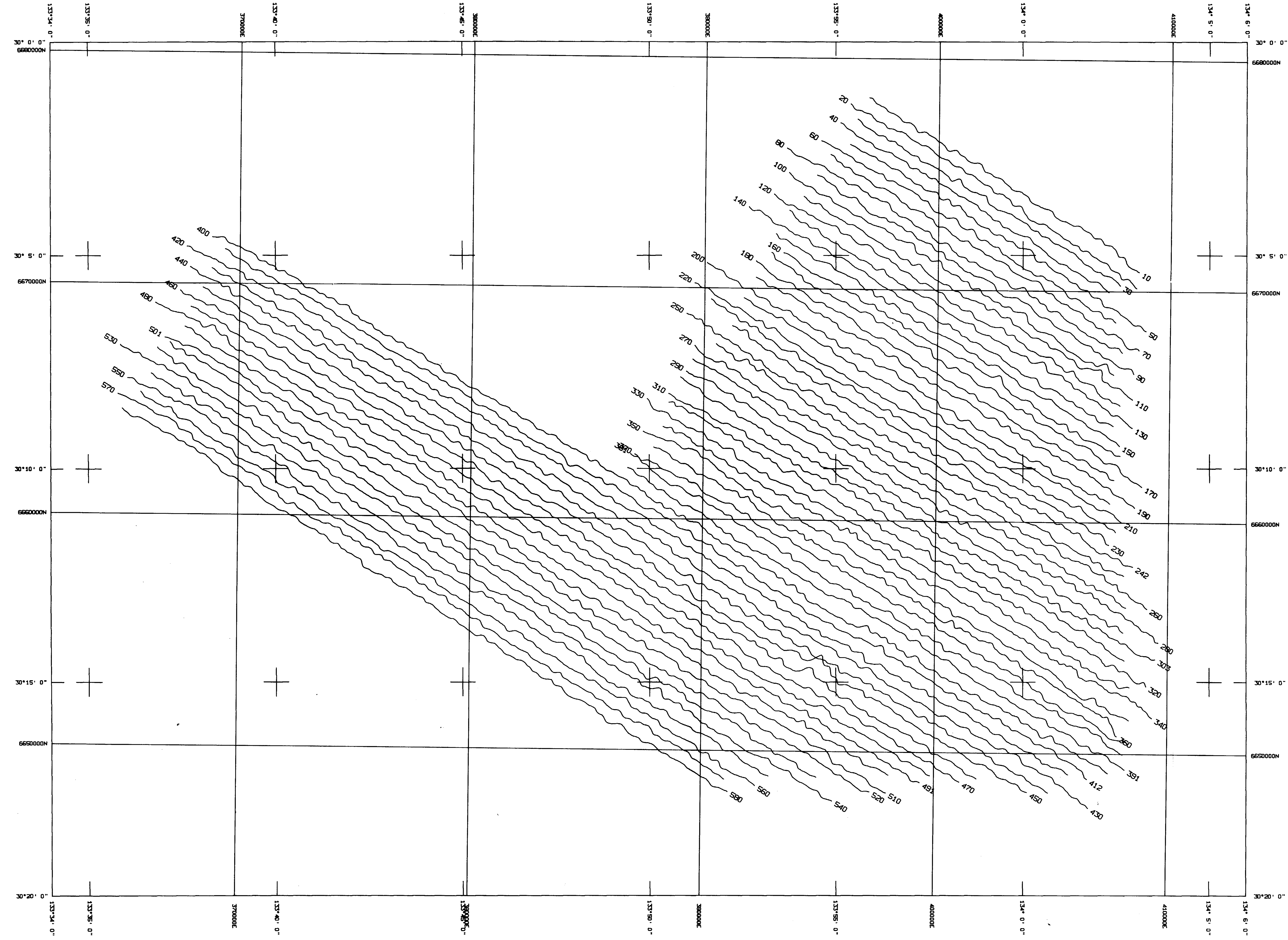
3777-5

PLATE 3

AFMECO (AUST) LTD

MULGATHING S.A.
URANIUM CHANNEL
SHEETS 5637, 5737

DWG No. SH53-10.124.2746	DATE: 02-MAY-80



3777-6

PLATE 4

MULGATHING - URANIUM

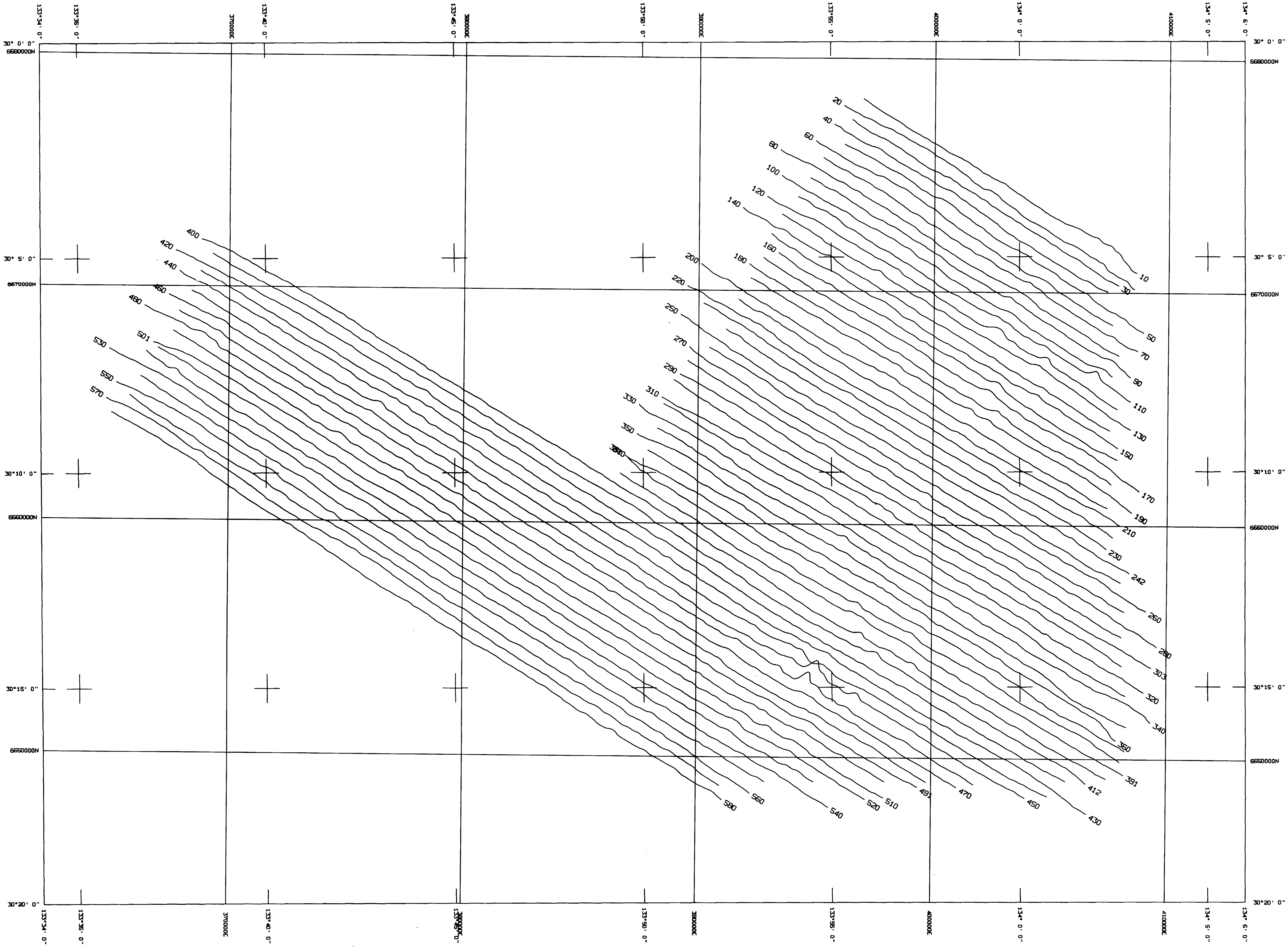
BASE: 0 COUNTS - SCALE: 80 COUNTS/CM

1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD.
22/MAY/80

DWG. No. SH53-10. GPR. 2076



3777-7

PLATE 5

MULGATHING - THORIUM

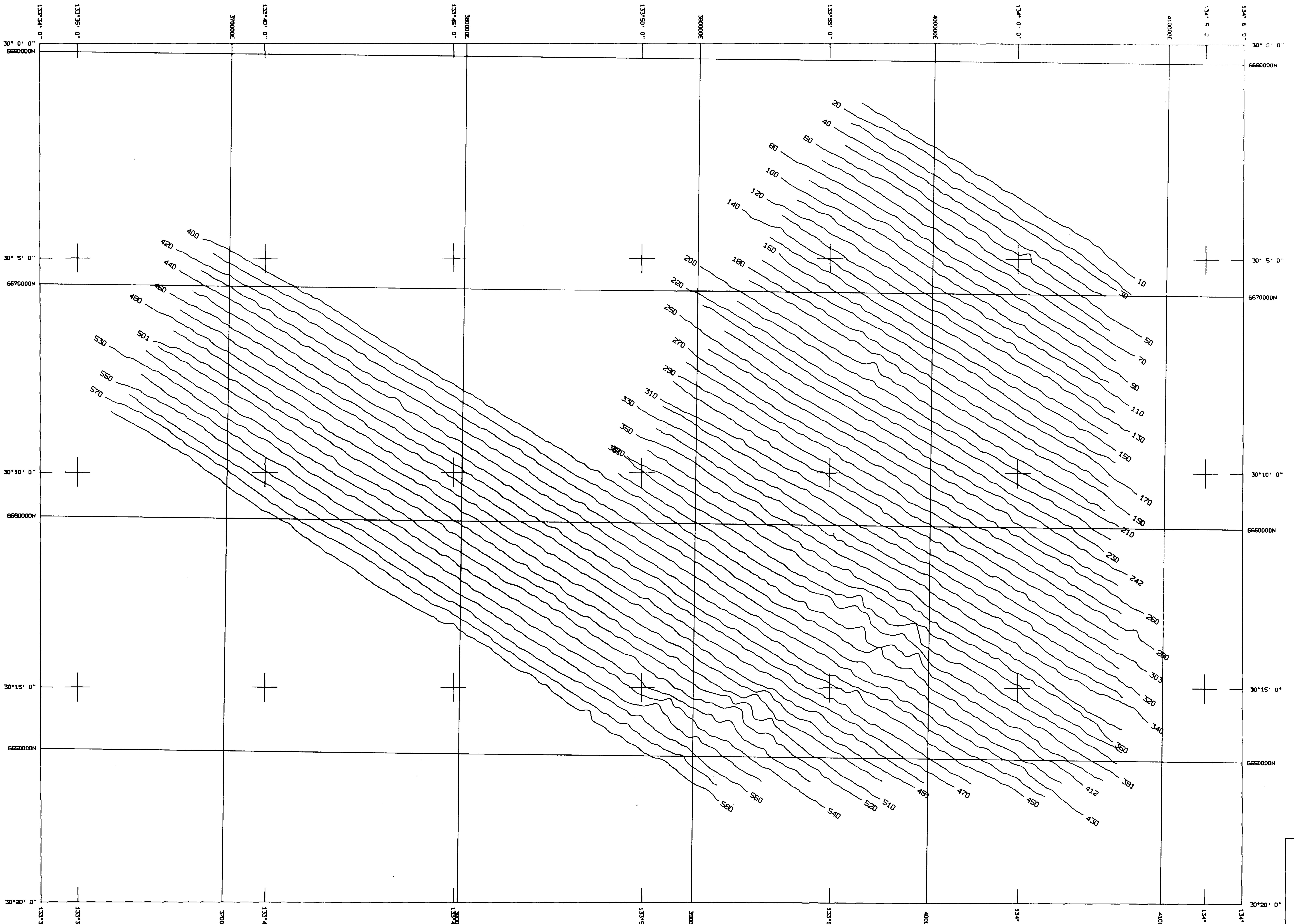
BASE: 0 COUNTS - SCALE: 400 COUNTS/CM

1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD. 22/MAY/80

DWG. No. SH53-10. GPR. 2071



3777-8

PLATE 6

MULGATHING - POTASSIUM

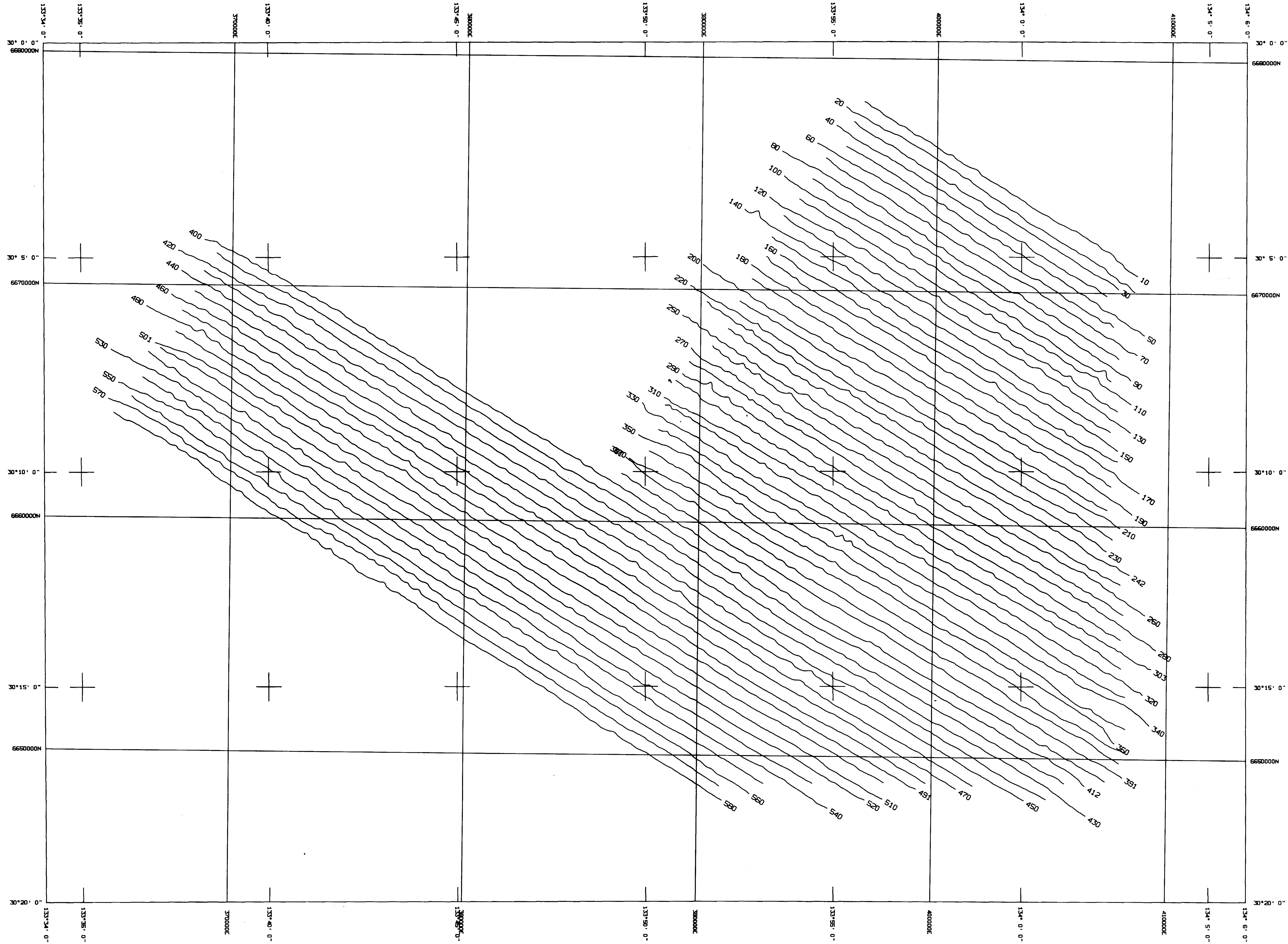
BASE: 0 COUNTS - SCALE: 400 COUNTS/CM

1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD. 22/MAY/80

DWG. No SH53-10 GPR 2073



3777-9

PLATE 7

MULGATHING - U/K

BASE: 0 - SCALE: 4.0 /CM

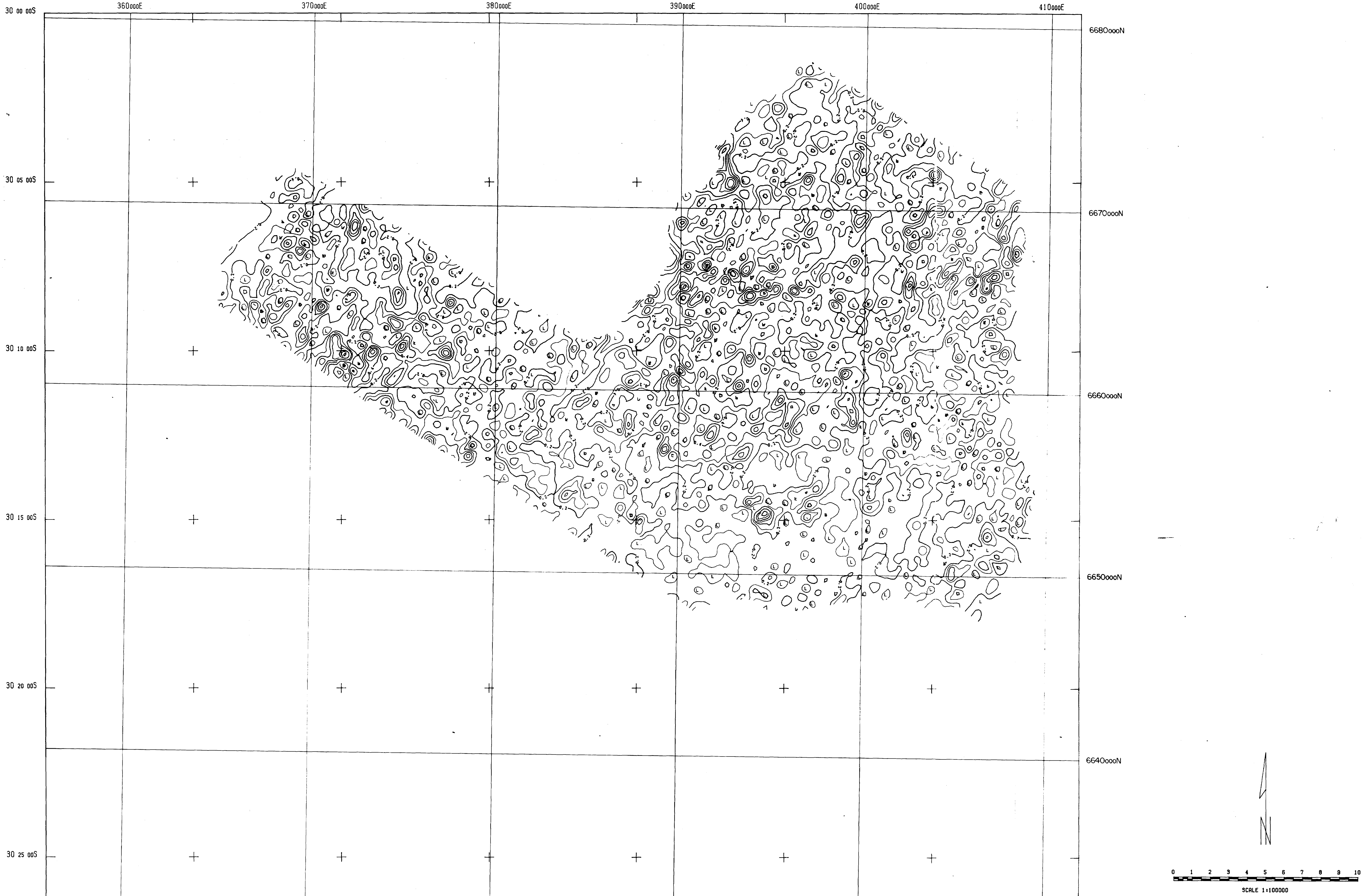
1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD.

22/MAY/80

DWG. N° SH53-10 GPR 2069



FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

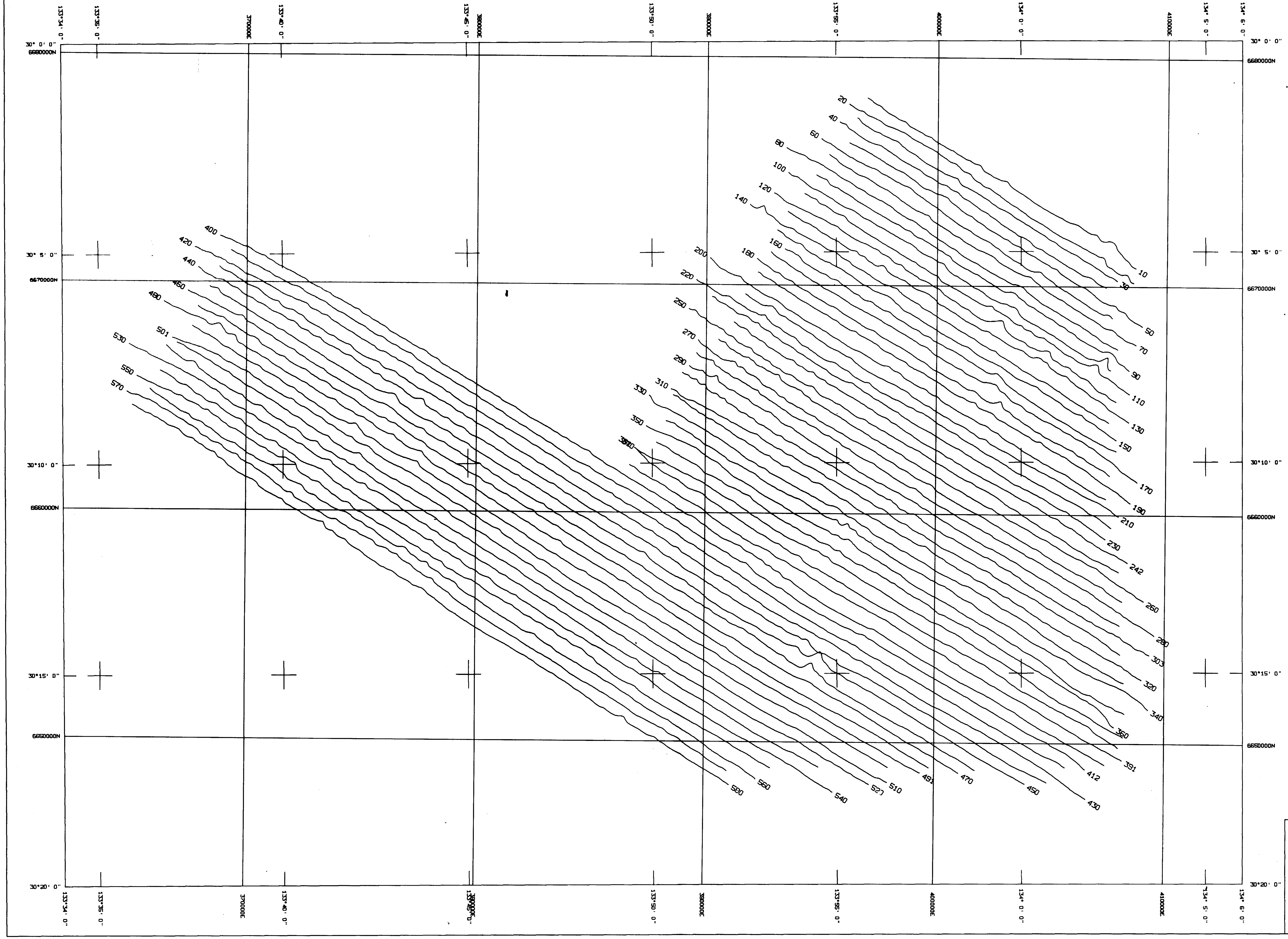
3777-10

PLATE 8

AFMECO (AUST) LTD

MULGATHING S.A.
U/K RATIO
SHEETS 5637, 5737

DWG. No. SH53-10.124.2745	DATE: 02-MAY-80



3777-11

PLATE 9

MULGATHING - TH/K

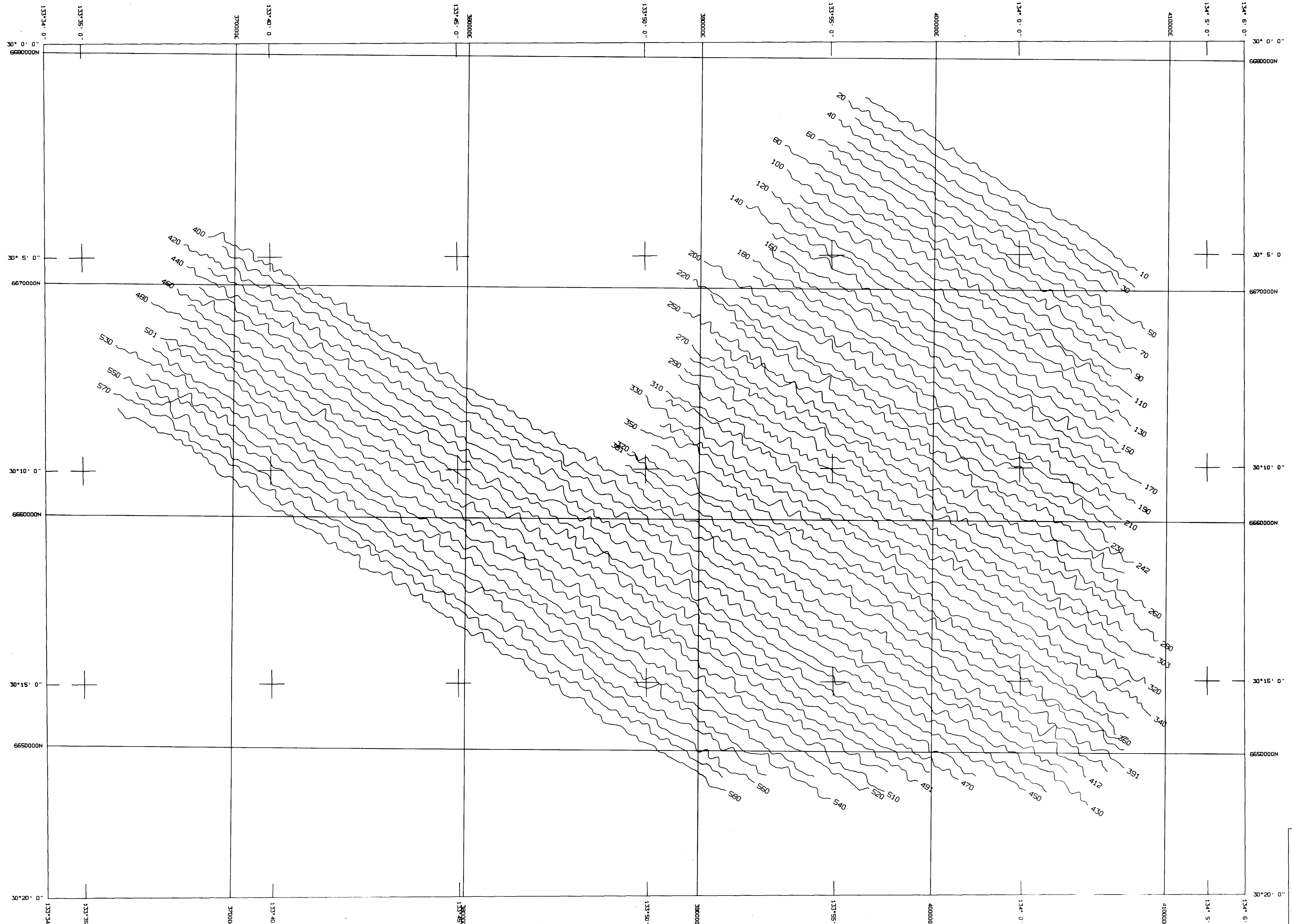
BASE: 0 - SCALE: 8.0 /CM

1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD. 23/MAY/80

DWG. No. SH53-10 GPR 2075



3777-12

PLATE 10

MULGATHING - U/TH

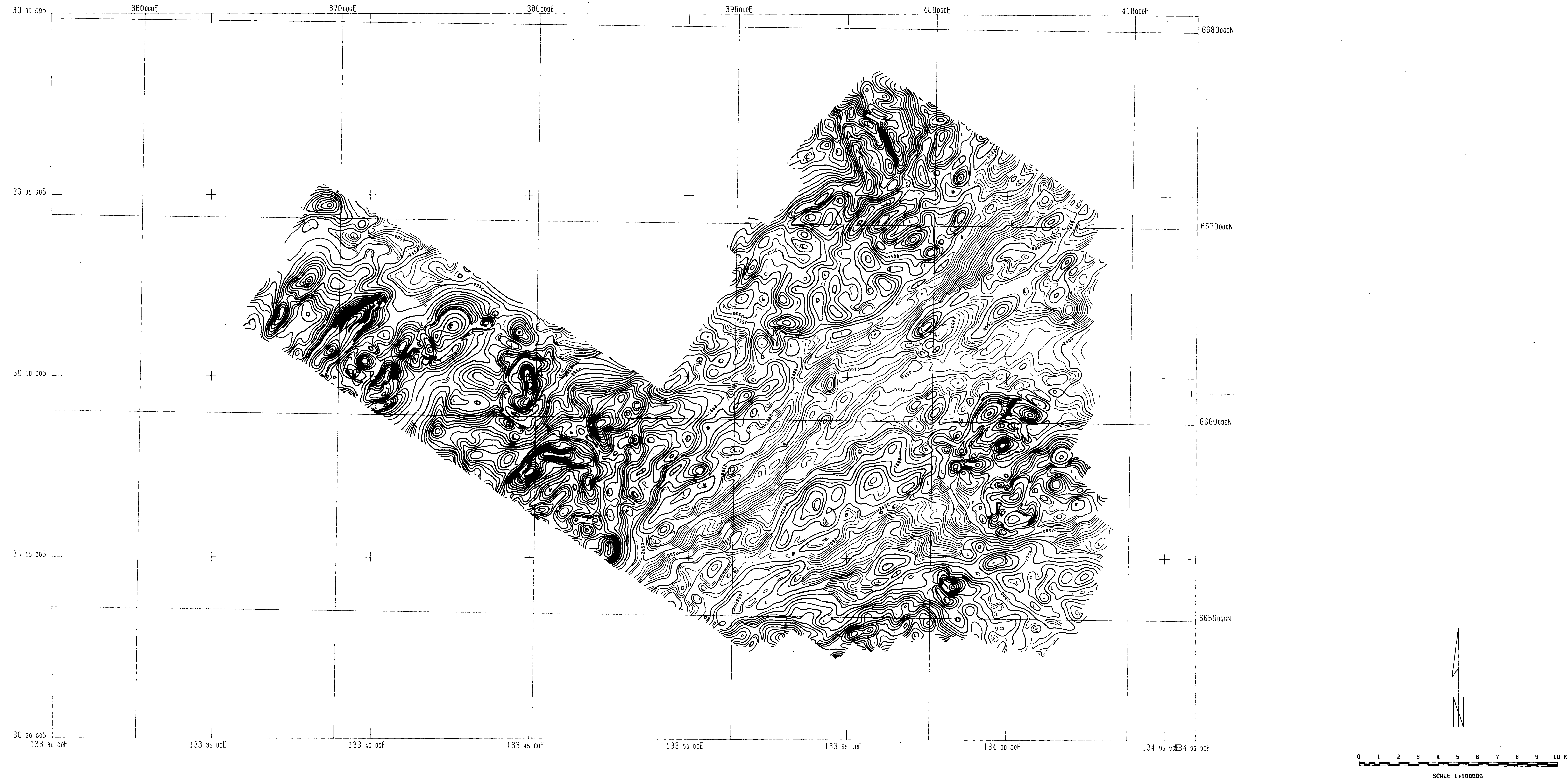
BASE: 0 - SCALE: 1.0 /CM

1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD. 22/MAY/80

DWG No.SH53-10.GPR.2072



FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

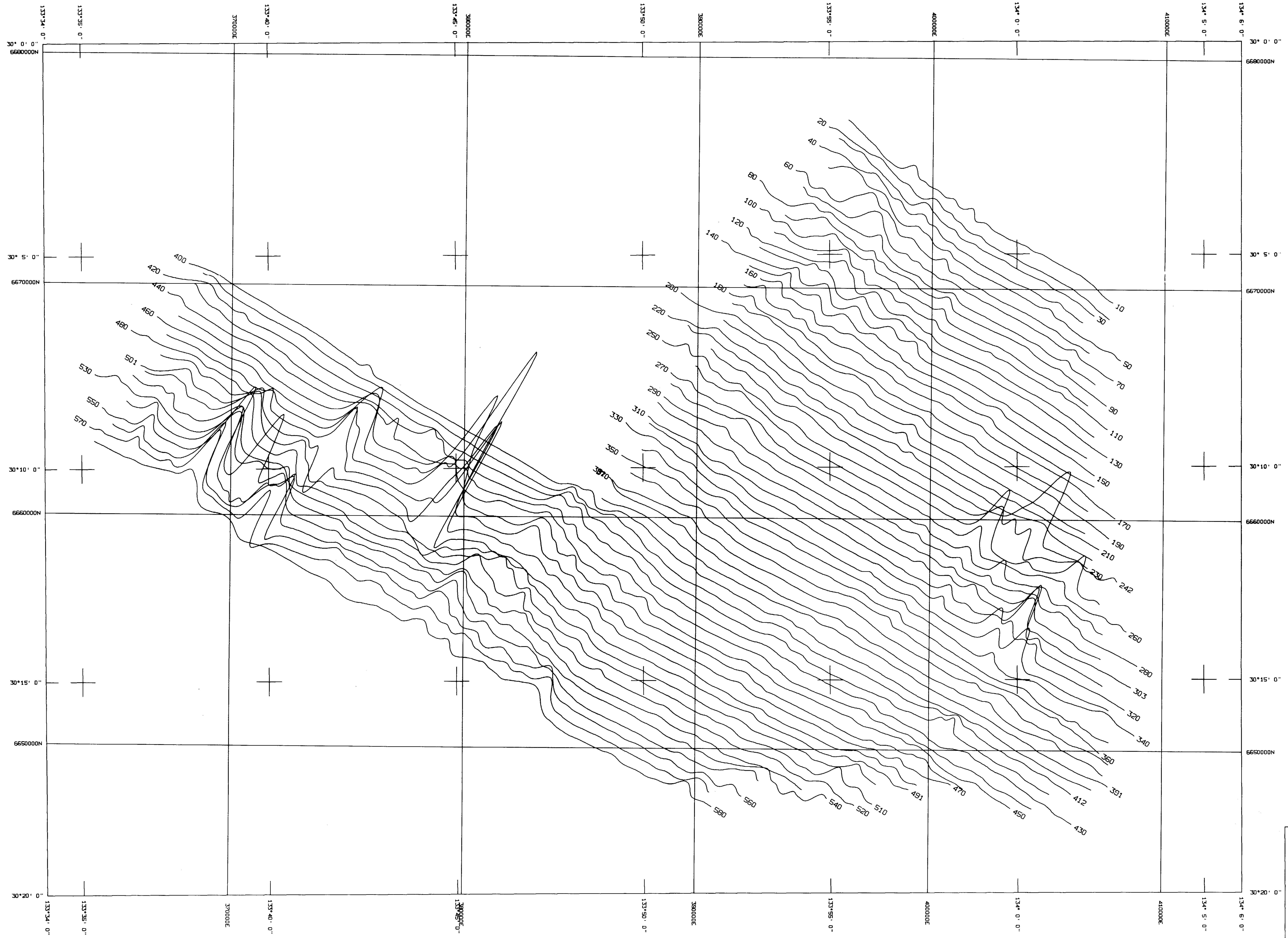
3777-13

PLATE II

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEETS 5637 & 5737

DWG. No. SH53-10.GPM 2077	DATE: 17-FEB-80



3777-14

PLATE 12

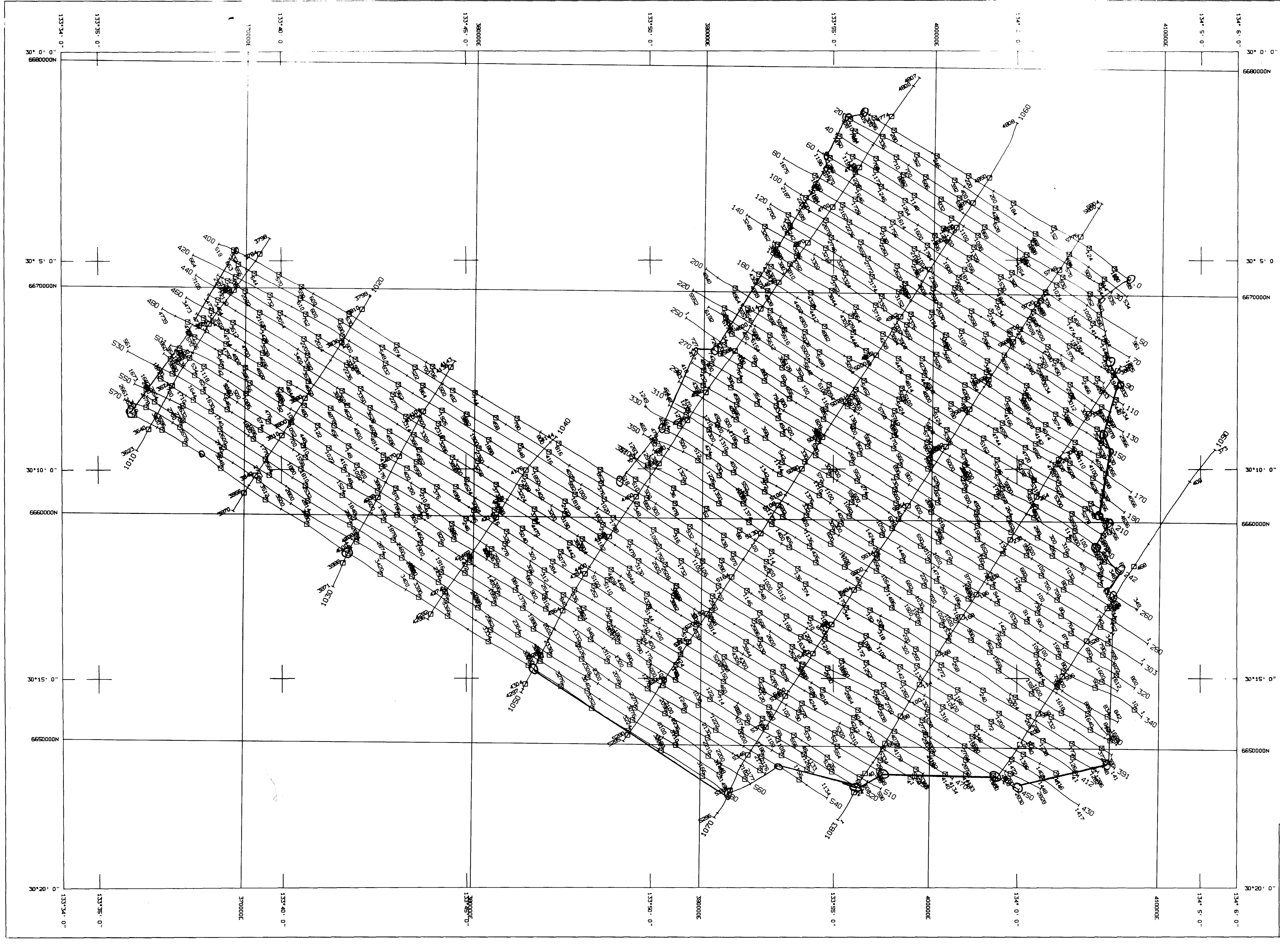
MULGATHING - MAGNETIC INTENSITY
BASE: 59000 NT - SCALE: 1000 NT/CM

1 : 100 000

2 0 2 4 6 8

AUSTIREX AERIAL SURVEYS PTY. LTD. 22/MAY/80

DWG. No. SH53-10. GPM.2070



3777-15

PLATE 13

MULGATHING - FLIGHT LINES

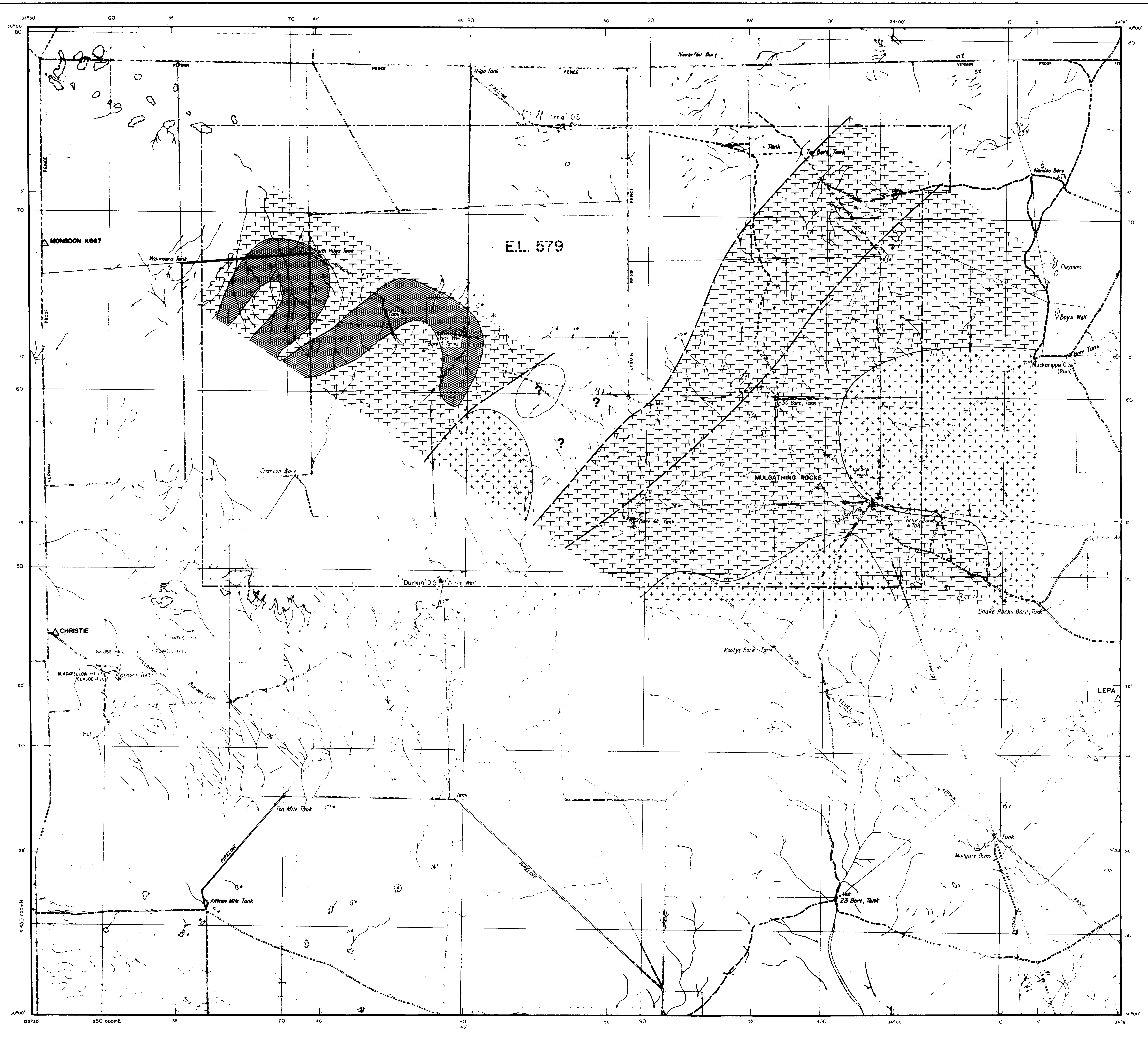
79SA17

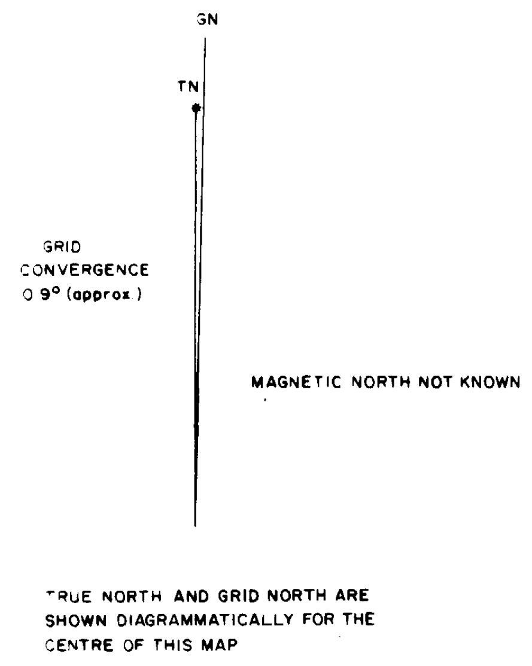
1 : 100 000

AUSTIREX AERIAL SURVEYS PTY. LTD.

23/MAY/80

SH53-10.S.2067





TRUE NORTH AND GRID NORTH ARE SHOWN DIAGRAMMATICALLY FOR THE CENTRE OF THIS MAP

LEGEND

	⊞	Younger Granite
Lower Proterozoic	⊤	Acid Gneiss
	▩	Banded Iron Formation

REFERENCE

────	Geological Boundary
━━━━	Fault
━━ ━━	Fault, inferred
━━ - ━━	Exploration Licence Boundary

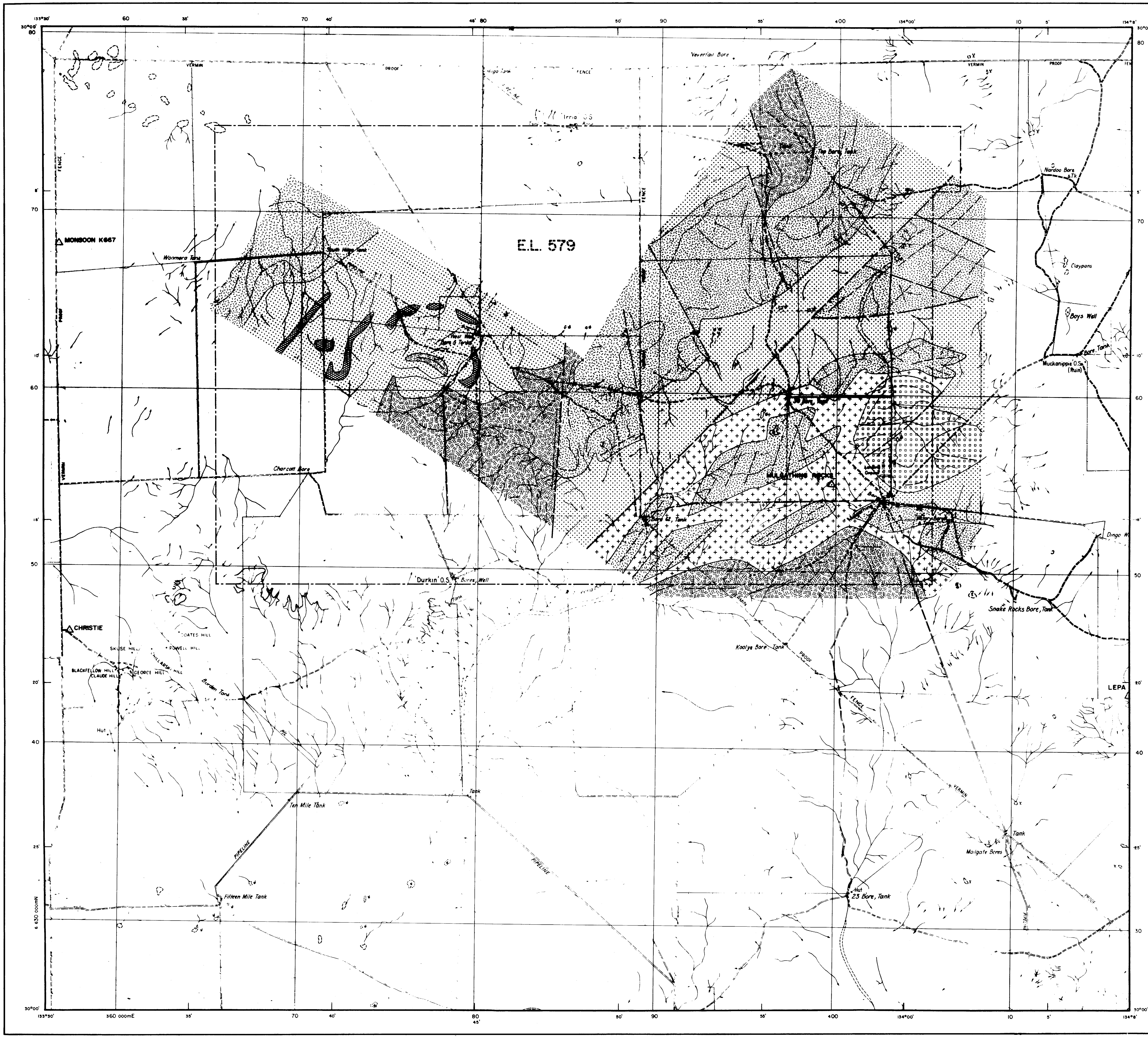
INTERPRETATION FROM FIELD WORK, AUSTIREX MAGNETICS & SADME GEOLOGY MAP (1:100 000)
Planimetric information compiled from 1:100 000 maps, Mulgathing (5637) and Carnding (5737), prepared by SADME

To accompany Report No. WY. 80. 4.

3777-16

PLATE 14

REVISION	DATE		
			AFMECO PTY. LTD.
		REV. No. 0	**SCALE** 1:100 000 — 2 0 2 4 Km
		DRAWN Tracey	MULGATHING PROJECT
		DATE August 1980	EXPLORATION LICENCE 579
		GEOLOGY Y.G. Bladier	INTERPRETATIVE GEOLOGICAL MAP
DWG. No. SH 53-10.124.2668		**APPROVED**	



GN

TN

GRID CONVERGENCE 0·9° (approx.)

MAGNETIC NORTH NOT KNOWN

TRUE NORTH AND GRID NORTH ARE SHOWN DIAGRAMMATICALLY FOR THE CENTRE OF THIS MAP.

LEGEND

░	Metasediment
▩	Banded Iron Formation
▨	Felsic Metamorphics
▨	Mafic Metamorphics
▫	Ultramafic kimberlite? or carbonatite?
+	Granite

REFERENCE

———	Geological Boundary
—— ——	Fault
— — — —	Trend lines
—— - ——	Exploration Licence Boundary

INTERPRETATION FROM AUSTIREX MAGNETICS

Planimetric information compiled from 1:100 000 maps, Mulgathing (5637) and Carnding (5737), prepared by SADME

To accompany Report No. WY. 80. 4. 3777-17 *PLATE 15*

REVISION	DATE		AFMECO PTY. LTD.
		REV. No. 0	SCALE 1:100 000 — 2 0 2 4 Km
		DRAWN Tracey	MULGATHING PROJECT
		DATE August 1980	EXPLORATION LICENCE 579
		GEOLOGY Bevin Dockery	INTERPRETATIVE GEOLOGICAL MAP
DWG. No SH 53-10.124.2667		APPROVED	

GEOSCIENCE

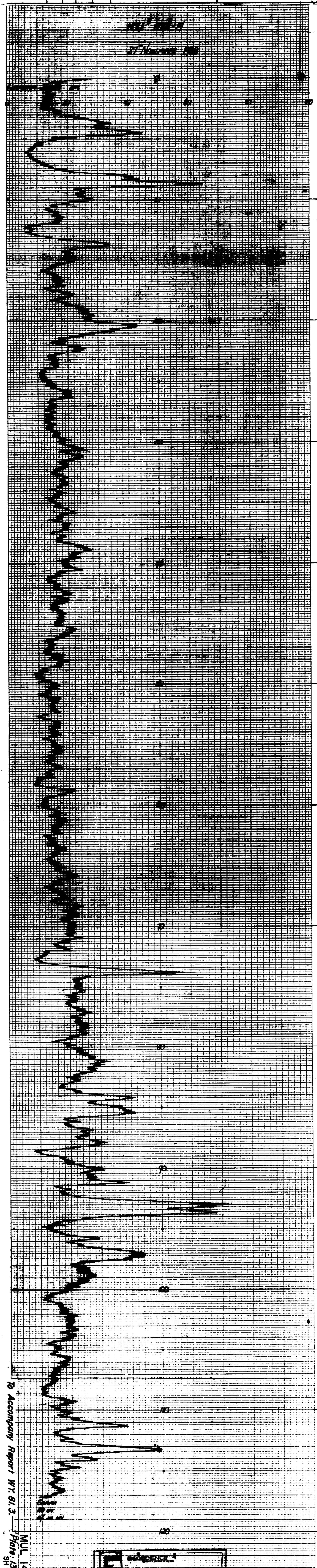
HOLE # MUL-14

LOGGING DATA

DATE 27th November 1980

LOCATION: MULGATHING STATION
State: SOUTH AUSTRALIA
HOLE NUMBER: MUL # 14
Depth drilled: 119.5 metres
CLIENT: AFMECO
Unit Operator: BARRETT
Sampled interval: 1 metre
Type: AIR + DIAMOND CORE
Logged depth (m.): 117.8
Range (Full scale): 100
Paper speed: 1
Logging speed: 9
REMARKS: WHOLE HOLE - 60°
LOGGED THRU RODS

HOLE # MUL-14
27th NOVEMBER 1980



GEOSCIENCE
LOGGING DATA
GAMMA RAY | S.P. | RESISTIVITY
RANGE | ATTEN. | ATTEN.
T.C. | LOG-SPEED |
CAL. | | LOG-SPEED
LOG-SPEED
PROBE No.
K-FACTOR | UNIT No.
HOLE No. MUL # 14 | DATE 27/11/80 | T.D. 119.5 mtr

AFMECO PTY. LTD. HOLE No: MUL 14

PROJECT: MULGATHING, No.: 124
1:250 000 MAP SHEET: TARCOOLA, No.: SH53-10
Collar Coords (m): 770 E, 615 N, (AMG ☑ GRID ☐)
Collar R.L.:
Azimuth: 190°, (Mag ☑, Grid ☐)
Inclination: -60°,

Date begun: 22/11/80
Date terminated: 27/11/80
Contractor: WALLIS
Drill:
Drilling techniques: AIRCORE DIAMOND

Reasons for termination
BROKEN GROUND AT 119.5m, DRILL UNABLE TO PENETRATE

GEOLOGIST: G. STYLES
DATE: 27/11/80

LITHOLOGY (Use BMR Symbols).
- CLAY
- GNEISS
- MYLONITE, SHEARING
- GRANOFELS
- AMPHIBOLITE
- SCHIST

CASING			WEDGES PLACED	
Size	From	To	Type	Depth

STANDING WATER:
DEPTH:
SAMPLE No.:

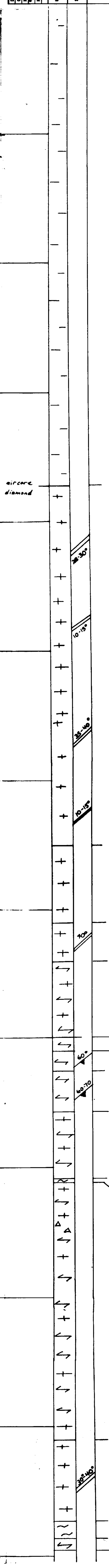
HOLE CONDITIONS WHILE LOGGING
☐ DRY ☐ OPEN HOLE
☐ WATER ☐ IN PIPE
☐ MUD
ADDITIVES:

STRUCTURE
- Bedding
- Banding
- Foliation
- Fracture, joint
- Fault
- Breccia

GENERAL COMMENTS

SCALE: 1:

Depth (m)	Core/Non core	Hole size	% core recovery	Hole attitude	Lithology	Structure (angle to core)	OBSERVATIONS	UNITS	U	Th



white - yellow kaolin - qtz rock

qtz-fs-bt-gn gneiss
bt is brown, gn is largely altered to dk. green-black bt
52-57 gn is largely unaltered

qtz-fs-bt-gn gneiss
more mafic than above, minor brecciation and mylonitization

fg sillimonite (?) gneiss

strongly sheared, mylonitized and brecciated bt-qtz-fs gn ss
74.1 qtz-fs breccia 105 c/s SPP2

dk. green mafic ultramylonite

qtz-fs-bt mylonite ↔ ultramylonite

dk green mafic ultramylonite
84.5 - 84.9 qtz-fs breccia

strongly sheared, brecciated and mylonitized qtz-fs-bt-gn gneiss, gn altered to bt/chl, thin zones of qtz-fs breccia.

green mafic schistose rock with brown carbonate veins and sulphides, similar to 117.4

chaotic zone, stressed, brecciated, mylonitized zones of sillimentite gneiss, qtz-fs-bt-gn gn ss-mylonite ultramylonite thin zones of qtz-fs breccia and massive sheared qtz.
93.2 petrology and analysis
94.2 qtz-fs breccia with bodies of ? chl-sillimanite, 150 c/s SPP2

100-110 zone of greatest mylonitization and thickest qtz-fs zones

qtz-fs-bt-gn (→bt) gneiss, undisturbed, similar 40m

green schist 117.35 - 117.4 petrology and analysis

fault stressed qtz, broken zone

To Accompany Report WY. 81.3 Plate: 13
MUL 14
SH 53 - 10.124.3534

3777-19

GEOSCIENCE
P.O. Box 350
Kilkenny, S.A. 5009
Phone: 268 3000

HOLE # MUL 15

LOGGING DATA

DATE 6th DECEMBER 1980

LOCATION MULGATHING STATION
State: SOUTH AUSTRALIA
Area:
Project:
Prospect:
Lat: ° ' " Long ° ' "

HOLE NUMBER: MUL # 15
Collar elev. metres
Depth drilled: 140·1 metres

CLIENT: AFMECO
Claim:
Owned by:
Operated by:
Unit Operator: BARNETT
Unit No. AL 8 Office: ADELAIDE

CASING DATA		HOLE DATA
Wall size	1/4 in.	Dia. 3 1/4 from 0 to 59·2
Dia. (inside)	3" in.	Dia. 3" from 59·2 to 140·1
Cased from 0 to 48 metres		Dia. from to
Cored hole ☑		Non-cored hole ☐

GAMMA RAY

	INITIAL RUN	2	3	4
Logged depth (ft.)	139·7			
Range (Full scale)	100 cps			
Time constant (sec.)	10% std dev			
Paper speed cm/m	1			
Logging speed m/min	9			
Bkgnd count (cps)	24			
Probe No.	GPA 5			
Size (dia.) (in.)	40 mm			
Type No I	1½" × ½"			
Standard (cps)	495			
Dead time	6			μ sec.
Amp. Gain				
Ratemeter No.				
Bore hole medium				
Mud density				
Digital readout	2nd			
Time base	1 sec			
Upper Disc.				
Lower Disc.				

Sampled Interval	Type
1 metre	AIR + DIAMOND CORE

INTERPRETATION DATA

Probe No.	Standard (cps)	K factor
GPA 5	495	3·15 × 10⁻⁶

REMARKS

Fluid Level metres

LOGGED THROUGH RODS
(NO INNER TUBES)

ELECTRIC

	1	2	3	4
Logged depth				
Resist. scale				
S.P. scale				
Paper speed				
Logging speed				
Probe size	in			
Type	N/d			
Bias				

CALIPER

Logged depth				
Scale	in/in. def.			
Paper Speed				
Logging speed				
Arm Length	in.			
Max. Def.	in.			

HOLE # MUL-15

6th DECEMBER 1980

GEOSCIENCE

LOGGING DATA

GAMMA - RAY	S. P.	RESISTIVITY
RANGE 100 cps	ATTEN.	ATTEN.
T.C. 10% std dev	LOG-SPEED	BIAS
CAL.		SCL
LOG-SPEED 9m/min		LOG-SPEED
PROBE No. GPA 5		
K-FACTOR 3·15×10⁻⁶	UNIT No. AL 8	
HOLE No. MUL # 15	DATE 6·12·80	T.D. 139·7 metres

AFMECO PTY. LTD. HOLE No. MUL 15

PROJECT: MULGATHING , No.: 124
1:250 000 MAP SHEET: TARCOOLA , No.: SH53-10
Collar Coords (m): 770 E, 615 N, (AMG ☑ GRID ☐)
Collar R.L.:
Azimuth: 200 °, (Mag ☑, Grid ☐)
Inclination: – 60 °,

Date begun: 27/11/80
Date terminated: 6/12/80
Contractor: WALLIS
Drill:
Drilling techniques: AIR CORE DIAMOND

Reasons for termination
Target depth reached

GEOLOGIST: G STYLES
DATE: 6/12/80

LITHOLOGY (Use BMR Symbols).

☐	CLAY
☐	GNEISS
☐	MYLONITE, SHEARING
☐	GRANOFELS
☐	AMPHIBOLITE
☐	SCHIST

CASING			WEDGES PLACED	
Size	From	To	Type	Depth

STANDING WATER:
DEPTH:
SAMPLE No.

HOLE CONDITIONS WHILE LOGGING
☐ DRY ☐ OPEN HOLE
☐ WATER ☐ IN PIPE
☐ MUD
ADDITIVES:

STRUCTURE

Bedding	Fracture, joint
Banding	Fault
Foliation	Breccia

GENERAL COMMENTS

SCALE: 1:

Depth (m)	Core / Non core	Hole size	% core recovery	Hole attitude	Lithology	Structure (angle to CORE)	OBSERVATIONS	UNITS	ANALYSIS U	Th

WHITE - YELLOW KAOLIN - QTZ ROCK

qtz - fs - bt - gn gneiss, bt is brown, gn is largely altered to black bt, the brown bt has a strong 2° foliation ⊥ to banding.

gneiss, partially altered/decomposed qtz-fs - brown micacious mineral, ab. large (up to 4cm) rolled garnets - largely altered to green bt/chl, towards the top.

sheared qtz-fs-bt-gn gneiss – proto mylonite, thin zones qtz-fs breccia
85·2 gneiss, petrology + analysis
86·5 qtz-fs breccia 100 c/s SPP2

green (?) chloritized garnet gn ss with ab. sulphides

qtz-fs-bt gneiss – microfaulted and brecciated with dk. coloured ultramylonite at top

fg grey-green granofels

qtz-fs-gn (→bt) - bt gneiss, strongly microfaulted + broken + incipient brecciation, some augen like bodies of qtz/fs

green, mafic amphibolite, several thin zones dk. green ultramylonite

102·2 20cm dk. coloured brecciated and recemented qtz ultramylonite zone

dk. coloured qtz-bt proto mylonite – mylonite

qtz-fs-gn (→bt) – bt gneiss, strongly microfaulted + broken + incipient brecciation.

110·6 10cm massive qtz + dk green – black ultramylonite

green mafic amphibolite, ab. sulphides, weakly banded

115·2 petrology + analysis

qtz-fs - bt gneiss, microfaulted, ab. sulphides

qtz - bt gneiss – mylonite, qtz. is dom. component + is strongly sheared

ab. large pink gn (→bt) in last metre

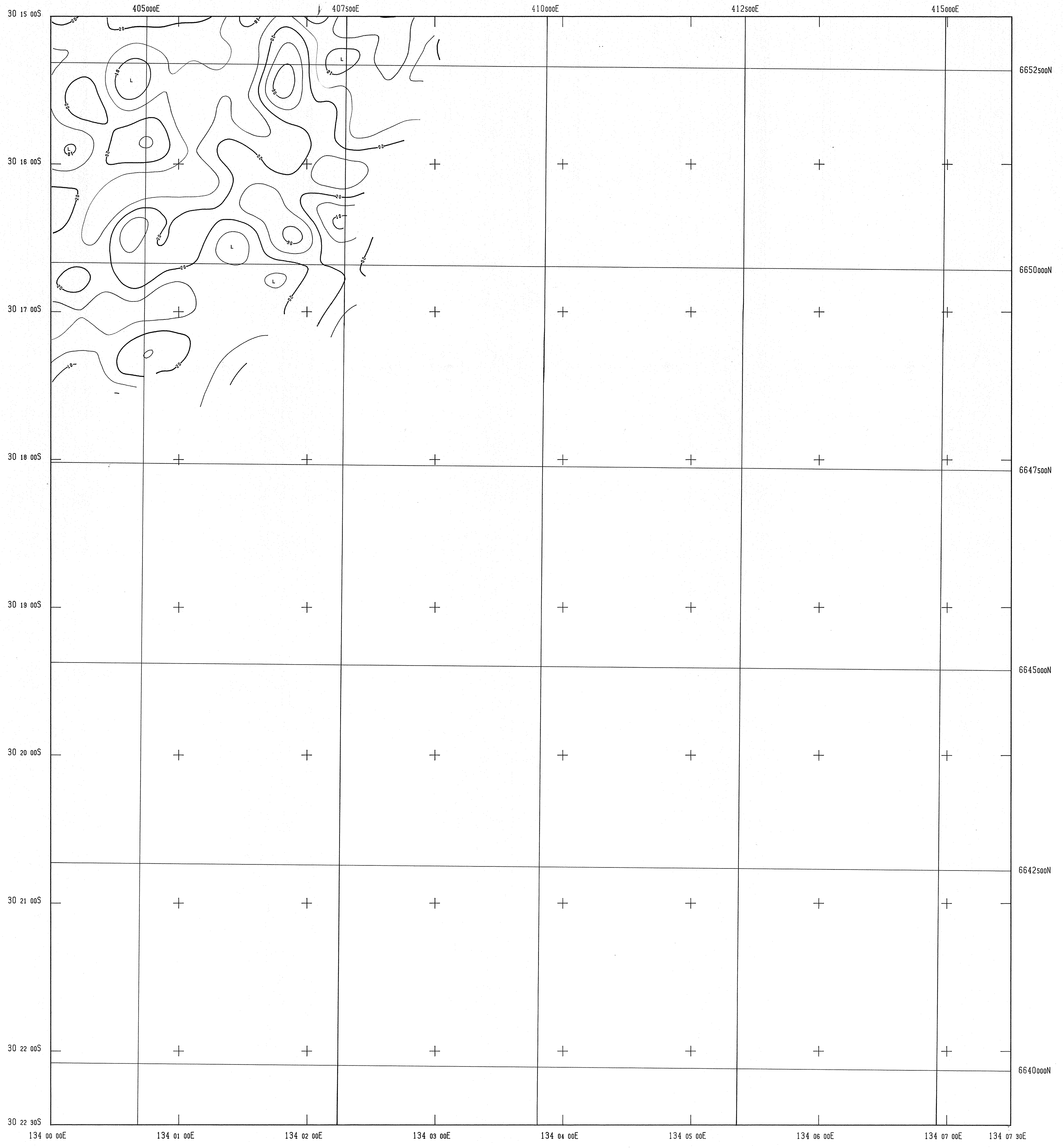
v. cg breccia, orange > lt. green fs, minor bt cemented by translucent white qtz. max SPP2 90 c/s

qtz - fs - gn - bt gneiss, banding is variable and appears highly disturbed.
foliation of qtz + bt often ⊥ to banding.

135·0 20 cm v. cg breccia as above.

3777-20

To Accompany Report WY.81.3. Plate : 14
MUL 15
SH 53-10.124.3535.



N

0 1 2 Km

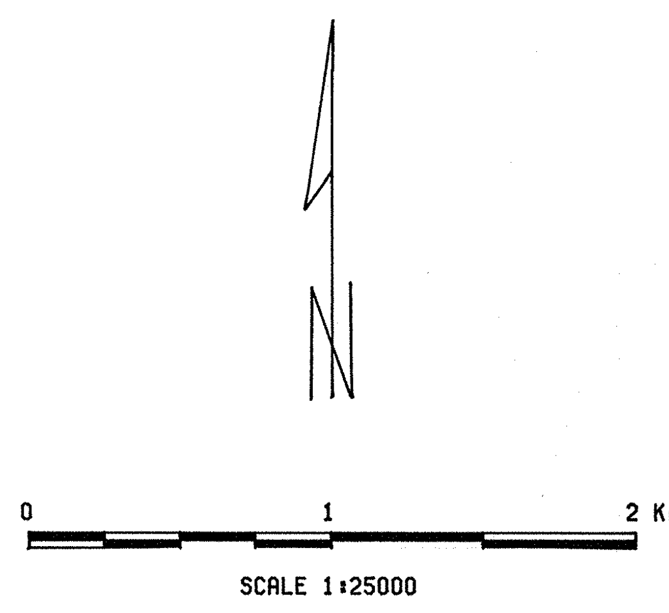
SCALE 1:25000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
URANIUM CHANNEL
SHEET 5737 - III - NW

DWG.No.SH53-10.GPR2211 DATE: 02-MAY-80

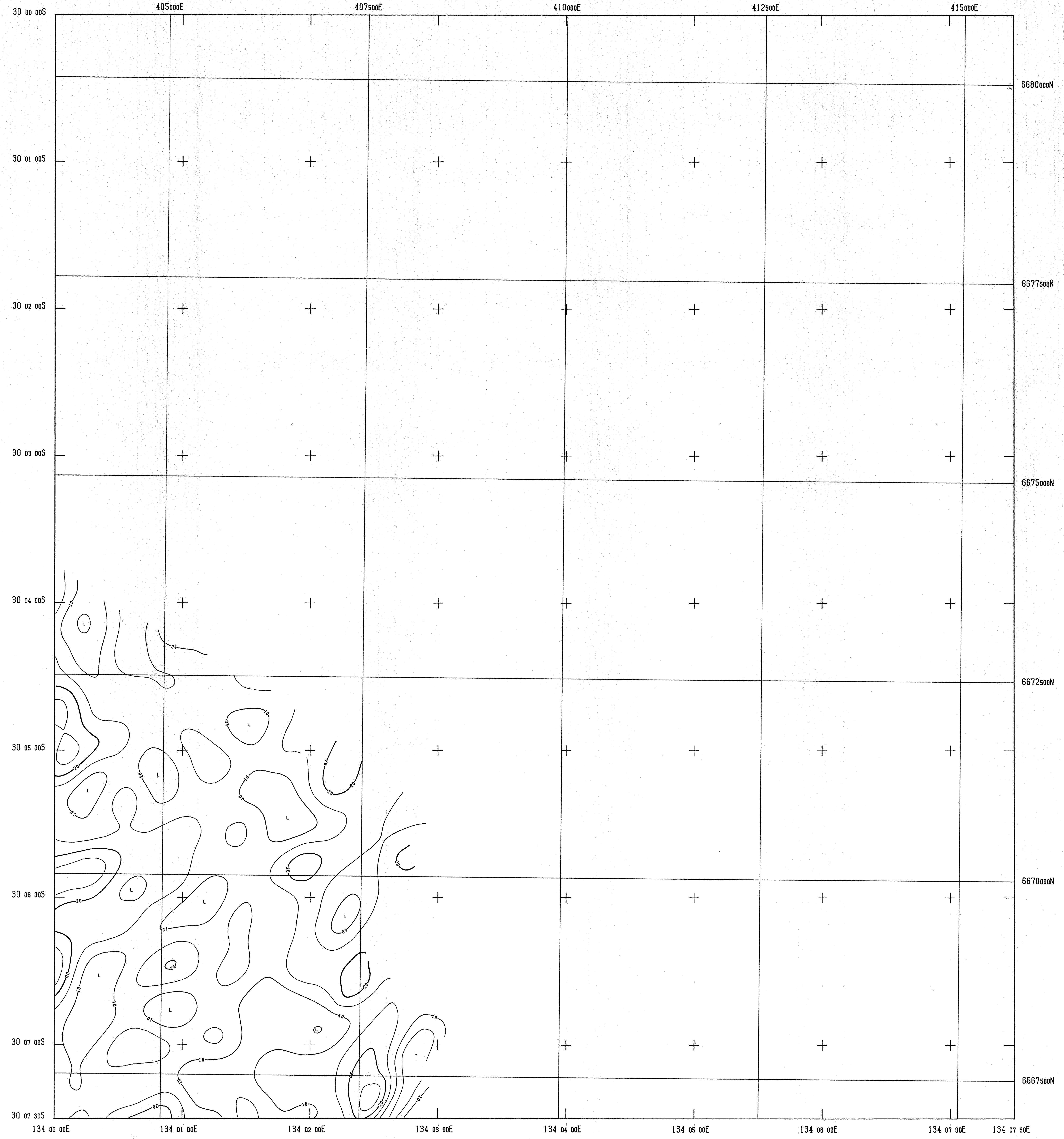


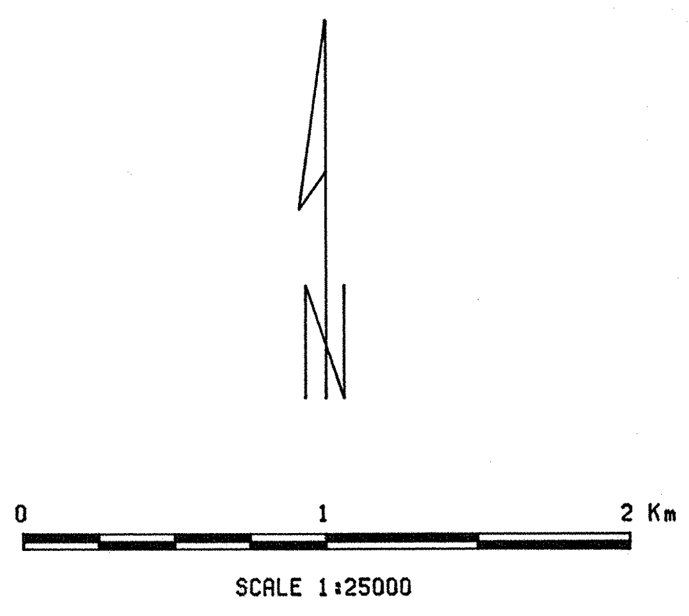
FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
URANIUM CHANNEL
SHEET 5737 - IV - SW

DWG.No.SH53-10.GPR.2212
DATE: 02-MAY-80





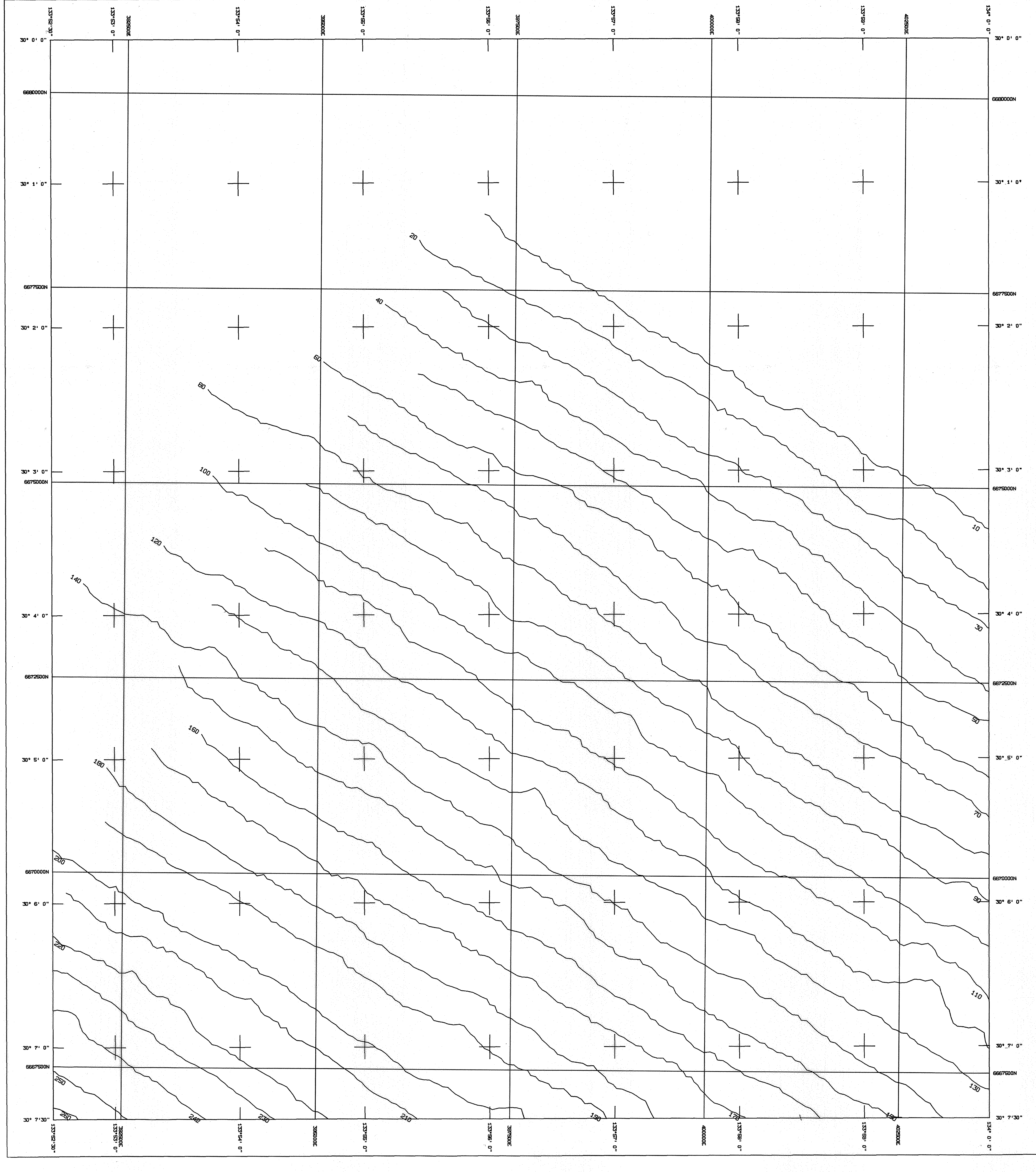
FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
URANIUM CHANNEL
SHEET 5737 - IV - NW

DWG.No.SH53-10.GPR 2213

DATE: 02-MAY-80



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

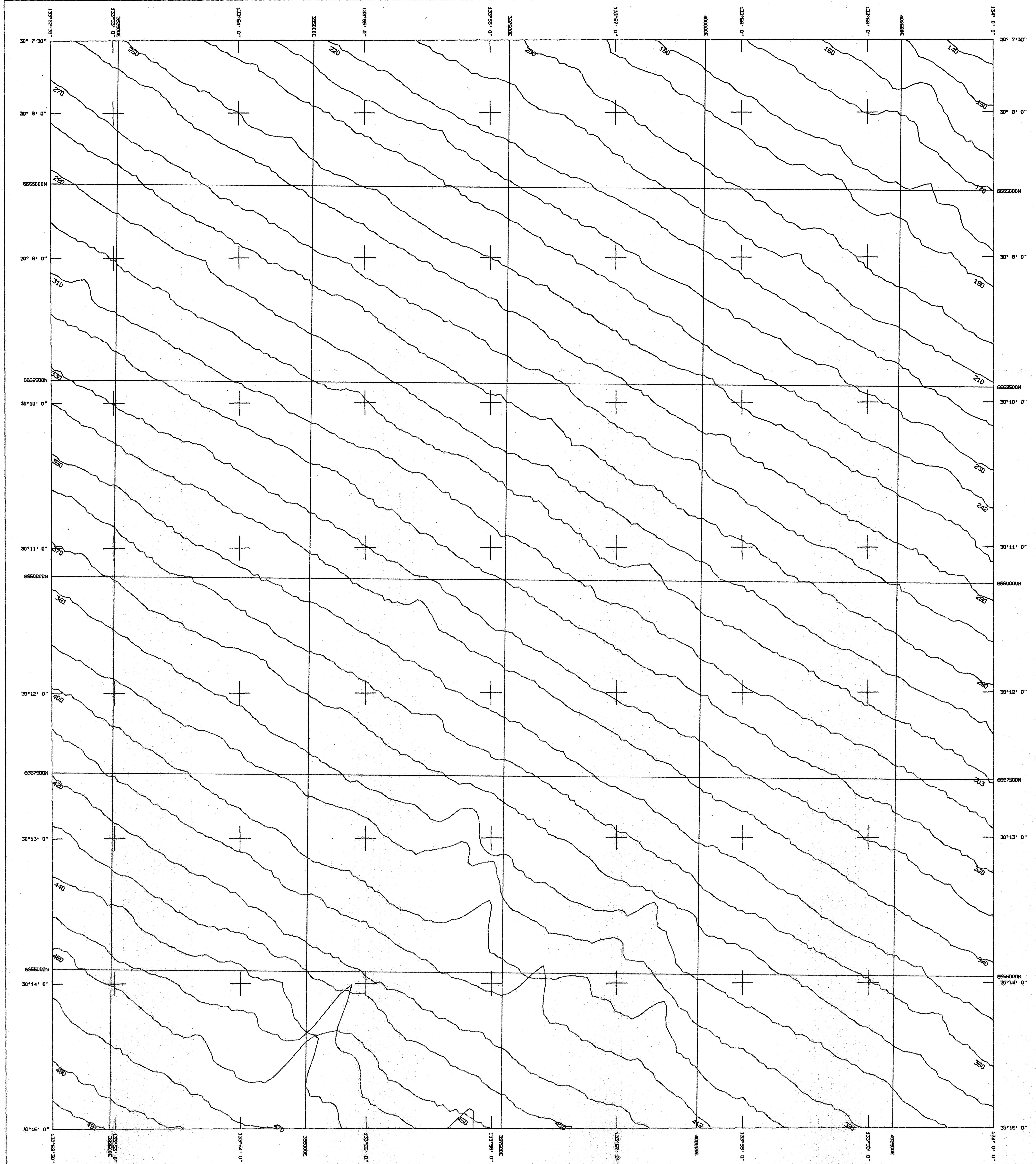
SHEET - 5637-I-NE

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 6/MAR/80

DWG. No. SH53-10.GPR.2153



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

SHEET - 5637-I-SE

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 4/MAR/80

DWG.No.SH53-10.GPR.2154

MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

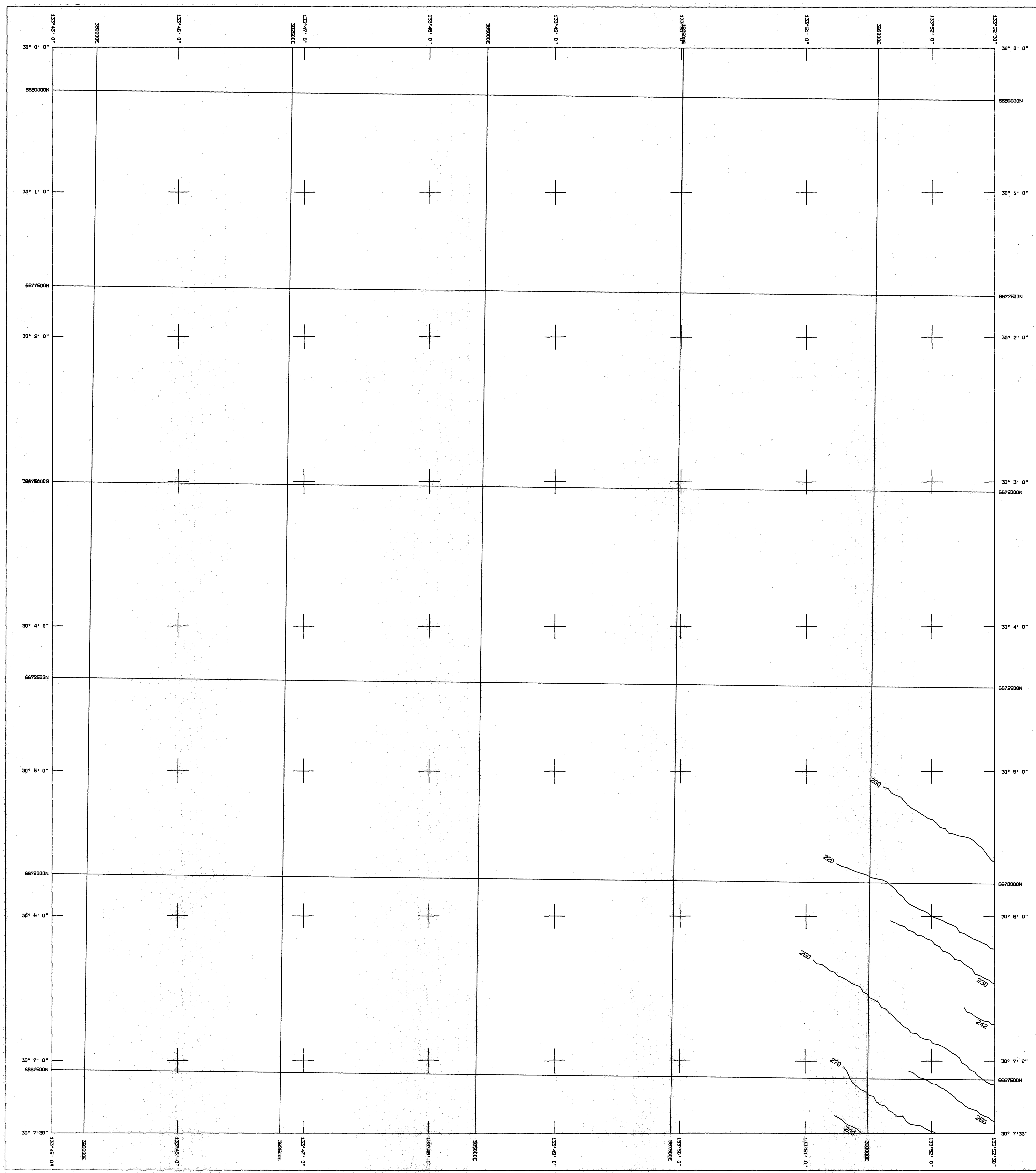
SHEET - 5637-I-SW

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 4/MAR/80

DWG:No.SH53-10.GPR.2155



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

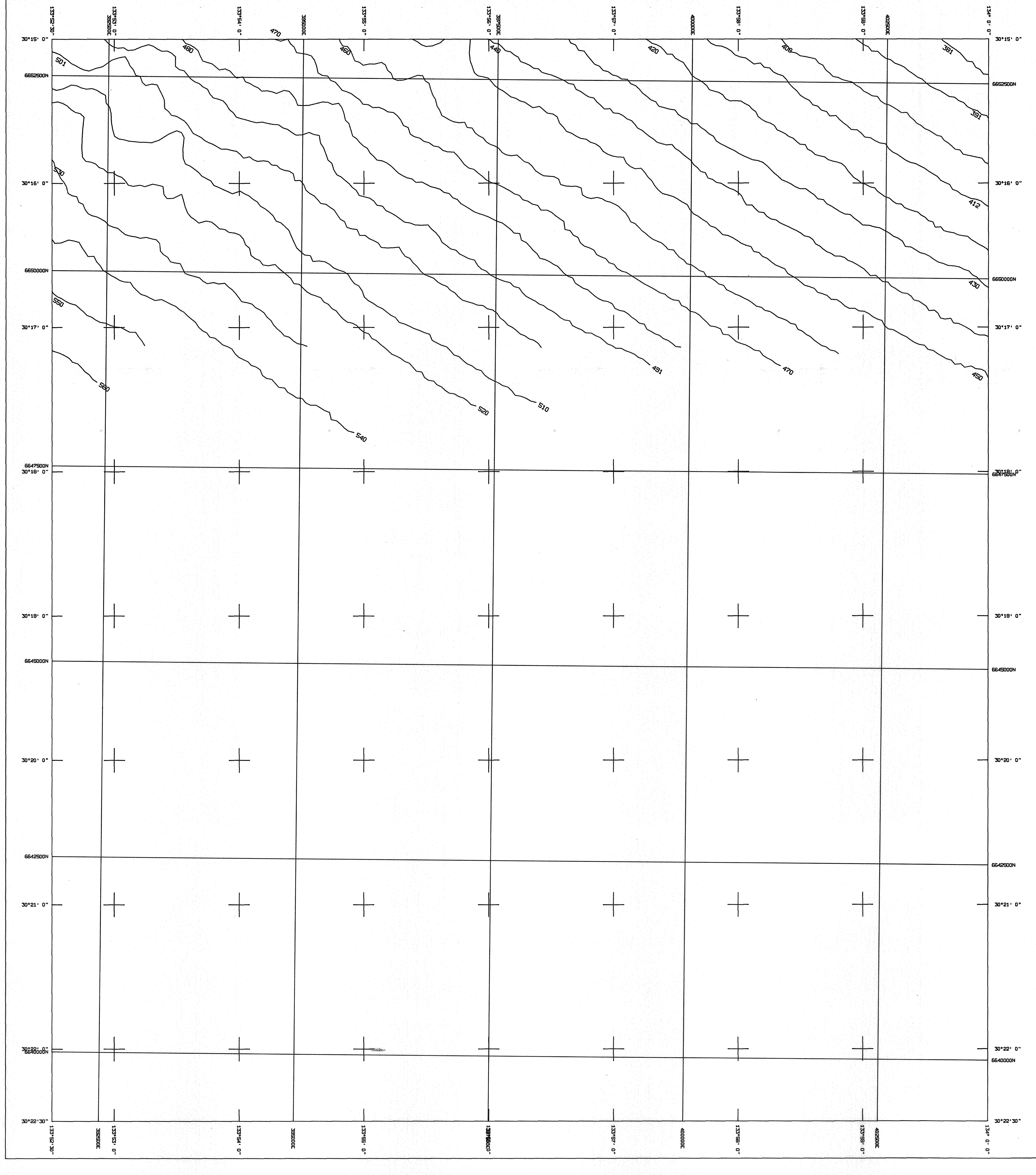
SHEET - 5637-I-NW

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 5/MAR/80

DWG.NoSH53-10.GPR.2156



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

SHEET - 5637-II-NE

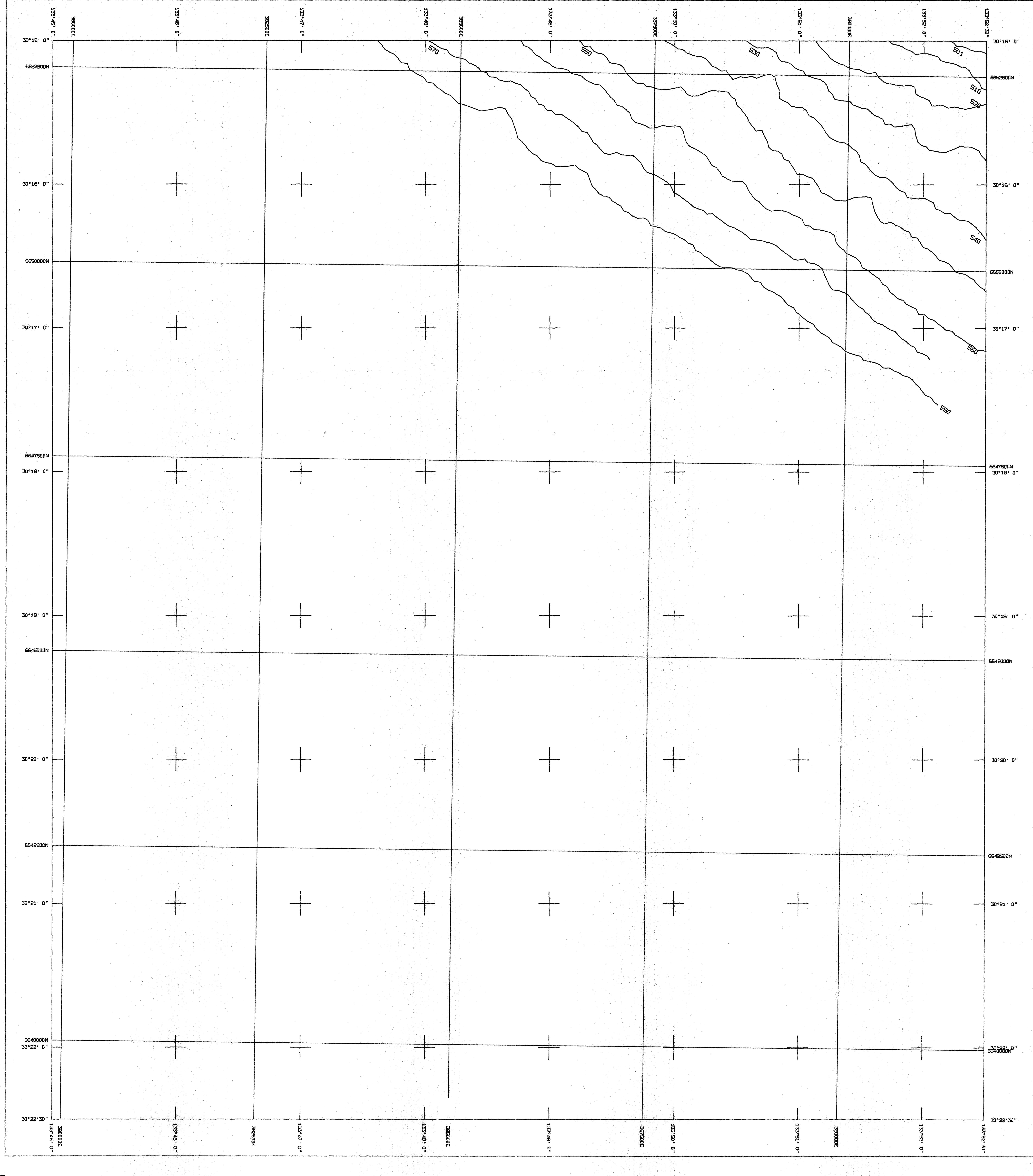
1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD.

28/FEB/80

DWG. No. SH53-10.GPR.2157



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

SHEET - 5637-II-NW

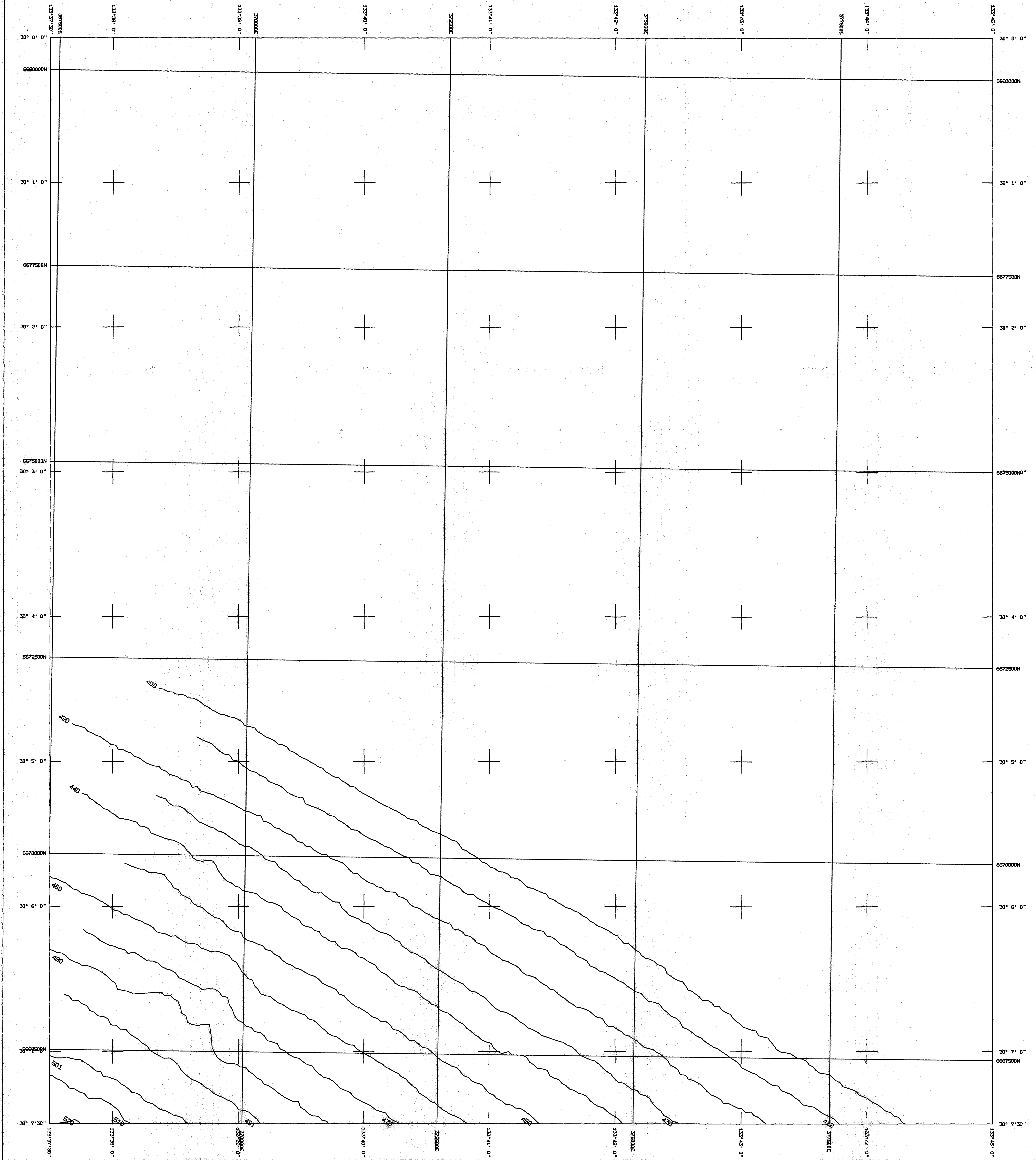
1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD.

28/FEB/80

DWG.No.SH53-10.GPR.2158



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

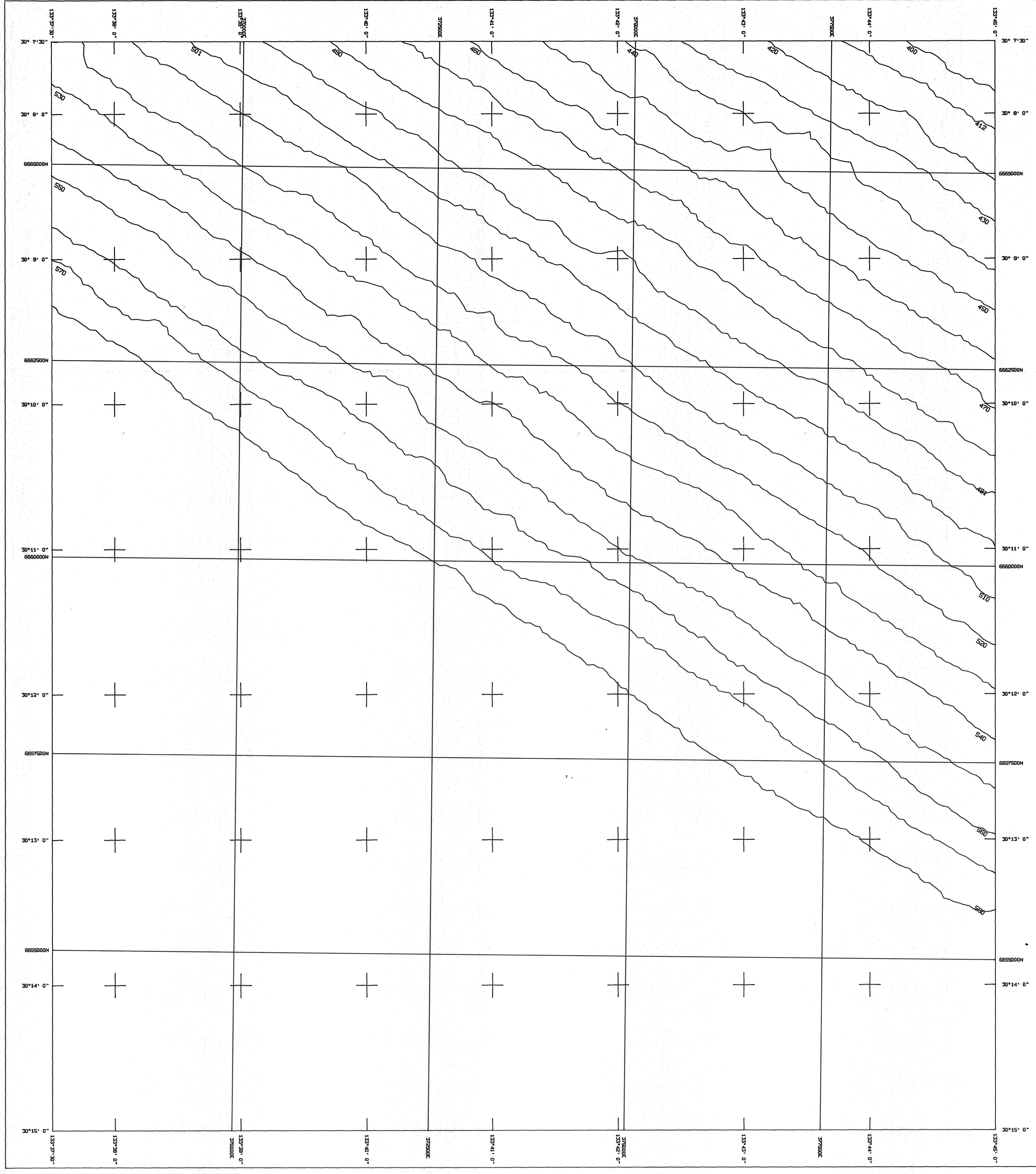
SHEET - 5637-IV-NE

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 5/MAR/80

DWG. No.SH53-10GPR.2159



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

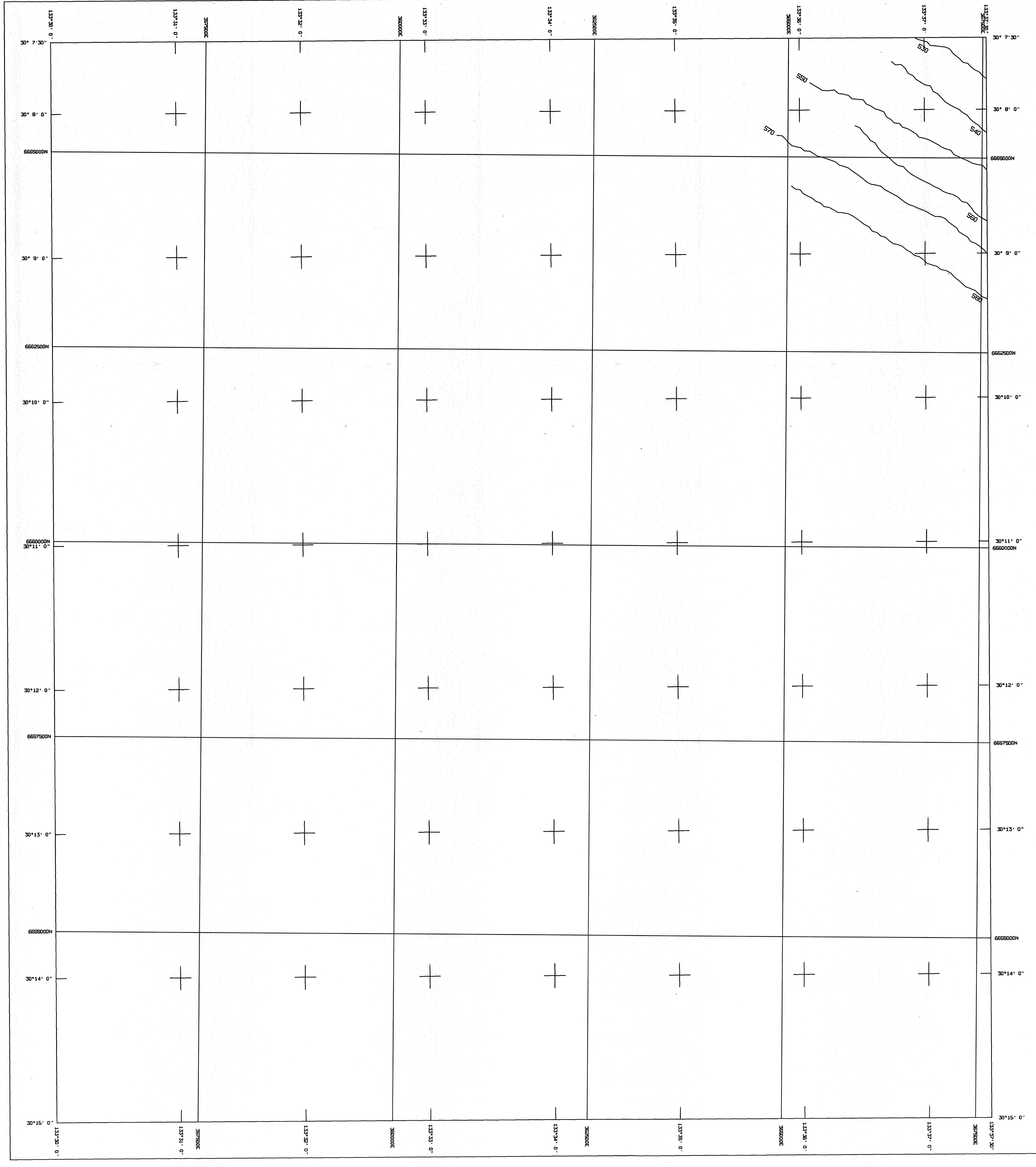
SHEET - 5637-IV-SE

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 3/MAR/80

DWG.No.SH53-10.GPR.2160



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

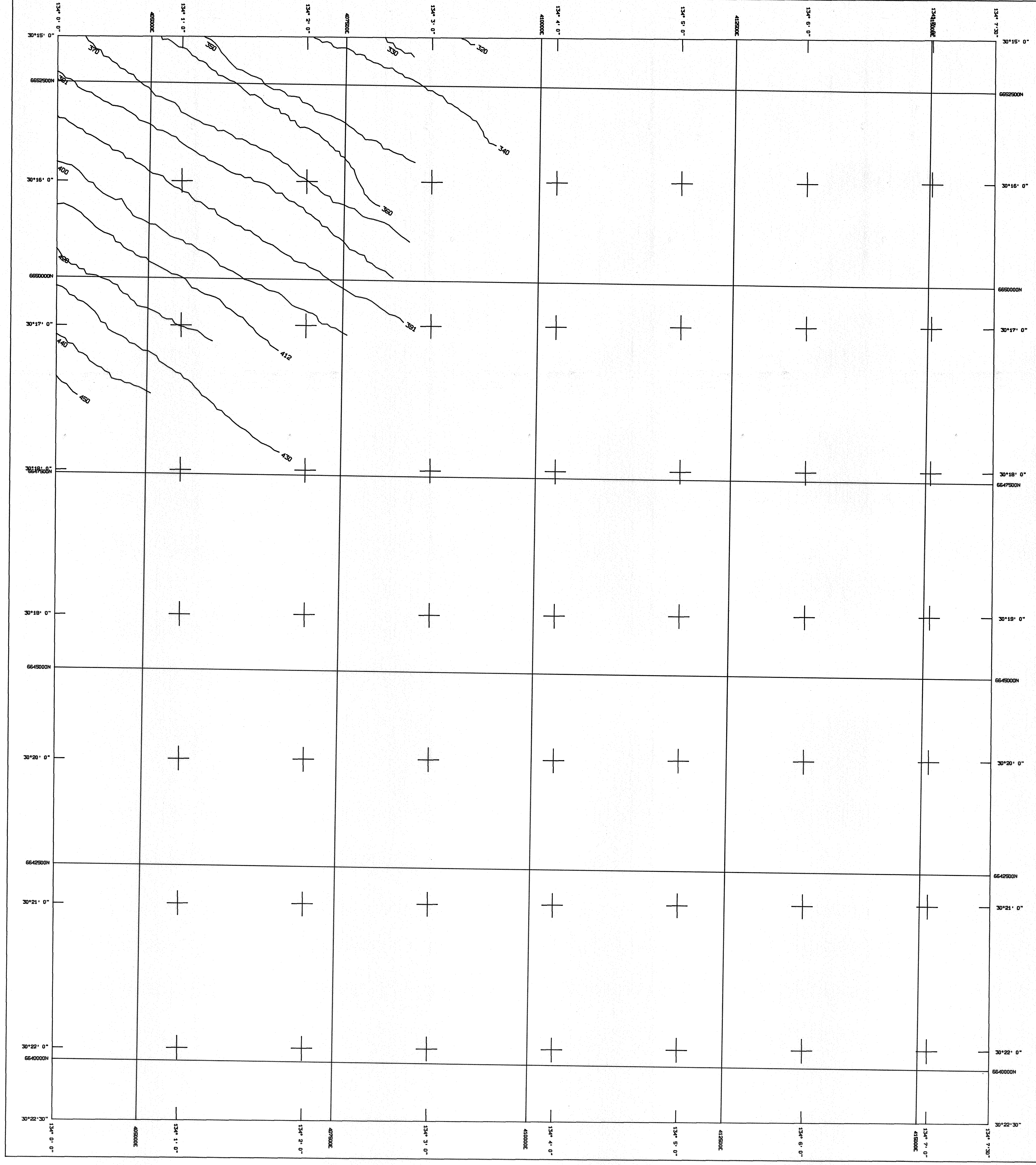
SHEET - 5637-IV-SW

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 29/FEB/80

DWG.No.SH53-10.GPR.2161



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

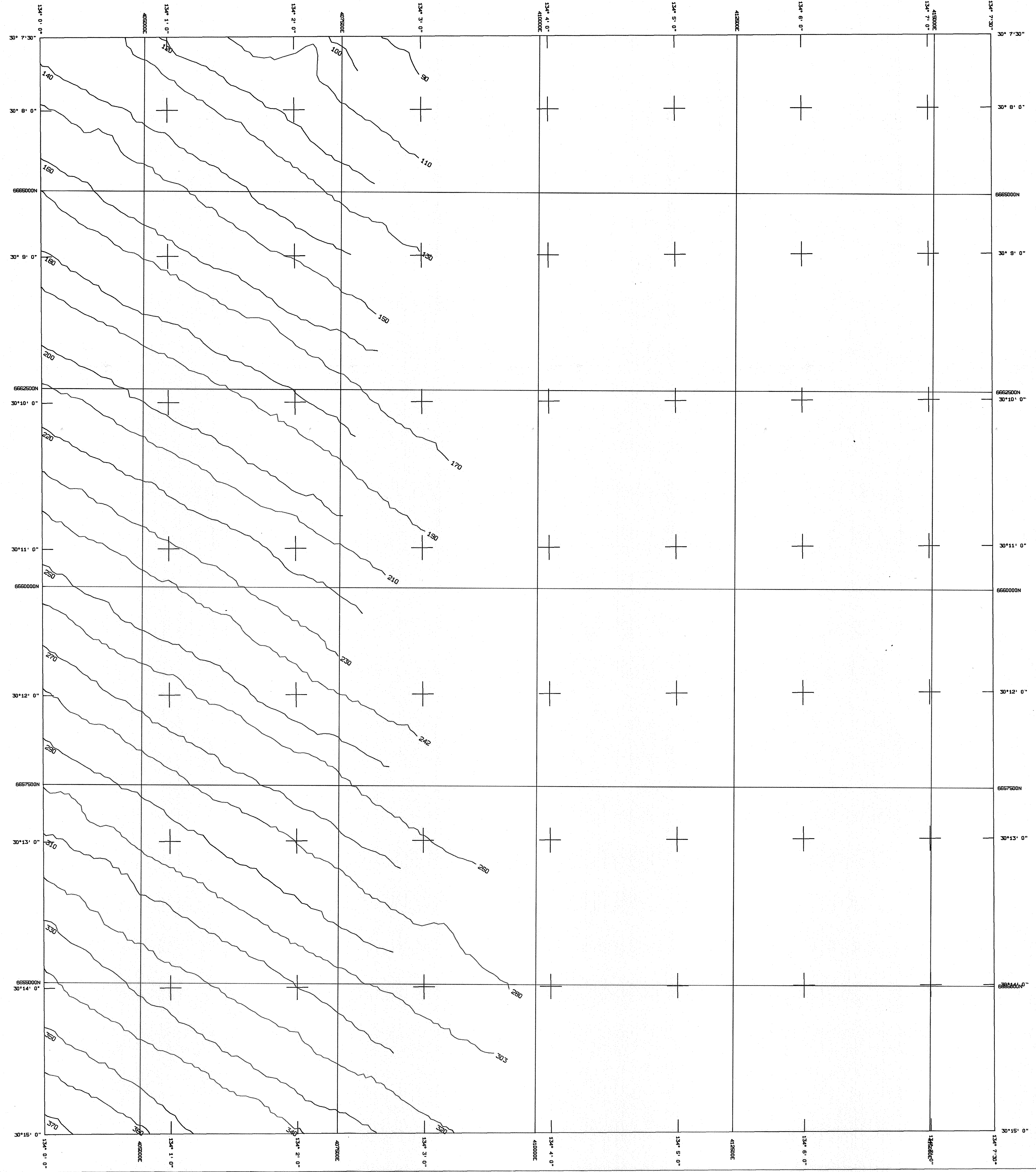
SHEET - 5737-III-NW

1 : 25 000

AUSTIREX AERIAL SURVEYS PTY. LTD.

29/FEB/80

DWG. No. SH53-10.GPR.2199



MULGATHING - TOTAL COUNT

BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

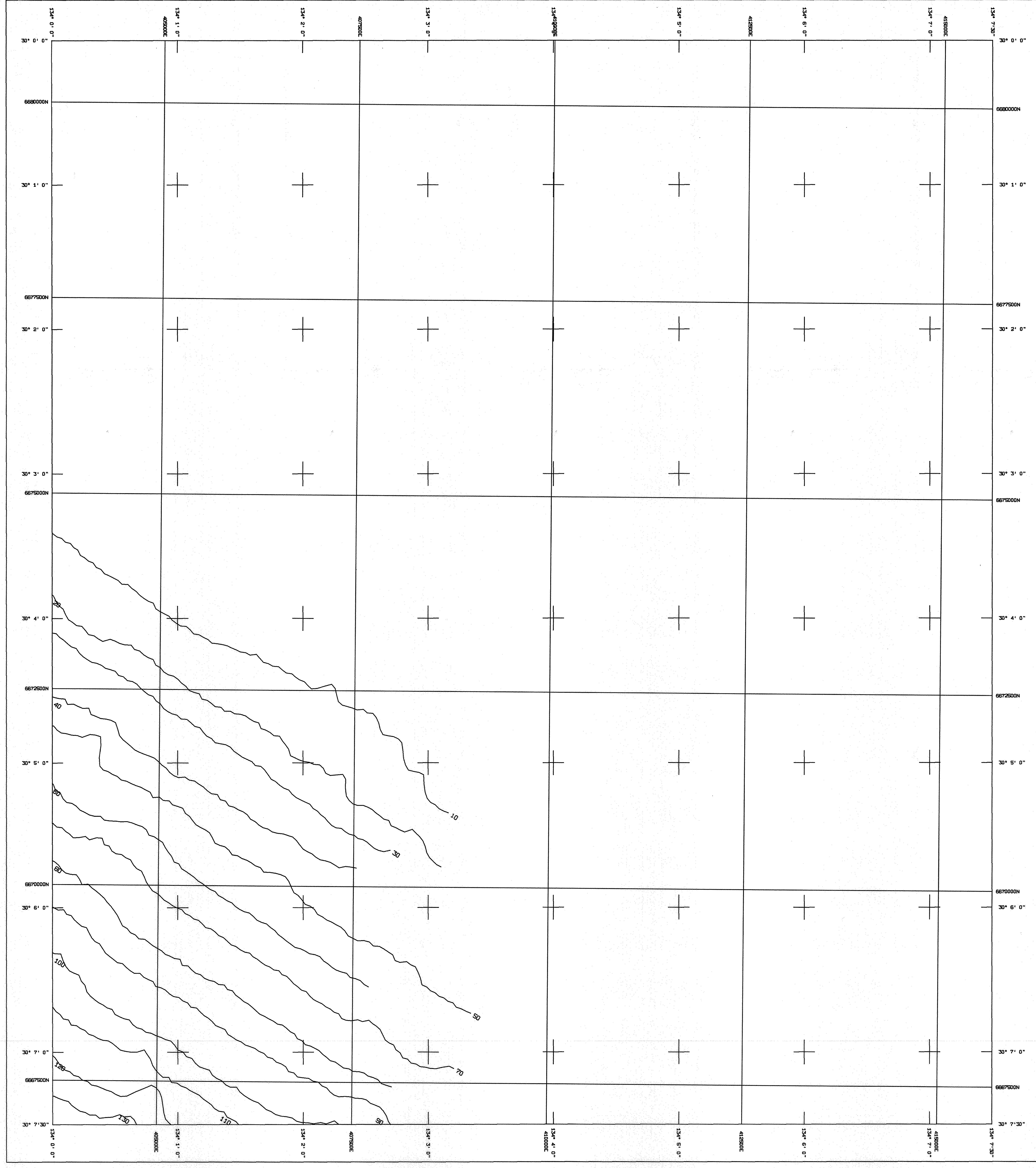
SHEET - 5737-IV-SW

1 : 25 000

0 1 2

AUSTIREX AERIAL SURVEYS PTY. LTD. 4/MAR/80

DWG.No.SH53-10.GPR.2200



MULGATHING - TOTAL COUNT

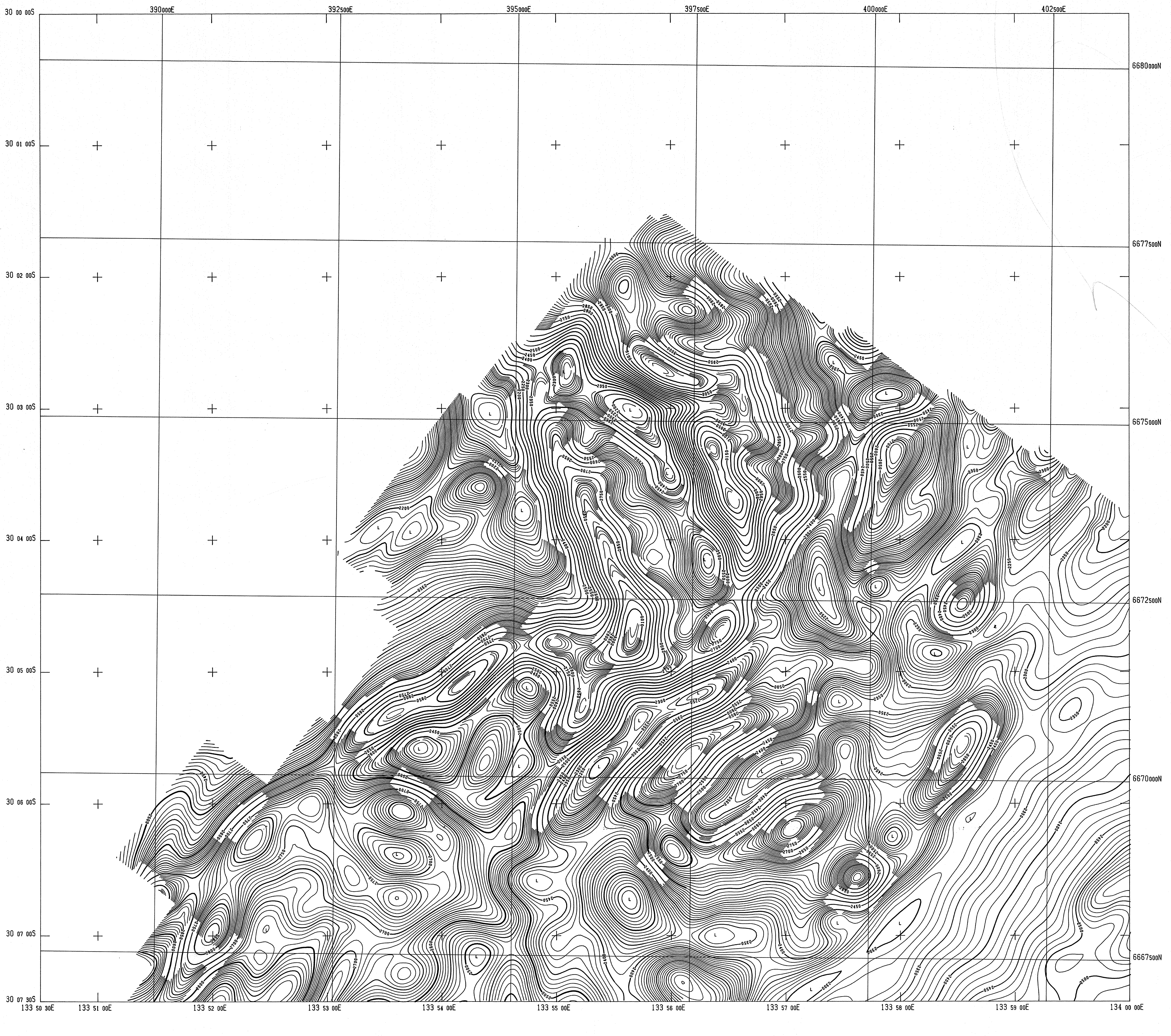
BASE: 0 COUNTS - SCALE: 1000 COUNTS/CM

SHEET - 5737-IV-NW

1 : 25 000

AUSTIREX AERIAL SURVEYS PTY. LTD.   6/MAR/80

DWG.No.SH53-10.GPR.2201



0 1 2 Km

SCALE 1:25000

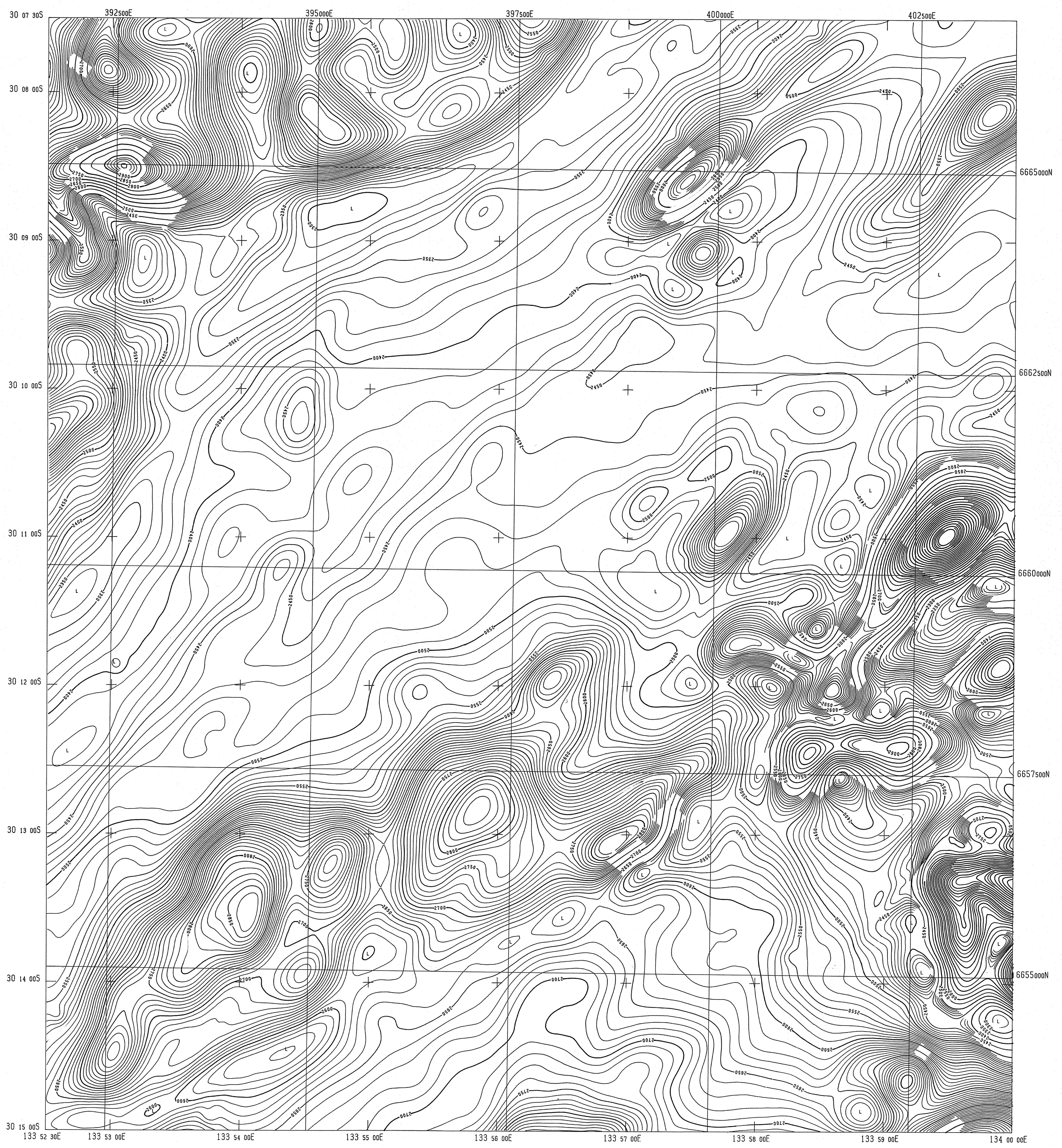
FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637-I-NE

DWG. No. SH53-10. GPM. 2135

DATE: 17-FEB-80



N

0 1 2 Km

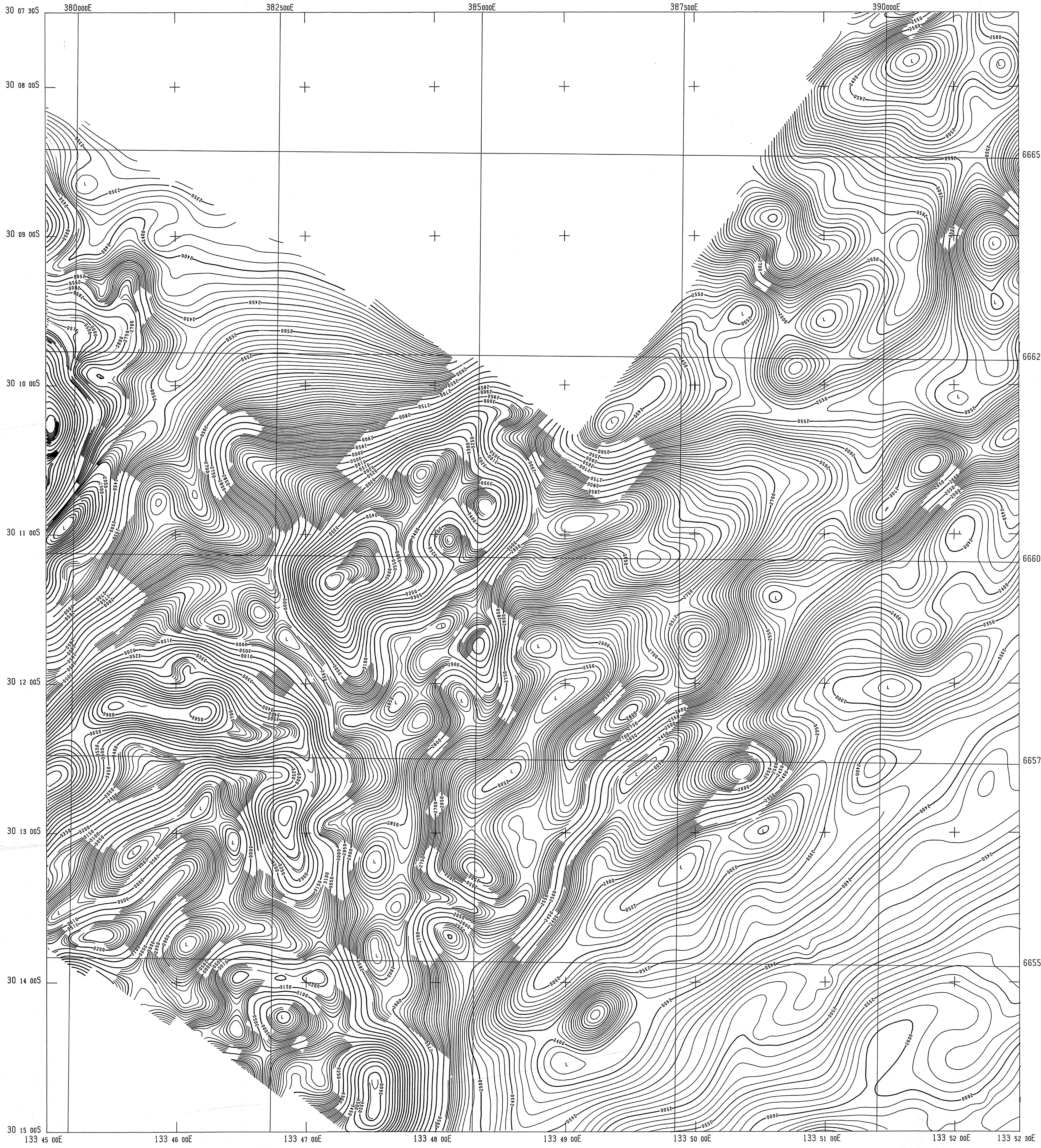
SCALE 1:25000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637-I-SE

DWG. No.SH53-10.GPM.2136 | DATE: 17-FEB-



N

0 1 2 Km

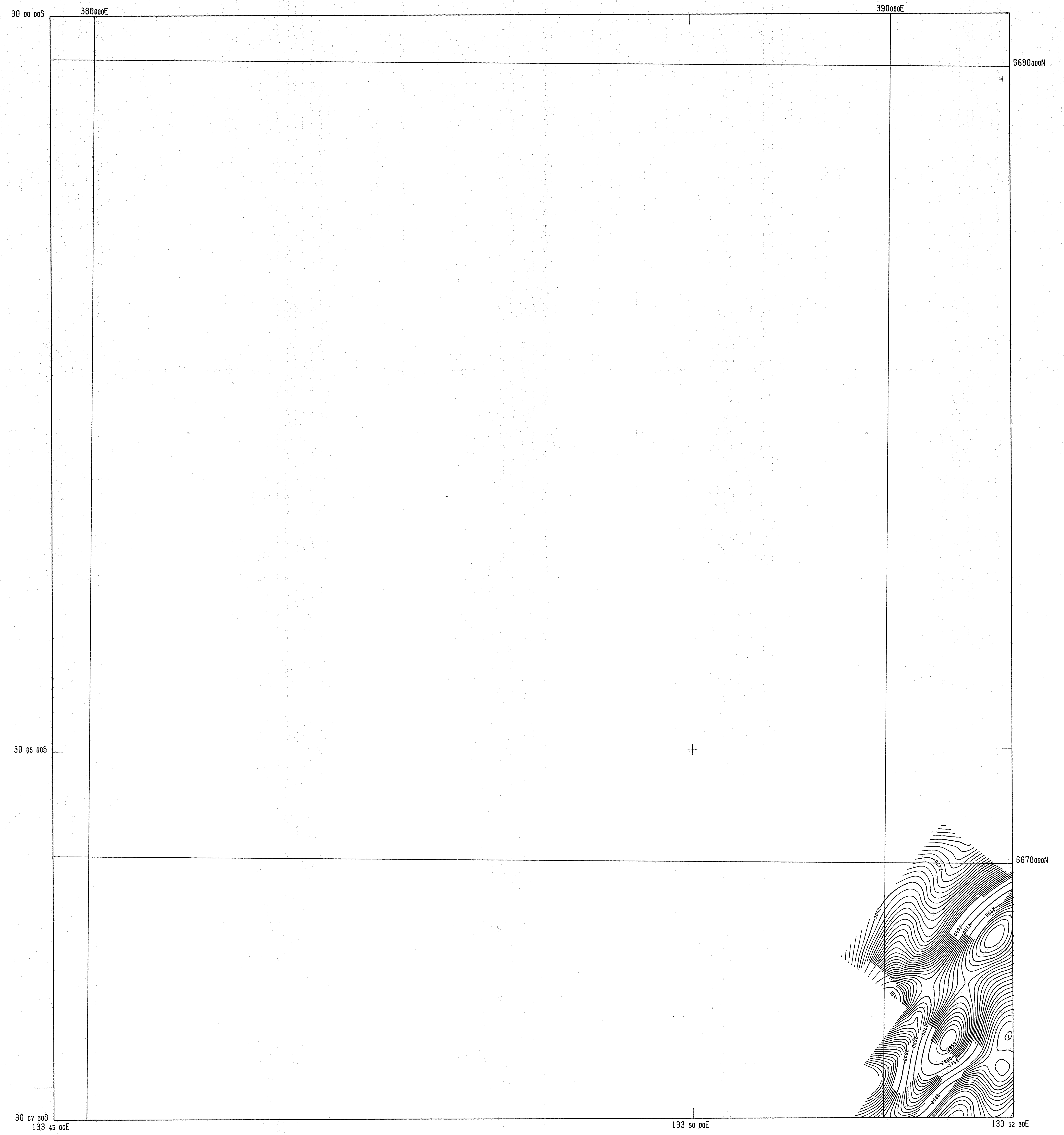
SCALE 1:25000

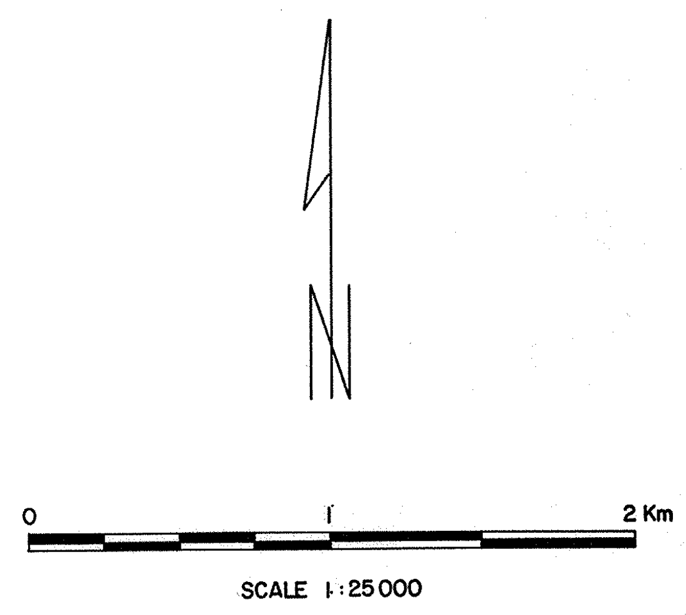
FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S. A.
TOTAL MAGNETIC FIELD
SHEET 5637-I-SW

DWG. No. SH53-10. GPM. 2137
DATE: 17-FEB-80





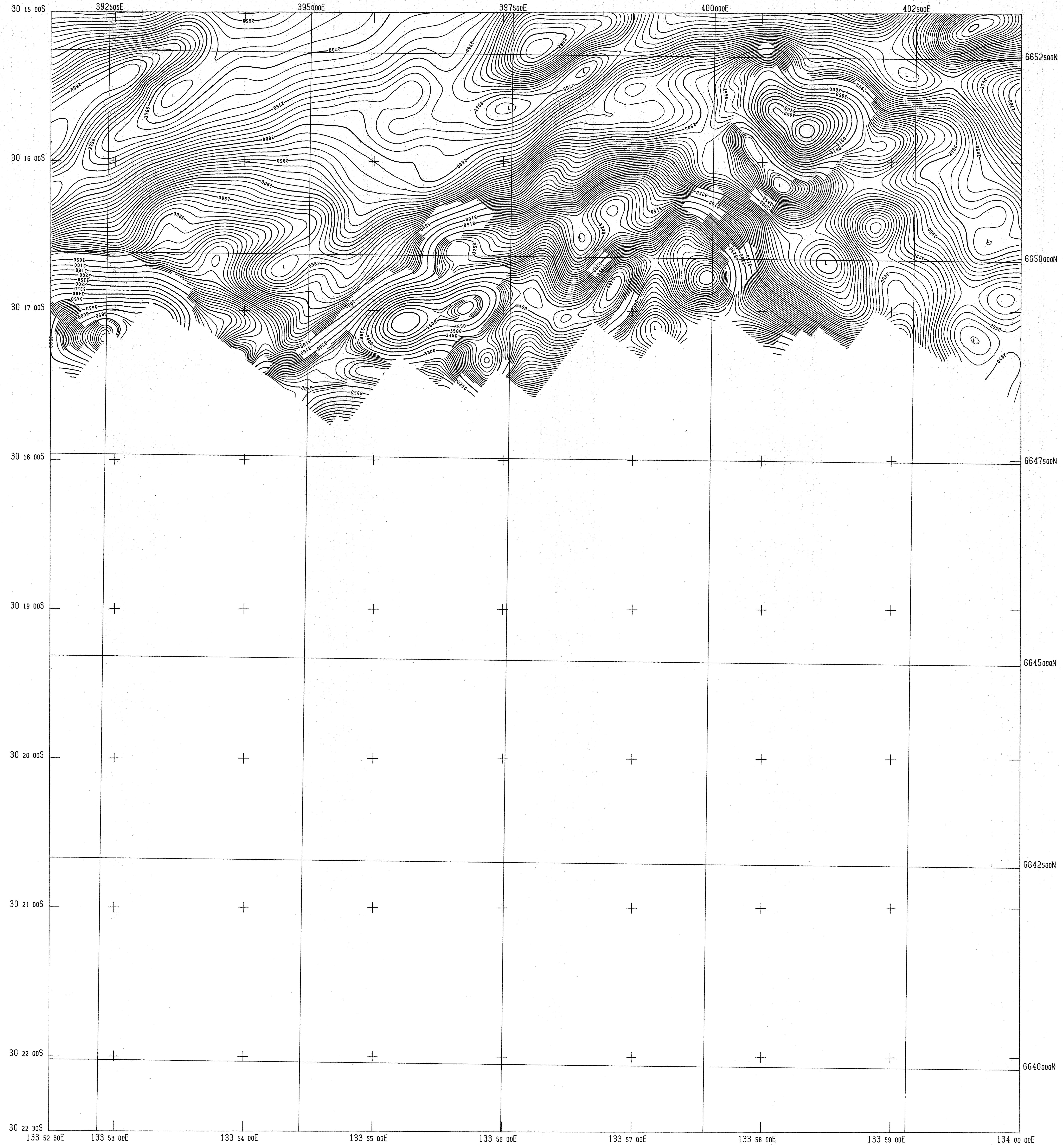
SCALE 1:25000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637 - I - NW

DWG.No.SH53-10.GPM.2138	DATE: 17-MAR-80



N

0 1 2 Km

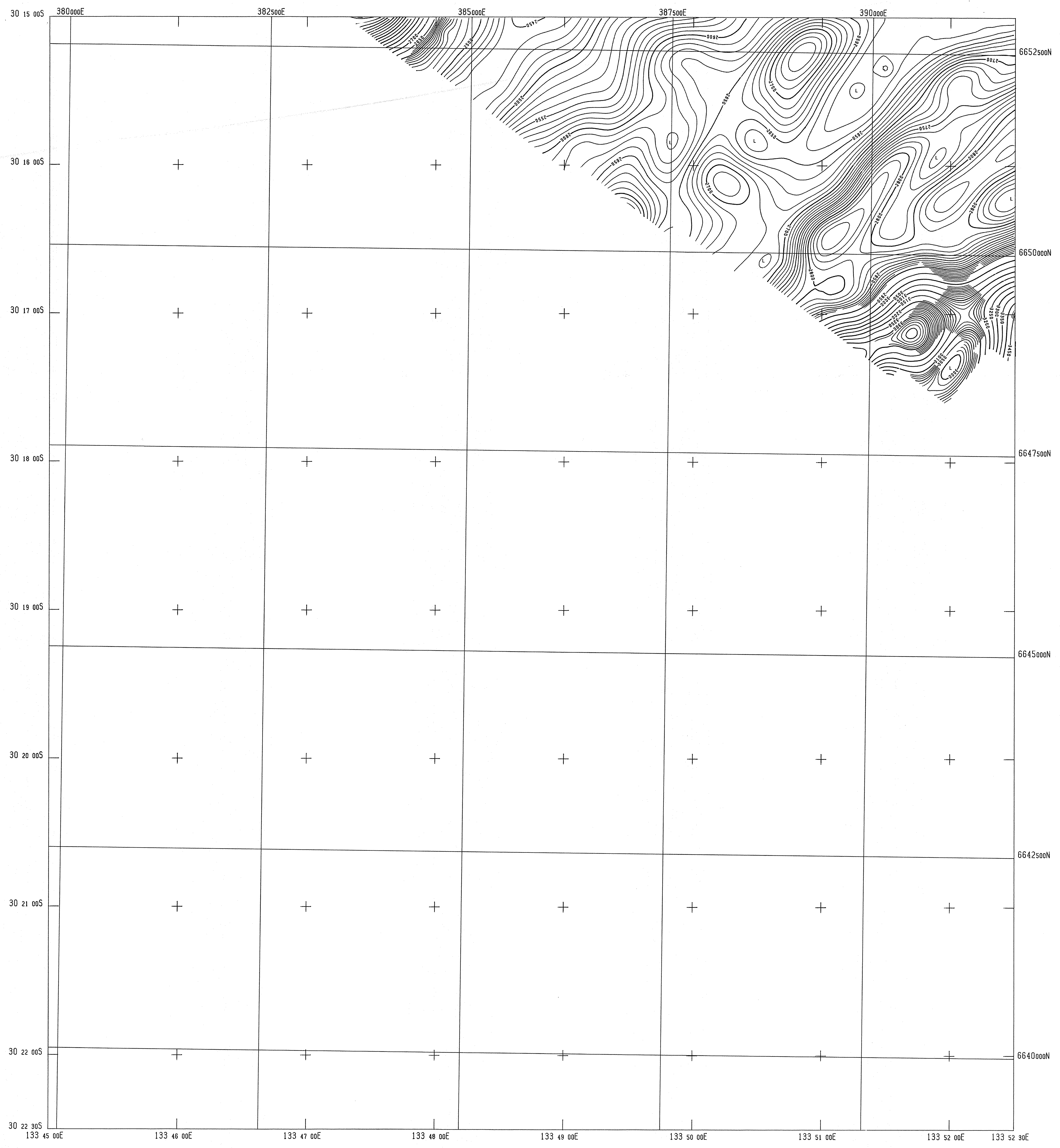
SCALE 1:25000

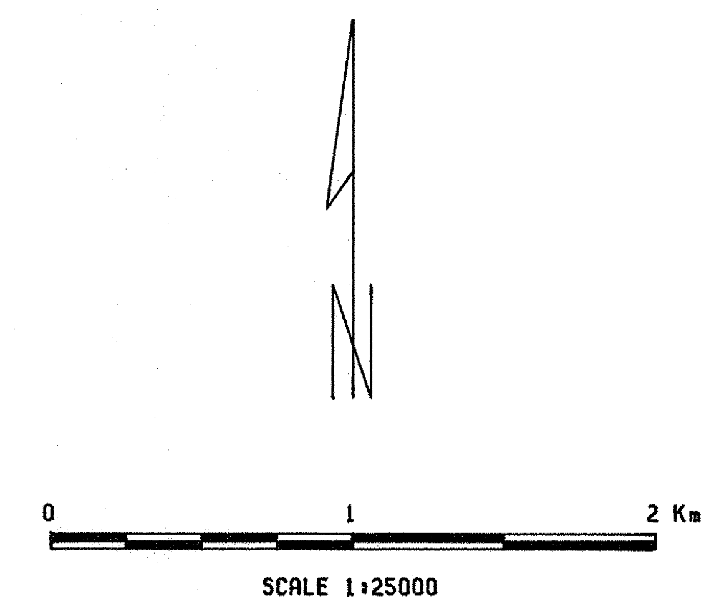
FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637-II-NE

DWG. No.SH53-10. GPM.2139 DATE: 17-FEB-80



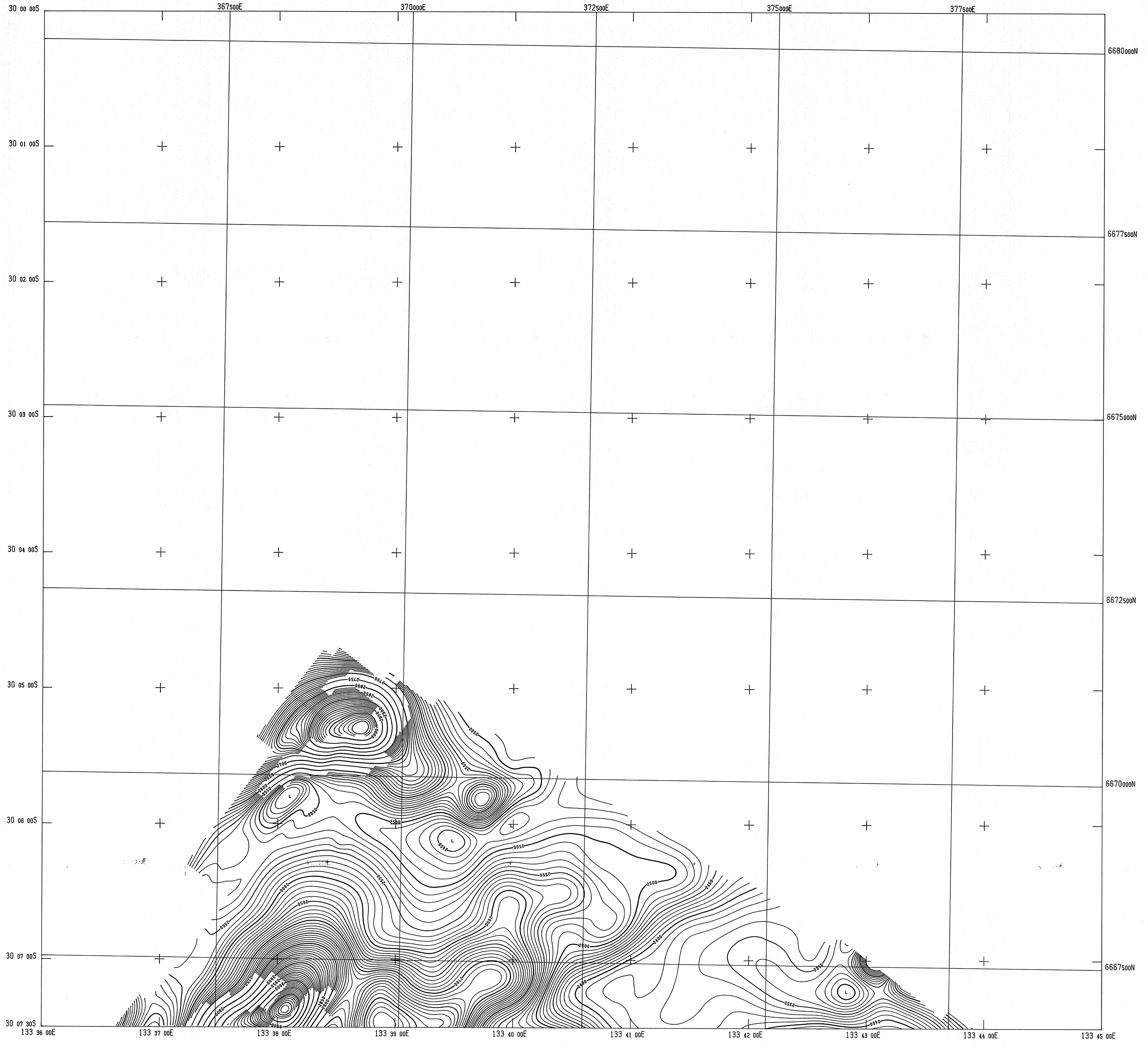


FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637-II-NW

DWG.No.SH53-10.GPM.2140 DATE: 17-FEB-80



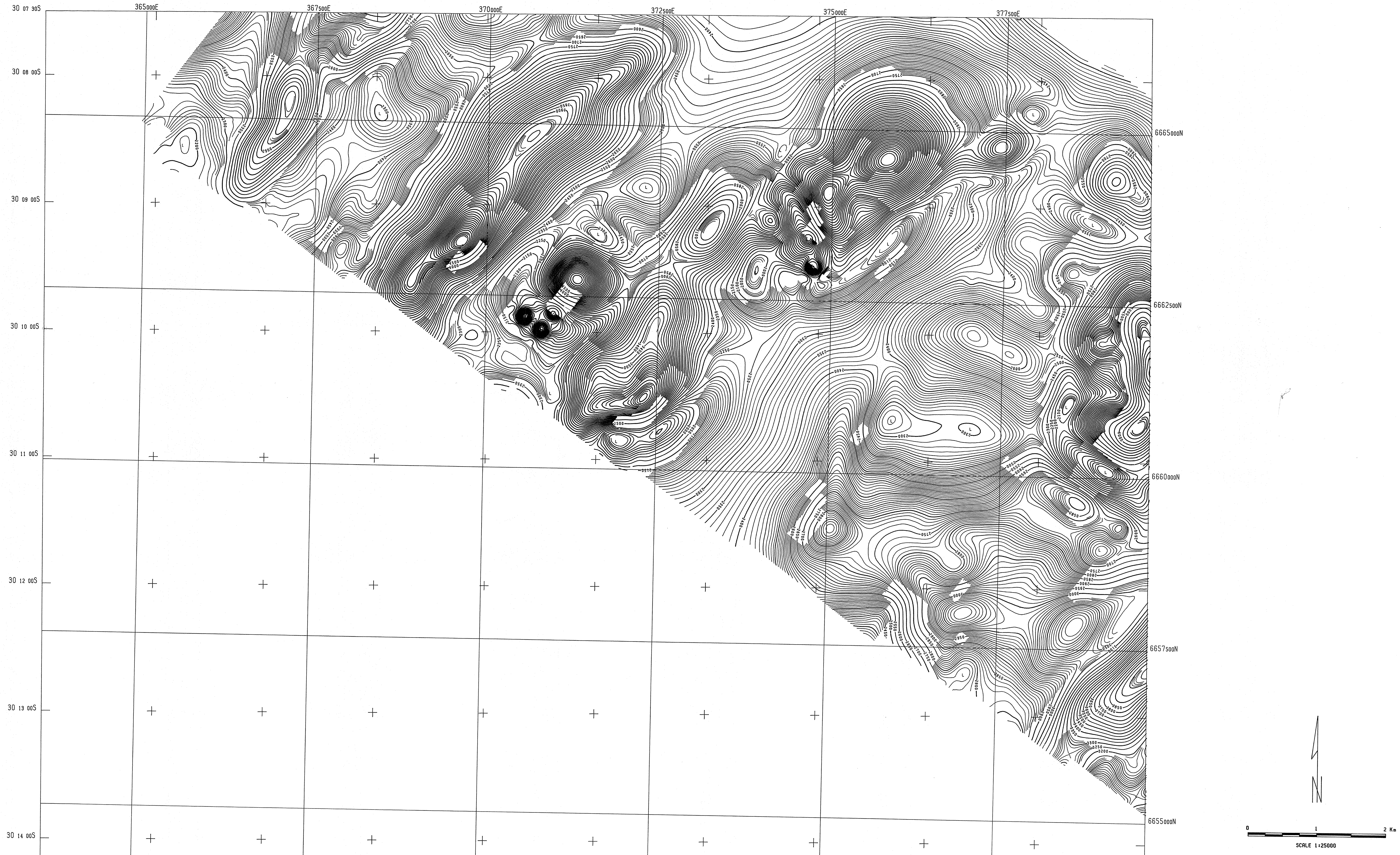
SCALE 1:25000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637-IV-NE

DWG.No.SH53-10.GPM.2141 DATE: 17-FEB-80



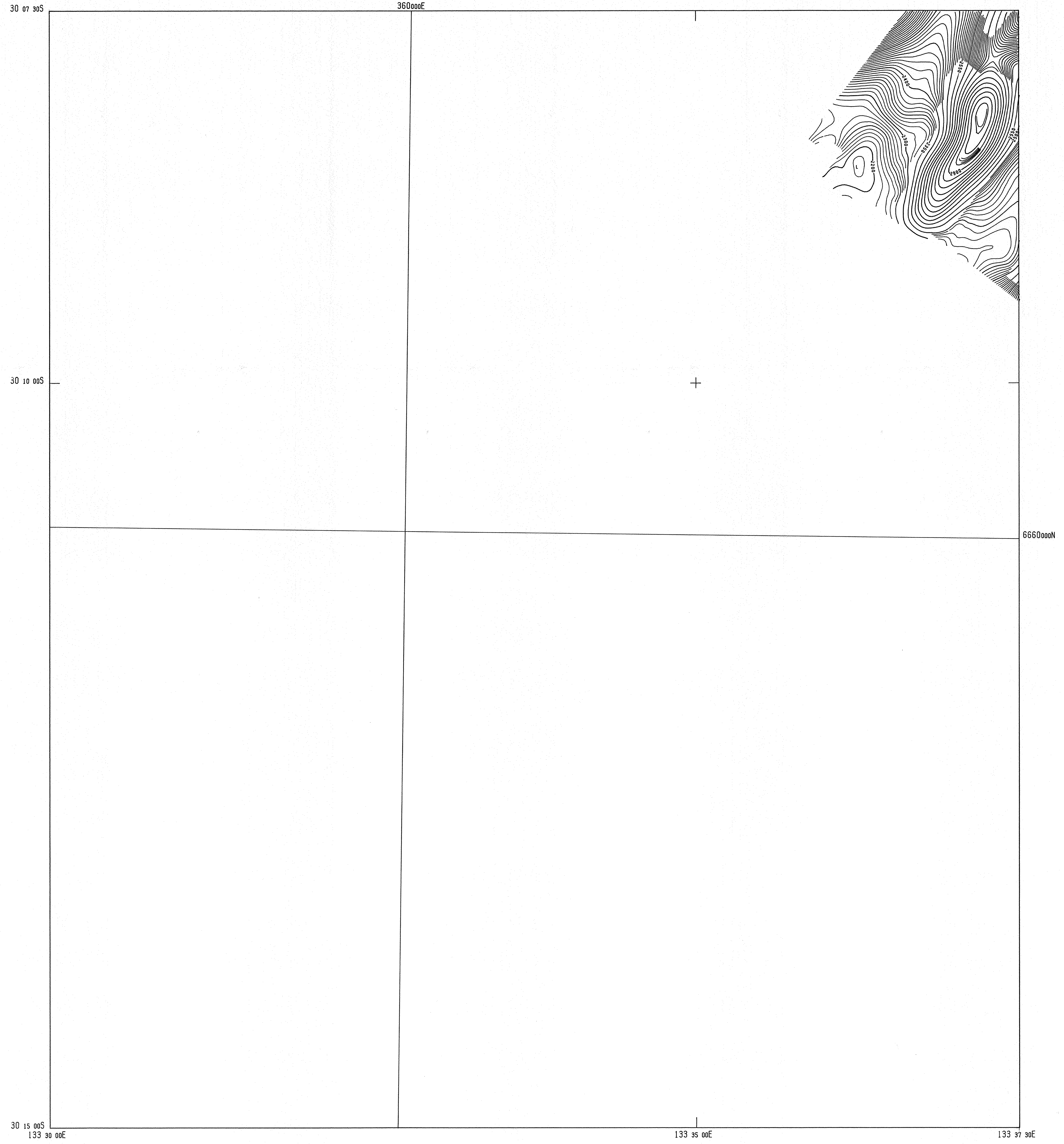
FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637-IV-SE

DWG.No.SH53-10.GPM.2142

DATE: 17-FEB-80



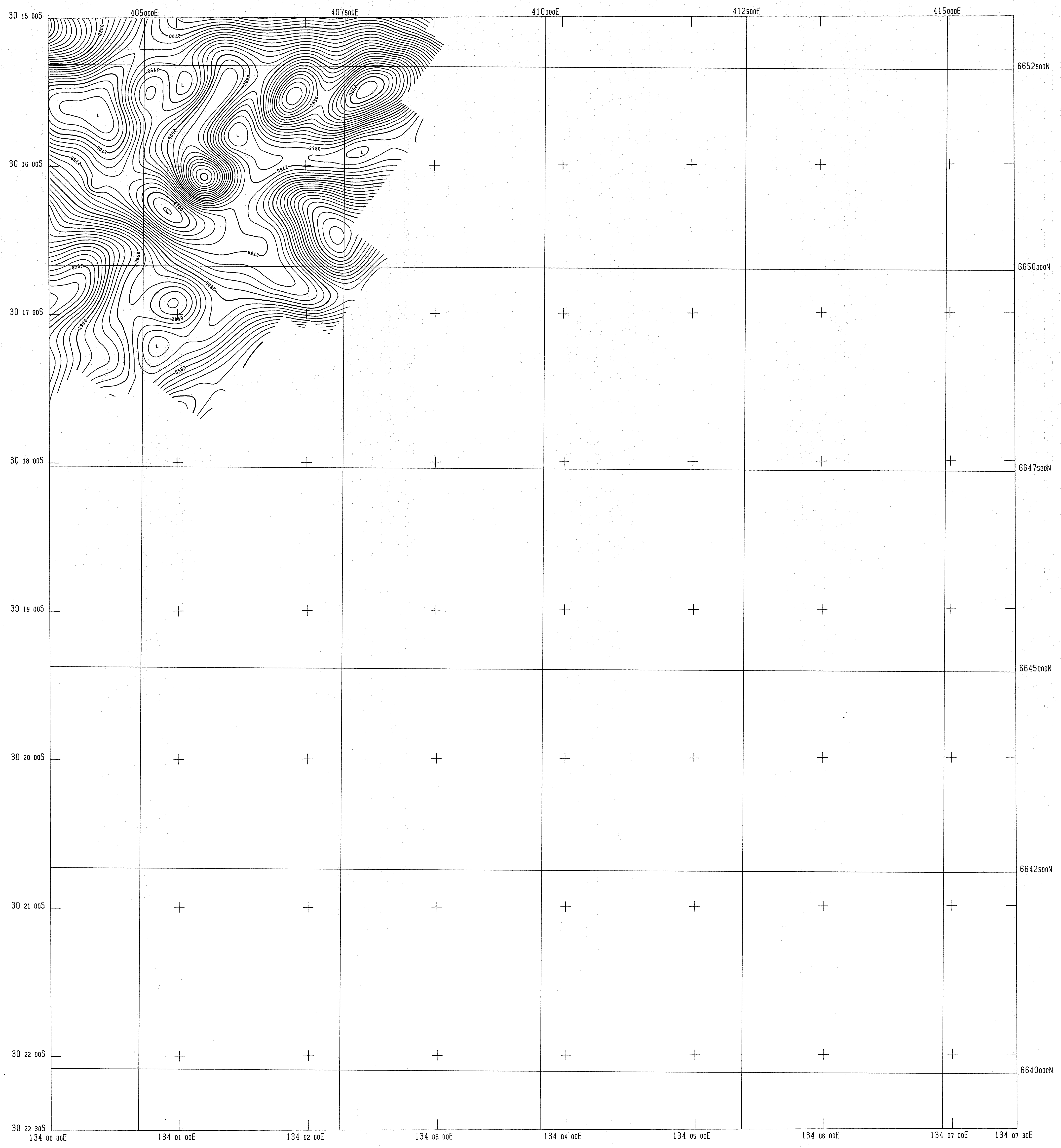
SCALE 1:25000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5637 - IV - SW

DWG. No.SH53-10.GPM.2143	DATE: 17-MAR-80



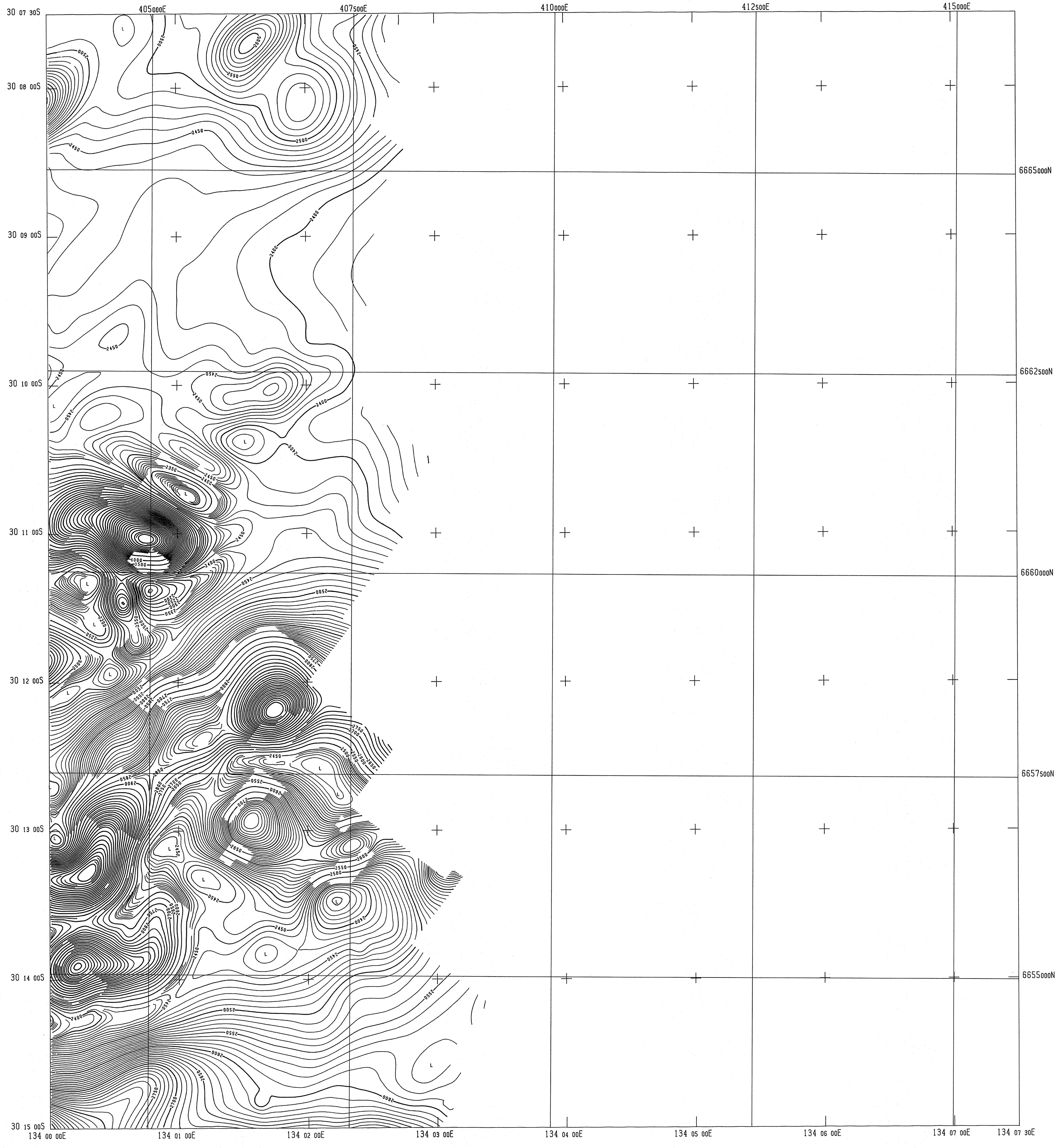
SCALE 1:25000

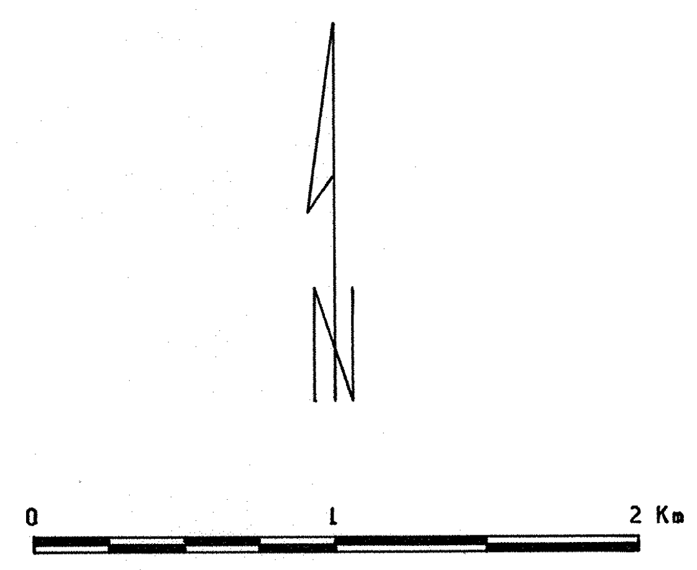
FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S. A.
TOTAL MAGNETIC FIELD
SHEET 5737-III-NW

DWG. No. SH53-10. GPM. 2226	DATE: 17-FEB-80





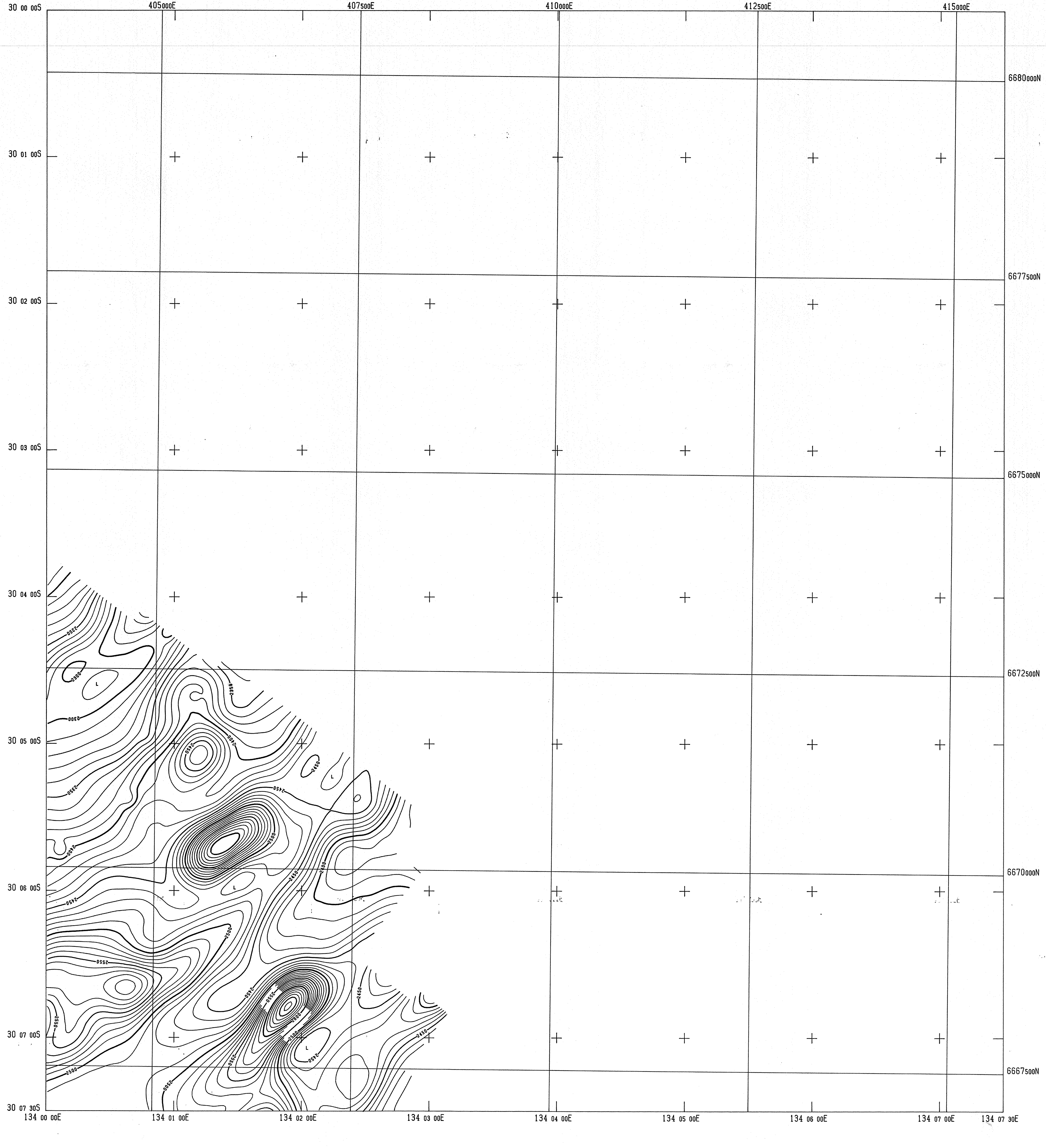
SCALE 1:25000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S.A.
TOTAL MAGNETIC FIELD
SHEET 5737-IV-SW

DWG.No.SH53-10.GPM.2227
DATE: 17-FEB-80



N

0 1 2 Km

SCALE 1:25000

FLOWN BY AUSTIREX : NOV 1979
COMPILED BY ENGINEERING COMPUTER SERVICES PTY LTD

AFMECO (AUST) LTD

MULGATHING S. A.
TOTAL MAGNETIC FIELD
SHEET 5737-IV-NW

DWG.No. SH53-10.GPM.2228

DATE: 17-FEB-80