DEPARTMENT OF MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1976/60

OPERATIONAL REPORT ON GLENBURG (PART), ROBINSON RANGE, PEAK HILL, W.A. AIRBORNE GAMMA-RAY SPECTROMETER SURVEY, 1972

B.W. Wyatt

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CONTENTS

SUMMARY

Four-channel gamma-ray spectrometer data were recorded by Aero Service Australia Pty Ltd and processed by Agip Nucleare Australia Pty Ltd for most of the 1:250 000 Sheet areas of ROBINSON RANGE and PEAK HILL and part of GLENBURGH. These data are presented as stacked profiles at 1:250 000 scale for each of the four channels.

This report outlines the survey and equipment parameters used and describes the steps carried out in the data processing.

1. INTRODUCTION

Aero Service Australia Pty Ltd contracted to carry out an aeromagnetic survey of several 1:250 000 sheet areas in Western Australia in 1972 for BMR. The results of this work have been reported by Wyatt (1975, 1976). During the survey, spectrometer data were recorded over parts of the GLENBURGH, ROBINSON RANGE, and PEAK HILL sheet areas as shown in Plate 1, in addition to the required magnetic data.

An agreenemt was reached between Aero Service and BMR in 1974 whereby Aero Service was permitted to offer the radiometric data for sale to the mining industry. A condition of sale was that copies of all data, including map presentations produced, be given to BMR for public release any time after one year from the date of sale.

Agip Nucleare Australia Pty Ltd purchased the raw data and produced stacked profiles of processed data at 1:100 000 scale for each of the four radiometric channels.

BMR has photographically reduced the stacked profiles to 1:250 000 scale and changed the title panels accordingly. In all other respects the data presented in this Record as Plates 2 to 9 remain the same as those produced by Agip Nucleare.

BMR holds transparent copies of the 1:100 000 scale stacked profiles as well as the digital data on magnetic tape in both raw and processed forms.

2. DATA ACQUISITION

The most significant information which relates to data acquisition is as follows:

Contractor:	Aero Service Australia Pty Ltd
Aircraft Ground Speed:	180 km/h
Aircraft Altitude:	150 m above ground level
Line Spacing:	1.5 km
Line Orientation:	East-west
Ties:	Flown north-south at 30 km spacing
Navigation:	Bendix Doppler navigation system synchronized with 35-mm Aeropath strip camera.
Altimeter:	Honeywell
Spectrometer:	Hamner Harshaw
Detector volume:	18517 cm^3 sodium iodide detectors (10 crystals each 15.24 cm diameter, 10.16 cm thick)

Gamma spectrometry recorded:

Channel	Energy range
Potassium (K)	1.36-1.56 MeV
Uranium (U)	1.66-1.86 MeV
Thorium (Th)	2.37-2.87 MeV
Total Count	0-3.0 MeV

Data Recording System: Lancer digital logging system

3. DATA PROCESSING

The flight path data were processed by Engineering Computer Services Pty Ltd for Aero Service (Australia) Pty Ltd as part of the original contract to supply BMR with aeromagnetic data.

The radiometric data were processed and presented by Pittmen Data Systems Pty Ltd for Agip Nucleare. Details of the radiometric data processing are given below.

Editing

The spectrometer and altimeter data were edited by use of an automatic program for spike removal and gap interpolation. The efficiency of the program is questionable in recognising spikes and in interpolating across gaps for the data involved. Because most gaps preceded an abnormally low gamma count, the gap interpolation program often introduced a large minimum anomaly to fill the gap. Such errors in data presentation are most common on lines 3530, 3601, and 3791 and can be recognised by their sharp, negative form.

Background determination

No background values were recorded during the survey. The mean background values (130, 26, 23, 15 counts/second for Total, K, U, Th channels respectively) were obtained from a statistical analysis of the raw data supplemented by a comparison of Aero Service and other company measurements over the sea and at 600 to 900 m above ground level over the survey area.

Flight-by-flight adjustments to the mean backgrounds were computed from a line/tie misclosure analysis as follows:

Step 1. A crossover file, with five readings either side of the crossover, was created for the five channels Total count, Potassium, Uranium, Thorium, and Altimeter.

Step 2. Data were subjected to smoothing using a low-pass filter

$$\phi'(r_o) = \sum_{l=-N}^{N} \phi(r_l) \cdot W(r_l)$$

where $\phi'(r_o)$ is the filtered output at r_o

$2N + 1$ is the number of filter coefficients

$\overline{\phi}(r_1)$ is the raw data value at r_1

$W(r_1)$ is the weighting coefficient at r_1

Weighting coefficients used were:

0.0124 0.1055 0.2344 0.2956 0.2344 0.1055 0.0124 for Total count, Potassium, Uranium and Thorium, data, and

-0.0229 0.0634 0.2679 0.3832 0.2679 0.0634 -0.0299 for altimeter data.

Step 3. Mean background corrections were applied

Step 4. Height attenuation corrections were applied

Step 5. Ties were levelled by subtracting the average line/tie misclosure along each tie.

Step 6. Background levels peculiar to each flight were determined from the residual misclosures along traverses.

Data adjustment

Final corrections were applied to all data as follows:

Step 1. Filtering using the sets of coefficients:

-0.0403 0 0.2920 0.4965 0.2920 0 -0.0403 for Total count, Potassium, Uranium, Thorium data, and

-0.0229 0.0634 0.2679 0.3832 0.2679 0.0634 -0.0299 for altimeter data.

Step 2. Mean background corrections were applied.

Step 3. Data were corrected for sensor height variations from a datum of 500 feet above ground level using the formula $C_{500} = C_h e^{-\mu(500-h)}$ where C_{500}, C_h are the count rates at heights of 500 and h feet and μ is an attenuation coefficient. (μ = 0.0026, 0.0023, 0.0018, 0.0018 ft^{-1} for Total count, Potassium, Uranium, Thorium channels respectively).

Step 4. Specific flight background corrections as determined in the section above were applied.

Step 5. Compton scatter correction using stripping factors supplied by Agip Nucleare and based on statistical analysis of the data channels, were applied using the relations

$$U \text{ stripped} = U - \alpha.Th$$

$$K \text{ stripped} = K - \beta.Th - \gamma.U \text{ stripped}$$

where α = 0.36, β = 0.47, γ = 0.735 and K, U, and Th are the count rates in the respective channels after subtraction of background and correction for height.

Comments

Generally the results of processing appear to be satisfactory despite the lack of proper control and calibration at the time of survey data acquisition.

An antiphase relationship is evident between processed potassium and thorium channel data on some lines. This could be due to use of wrong background values and/or wrong stripping factors.

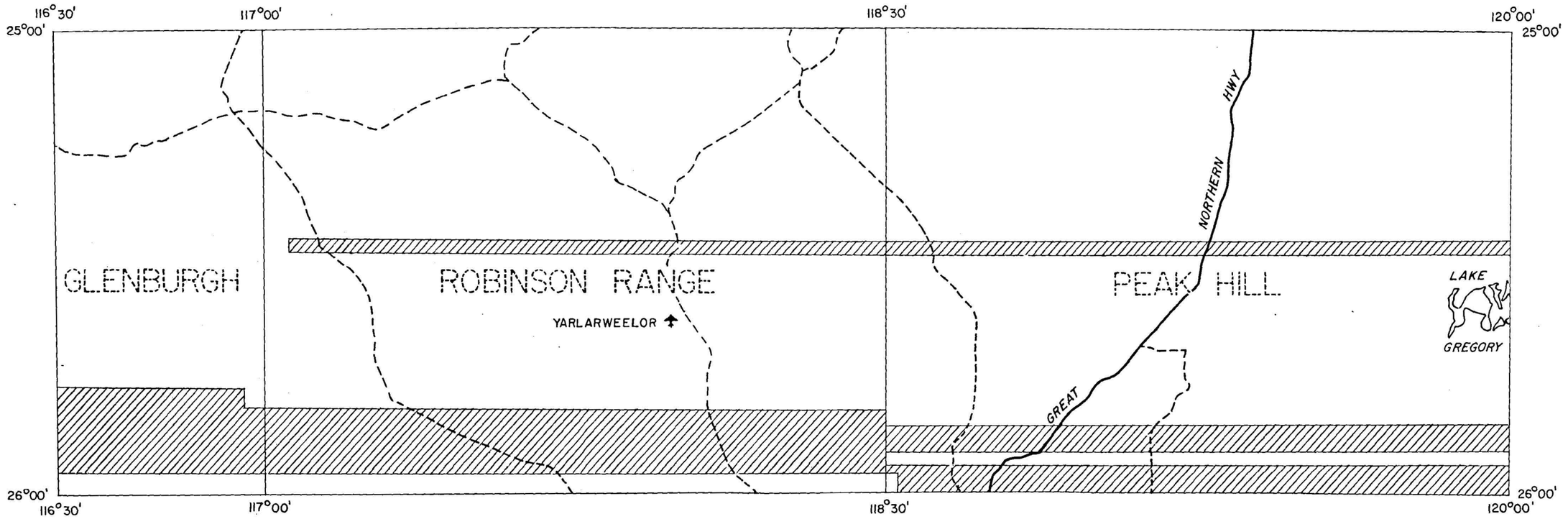
Some spikes (generally negative) have been extended and broadened by the automatic programs for gap interpolation and filtering. These should not be mistaken as real anomalies. Accordingly care needs to be exercised in using data displayed.

4. REFERENCES

WYATT, B.W., - Aeromagnetic survey of Perenjori, Ninghan, Bencubbin and Moora 1:250 000 Sheet areas, W.A., 1972. Bur. Miner. Resour. Aust. Rec. 1975/155.

WYATT, B.W., - Aeromagnetic survey of Glenburgh (Part), Robinson Range and Peak Hill 1:250 000 Sheet areas, W.A., 1972. Bur. Miner. Resour. Aust. Rec. (in prep).

PLATE 1



LOCATION DIAGRAM

AIRBORNE SURVEY, WESTERN AUSTRALIA 1972 (NORTH)

LOCALITY MAP AND RADIOMETRIC DATA COVERAGE

SCALE 1:1000 000

KILOMETRES 10 0 10 20 30 40 50 60 70 80 90 100 KILOMETRES

No Radiometric Data

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES

MOUNT PHILLIPS	MOUNT EGERTON	COLLIER	BULLER
GLENBURGH	ROBINSON RANGE	PEAK HILL	NABBERU
BYRO	BELELE	GLENGARRY	WILUNA

115°30' 121°30' 24°00' 27°00'

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GLENBURGH – ROBINSON RANGE

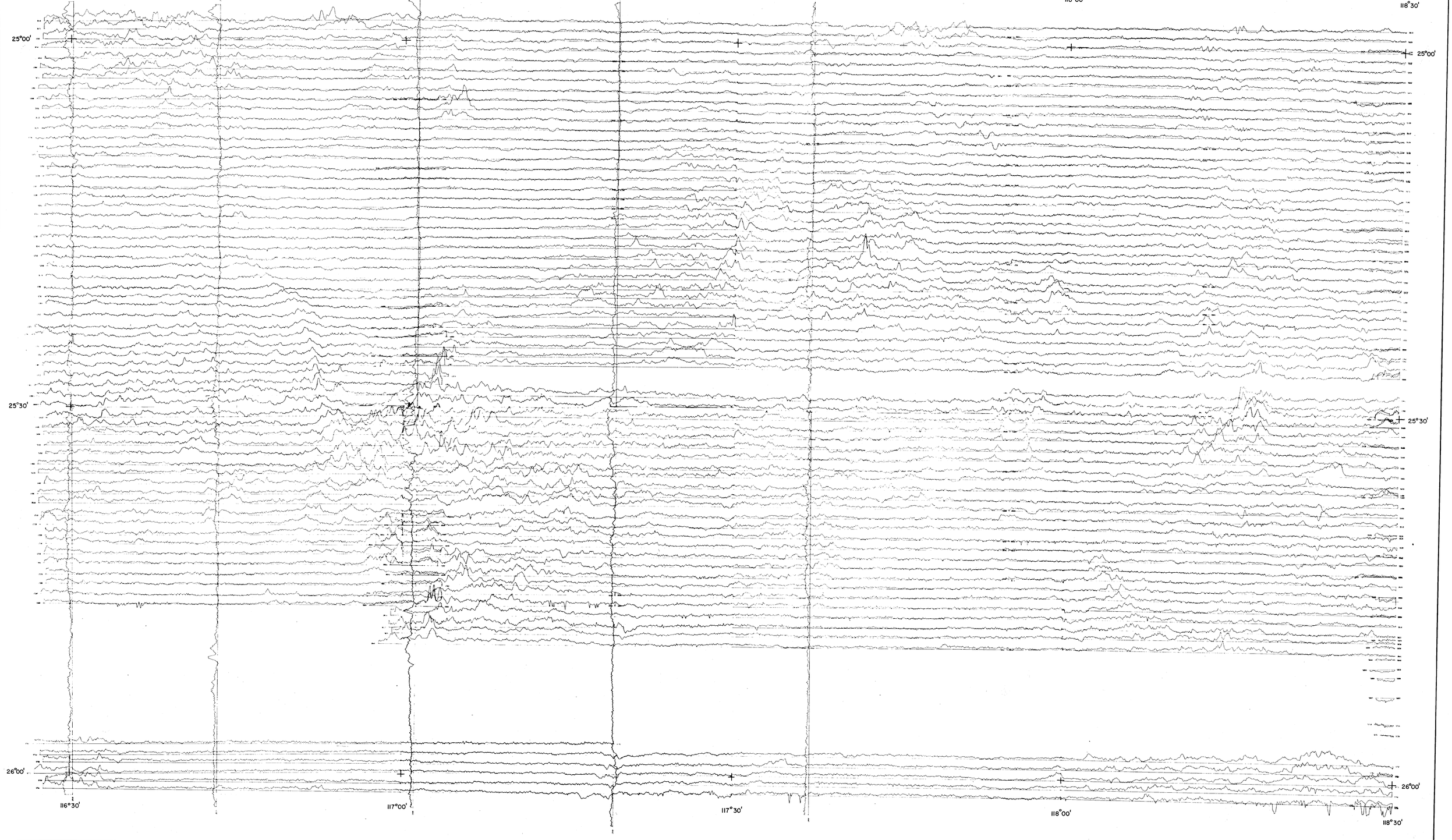
PLATE 2

116°30' 117°00' 117°30' 118°00' 118°30'

25°00'

25°30'

26°00'



DATA ACQUISITION

Contractor ..... *Aero Service (Australia) Pty Ltd*
Instrument ..... *Hamner Harshaw 18 400 cc NaI detector*
Altitude ..... *150 m agl*
Ground speed ..... *180 km/h*
Sample rate ..... *50 m*
Date of survey ..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *750 counts/s/cm*
Base value ..... *400 counts/s*

DATA PROCESSING

By ..... *Pittmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer ..... *CDC 6600*
Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

·04	0	·292	·497	·292	0	·04		

RADIOMETRIC PROFILES TOTAL COUNT

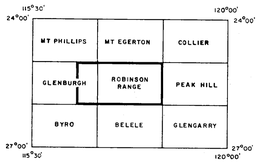
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

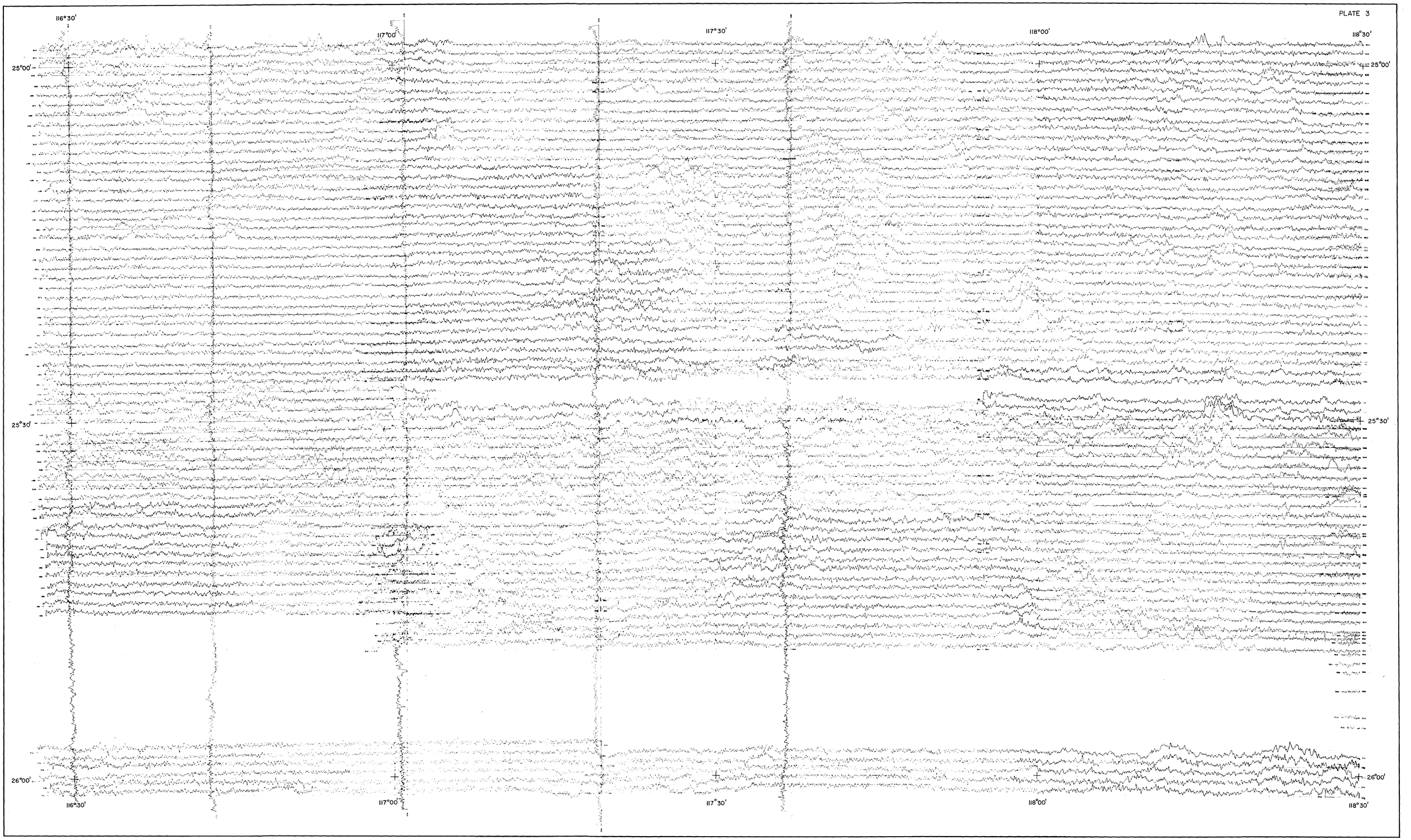
8400 —— *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



GLENBURGH–ROBINSON RANGE

PLATE 3



DATA ACQUISITION

Contractor ..... *Aero Service (Australia) Pty Ltd*
Instrument ..... *Hamner Harshaw 18400 cc NaI detector*
Altitude ..... *150 m agl*
Ground speed ..... *180 km/h*
Sample rate ..... *50 m*
Date of survey ..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *125 counts/s/cm*
Base value ..... *40 counts/s*

DATA PROCESSING

By ..... *Fittmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer ..... *CDC 6600*

Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

-0·4	0	2·92	4·97	2·92	0	-0·4		

RADIOMETRIC PROFILES
POTASSIUM

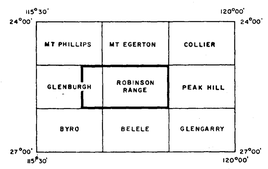
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

8400 —— *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



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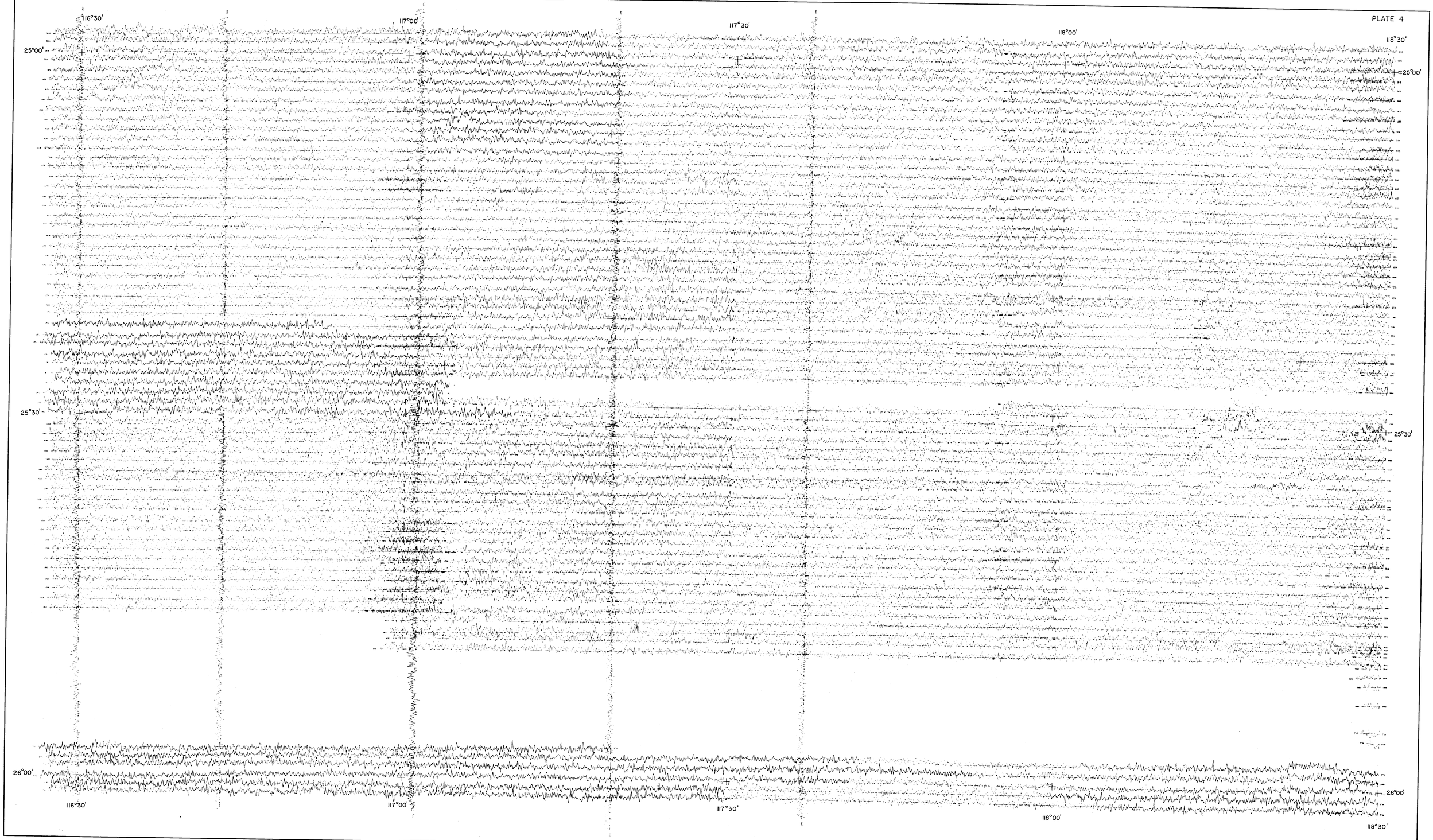
GLENBURGH–ROBINSON RANGE

PLATE 4



DATA ACQUISITION

Contractor ..... *Aero Service (Australia) Pty Ltd*
Instrument ..... *Hammer Harshaw*
(8400 cc NaI detector
Altitude ..... *150 m agl*
Ground speed ..... *180 km/h*
Sample rate ..... *50 m*
Date of survey ..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *50 counts/s/cm*
Base value ..... *15 counts/s*

DATA PROCESSING

By ..... *Fairmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer ..... *CDC 6600*
Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

-0·4	0	2·92	4·97	2·92	0	-0·4	

RADIOMETRIC PROFILES
URANIUM

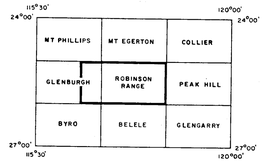
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

8400 — *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



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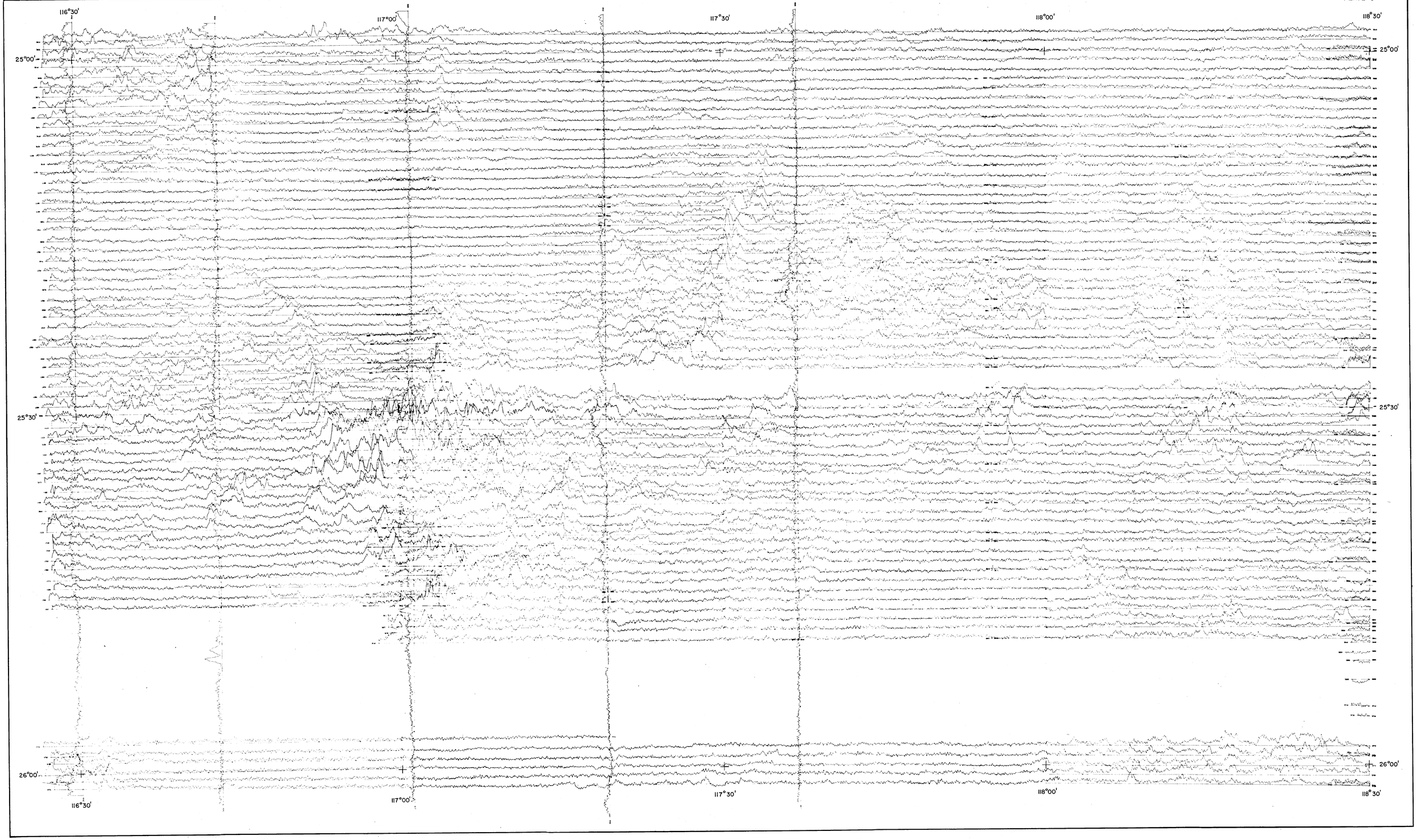
GLENBURGH–ROBINSON RANGE

PLATE 5



DATA ACQUISITION

Contractor ..... *Aero Service (Australia) Pty Ltd*
Instrument ..... *Hamner Harshaw 18400 cc NaI detector*
Altitude ..... *150 m agl*
Ground speed ..... *180 km/h*
Sample rate ..... *5.0 m*
Date of survey ..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *125 counts/s/cm*
Base value ..... *40 counts/s*

DATA PROCESSING

By ..... *Pittmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer ..... *CDC 6600*
Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

-04	0	292	497	292	0	-04	

RADIOMETRIC PROFILES
THORIUM

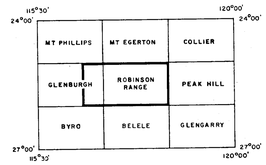
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

8400 —— *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



Record No. 1976/60

G50/BI-101

PEAK HILL

PLATE 6

DATA ACQUISITION

Contractor ..... *Aero Service (Australia) Pty Ltd*
Instrument ..... *Hamner Harshaw 18 400 cc NaI detector*
Altitude ..... *150 m agl*
Ground speed ..... *180 km/h*
Sample rate ..... *50 m*
Date of survey ..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *750 counts/s/cm*
Base value ..... *400 counts/s*

DATA PROCESSING

By ..... *Pittmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer ..... *CDC 6600*

Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

-04	0	292	497	292	0	-04		

RADIOMETRIC PROFILES
TOTAL COUNT

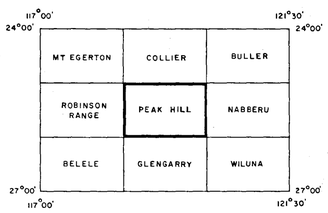
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

5400 ——— *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



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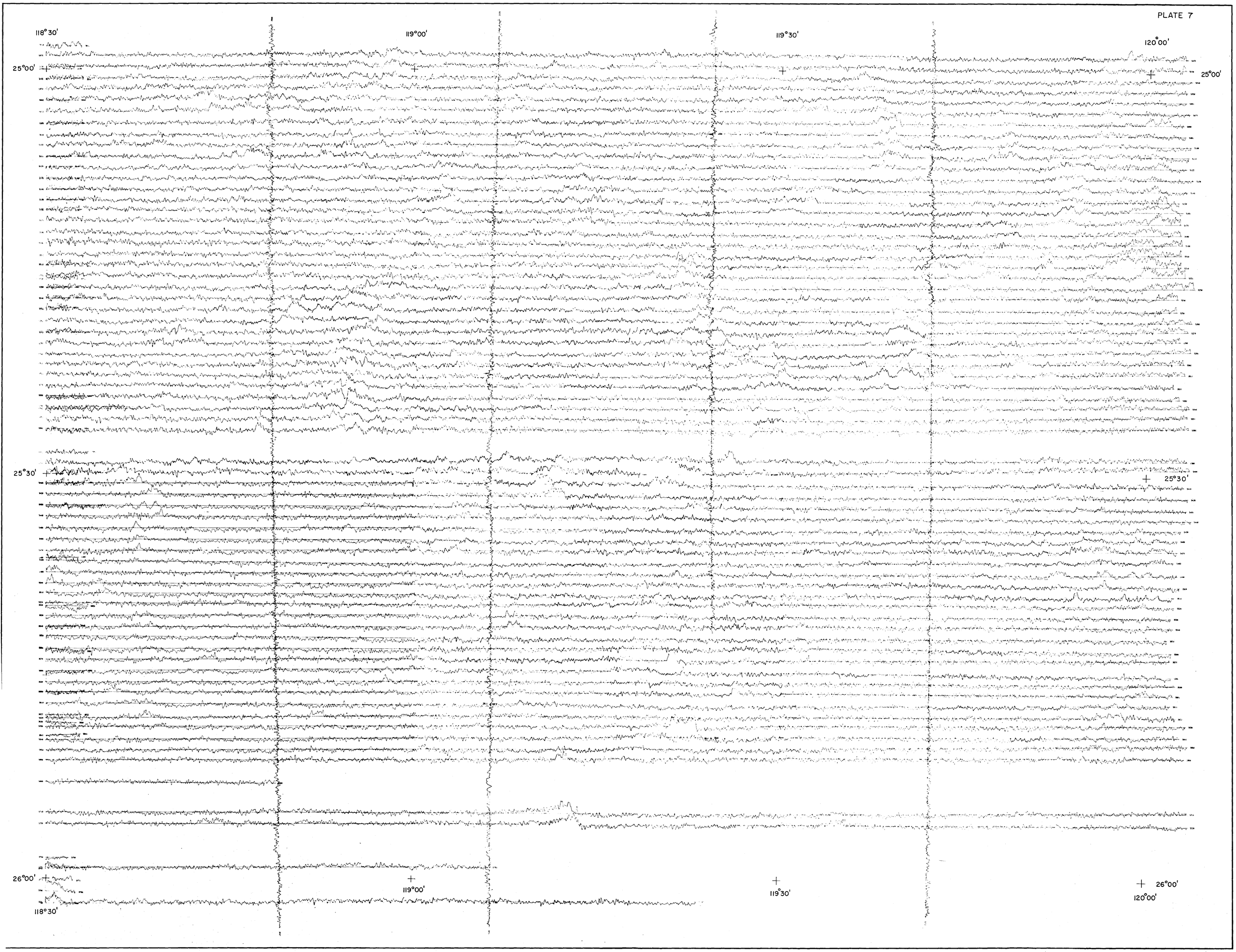
G50/BI–103

PEAK HILL

PLATE 7



DATA ACQUISITION

Contractor..... *Aero Service (Australia) Pty Ltd*
Instrument..... *Hamner Harshaw 18 400 cc NaI detector*
Altitude ..... *150 m agl*
Ground speed..... *180 km/h*
Sample rate..... *50 m*
Date of survey..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *125 counts/s/cm*
Base value..... *40 counts/s*

DATA PROCESSING

By..... *Pittmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer..... *CDC 6600*

Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

-·04	0	·292	·497	·292	0	-·04		

RADIOMETRIC PROFILES
POTASSIUM

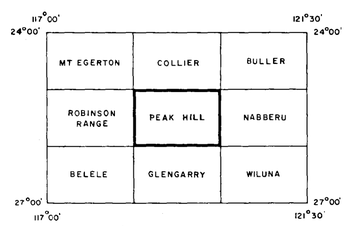
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

5400 —— *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



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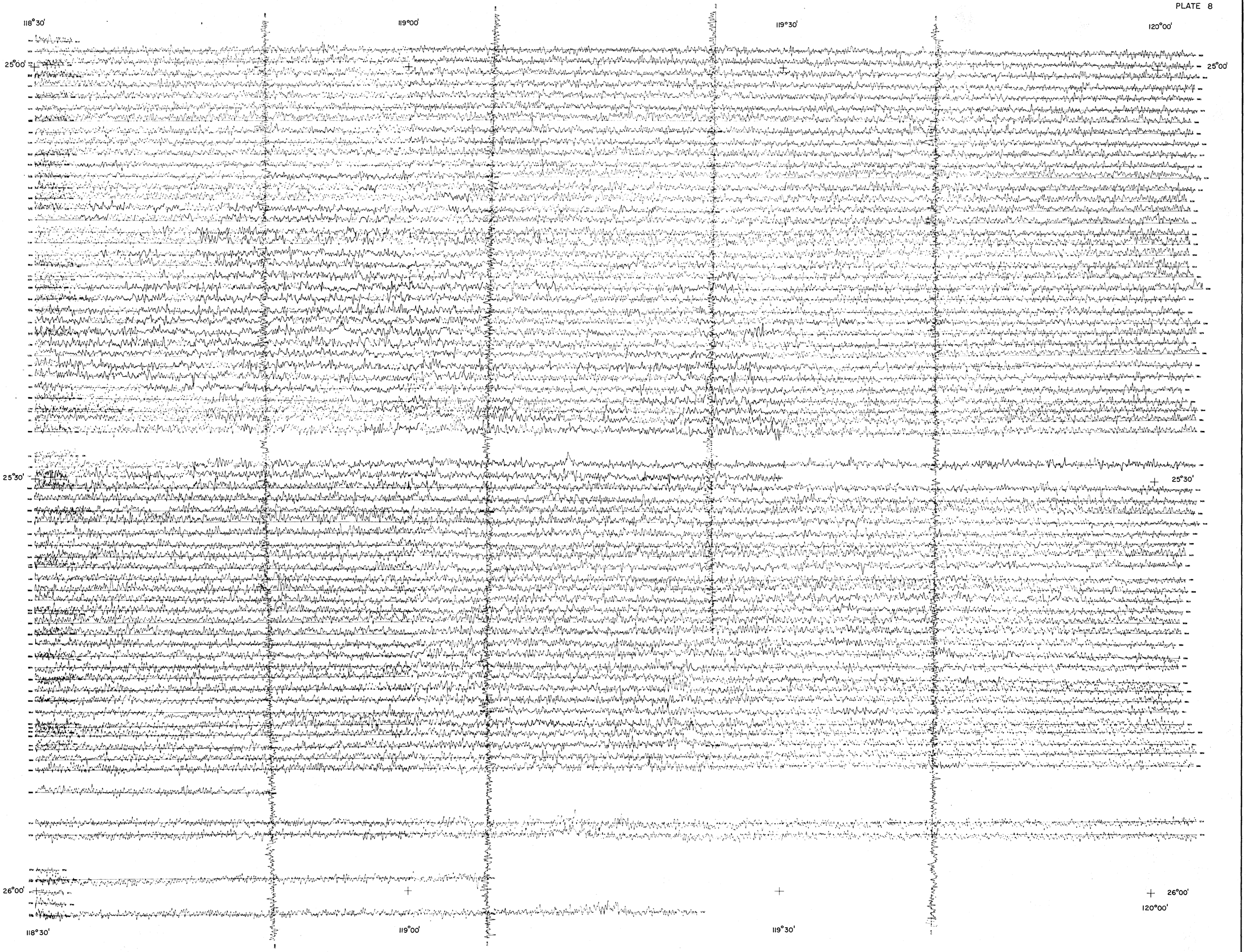
PEAK HILL

PLATE 8



DATA ACQUISITION

Contractor ..... *Aero Service (Australia) Pty Ltd*
Instrument ..... *Hamner Harshaw 18 400 cc NaI detector*
Altitude ..... *150 m agl*
Ground speed ..... *180 km/h*
Sample rate ..... *50 m*
Date of survey ..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *50 counts/s/cm*
Base value ..... *15 counts/s*

DATA PROCESSING

By ..... *Pittmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer ..... *CDC 6600*

Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

-·04	0	·292	·497	·292	0	-·04		

RADIOMETRIC PROFILES
URANIUM

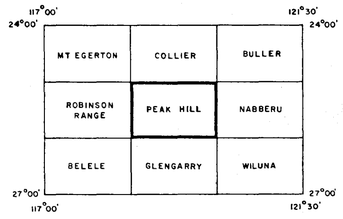
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

8400 —— *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



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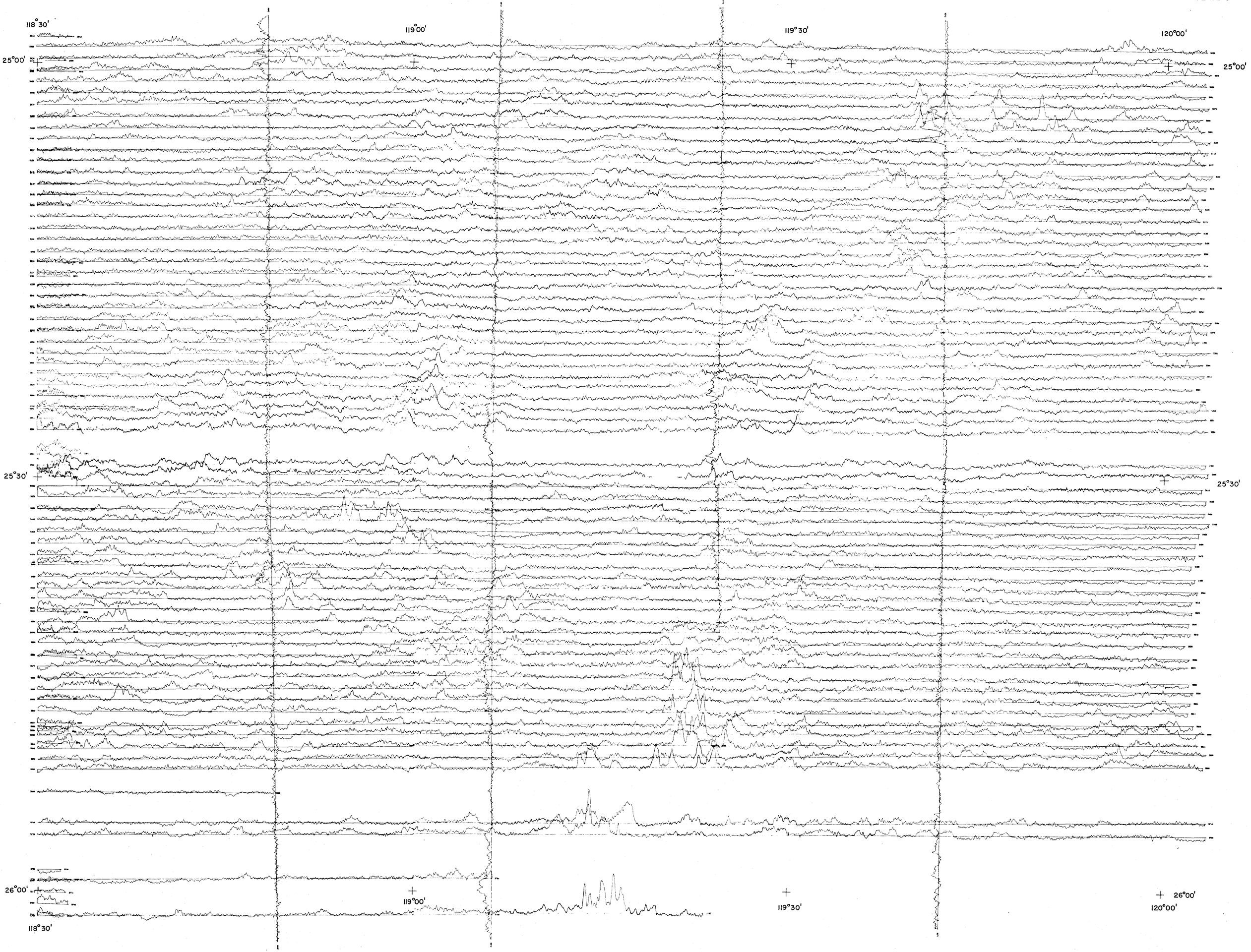
PEAK HILL

PLATE 9



DATA ACQUISITION

Contractor ..... *Aero Service (Australia) Pty Ltd*
Instrument ..... *Hamner Harshaw 18 400 cc NaI detector*
Altitude ..... *150 m agl*
Ground speed ..... *180 km/h*
Sample rate ..... *50 m*
Date of survey ..... *June – August 1972*

DATA PRESENTATION

Plotter ..... *Calcomp 936*
Scale ..... *125 counts/s/cm*
Base value ..... *40 counts/s*

DATA PROCESSING

By ..... *Pittmen Data Systems Pty Ltd for Agip Nucleare Australia Pty Ltd*
Computer ..... *CDC 6600*
Stripping factors

alpha	beta	gamma
0·36	0·47	0·735

Altitude Coefficients (ft^{-1})

Th	U	K	TC
0·0018	0·0018	0·0023	0·0026

Background average values (counts/s)

estimated			
15	23	26	130

Filter before stripping

-04	0	·292	·497	·292	0	-04		

RADIOMETRIC PROFILES
THORIUM

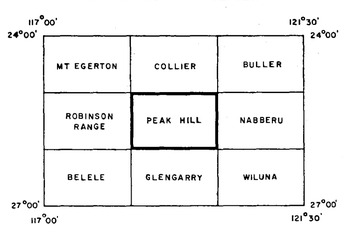
SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

LEGEND

8400 —— *Line number and flight-path*
Profile projected from base line

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



Record No. 1976/60

G50/BI-105