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GEOLOGY AND GEOPHYSICS

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OPERATIONAL REPORT ON BROKEN HILL REGIONAL AIRBORNE MAGNETIC AND
GAMMA-RAY SPECTROMETER SURVEY, 1975

by

B.W. Wyatt

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ABSTRACT

In 1975, the Bureau of Mineral Resources conducted regional magnetic and radiometric surveys of the Broken Hill 1:250 000 Sheet area, New South Wales. This report describes the acquisition, processing, and presentation of the data, and figures the total magnetic intensity and radiometric contours and profiles now available.

INTRODUCTION

During 1975 the Bureau of Mineral Resources, Geology and Geophysics (BMR) flew two airborne geophysical surveys in the Broken Hill area to assist geological mapping, by the Geological Survey of New South Wales and mineral exploration being carried out by mining companies.

From 26 June to 29 July, a regional survey was made over the Broken Hill 1:250 000 Sheet area (Fig. 1). This report describes the data acquisition and processing methods used for the regional survey. Part of the area was re flown as a detailed survey and is described separately (Wyatt, 1978).

The regional survey was flown along east-west lines 1.5 km apart at 100 m ground clearance. The survey was flown with Twin Otter aircraft VH-BMG fitted with fluxgate magnetometer, four channel gamma-ray spectrometer, radio altimeter, doppler navigation system, computer and digital recording system and strip camera.

Table 1 lists the preliminary maps released at a scale of 1:250 000 which are available from Copy Service, Australian Government Printer (Production),, Wentworth Avenue, Kingston, A.C.T. (P.O. Box 84, Canberra 2600), Phone 952111, Extension 235.

OR

NSW Department of Mines, 8-18 Bent Street, Sydney, (postal address State Office Block, Sydney 2000). Plates 2 to 10 illustrate these data at a reduced scale.

All data, in corrected and edited form used to produce the maps referred to above, recorded on magnetic tape are available for purchase from BMR.

TABLE 1

Maps available from Australian Government Printer (Production) or NSW Department of Mines

Title	Scale	Reference
Total Magnetic Intensity contours	1:250 000	H54/B1-63
Total Magnetic Intensity profiles	"	" 64
Flight-line system	"	" 65
Radio-altimeter profiles	"	" 66
Total Count profiles	"	" 67
Thorium profiles	"	" 68
Potassium profiles	"	" 69
Uranium profiles	"	" 70
Total Count contours	"	" 93

DATA ACQUISITION

Aircraft: Twin Otter VH-BMG

Ground speed: 55 m/sec

Altitude: 100 m above ground level

Line spacing: 1.5 km

Line orientation: East-west

Ties: 9 north-south double tie pairs

Doppler: Marconi AD-560 system

Camera: BMR 35 mm strip camera

Altimeter: Collins ALT 50

Spectrometer: Hamner - Harshaw modules

3700 cc NaI detector involving 2 crystals each
15.24 cm diameter, 10.16 cms thick.

Gamma spectrometry recorded: Channel Energy range

Total count 0.84 - 3.0 MeV

"Potassium" 1.3 - 1.6 MeV

"Uranium" 1.6 - 1.9 MeV

"Thorium" 2.4 - 2.8 MeV

Acquisition system:	Hewlett Packard 2114B Computer
	Kennedy MT Recorder
	NCR Thermal printer and keyboard
Timer:	BMR NZA1
Magnetometers:	BMR Fluxgate MFS-7 (airborne)
	BMR Proton MNS-2 (ground station)
	and Geometrics Proton G826 (ground station)
Sampling period:	Magnetic field 0.2 seconds
	Altimeter 1 second
	Spectrometer 1 second
	Doppler co-ordinates 10 seconds
Chart recorders:	HP Moseley 2100B
	Geometrics MARS-6

STAFF

B.W. Wyatt	Party Leader
G.A. Green	Technical Officer (part survey only)
K.A. Mort	Technical Officer
C. Kieltyka	Technical Assistant (part survey only)
L. Miller	Technical Assistant (part survey only)
F/O D. Jenner	Pilot (TAA)
F/O A. Cantrill	Pilot (TAA)

DATA PROCESSING AND PRESENTATION

All digital data tapes were merged and processed in Canberra using BMR's HP 2100 and CSIRO's Cyber 76 computers. Plotting of time-based multi-channel profiles for editing and all flight line plots, stacked profiles and contour maps was done on BMR's Calcomp drum and flatbed plotters except for the total count radiometric map which was contoured manually.

Flight path recovery

Four control points on each flight line were plotted on airphotos, transferred to 1:125 000 scale planimetric maps, digitized and then used to position absolutely the doppler co-ordinates as recorded every 10 seconds in flight (Plate 2).

Baselines for all stacked profiles are the best least squares straight line approximation to the actual flight path.

Magnetic Data

The total magnetic field was recorded every 0.2 seconds, but all the processing used 1 second averages of this. The 0.2-second data have been archived in an unedited form.

Recorded diurnal changes were removed from the edited data before levelling. The levelling process used data from the nine double tie pairs to remove up to third order polynomial drift from each flight.

The regional gradient was removed using the IGRF model for 1965.0 at 300 m above sea level and a constant, 5000 nT, was added for presentation purposes. The data were subjected to low pass filtering with a cutoff at 4 cycles/km.

Discrete data values were used at 15 seconds intervals along flight lines to interpolate a square grid of unit length 380 metres, from which the magnetic field was contoured (Plate 3).

The magnetic data have also been displayed as a set of stacked profiles (Plate 5), using 1-second values.

Gamma-ray Spectrometer Data

Background variation was assumed to be linear throughout a flight and was subtracted using measurements made at 660 above ground level at the start and end of each flight.

The data were normalized to 100 m above ground level using the formula,

$$C_{100} = C_h e^{-\mu(100-h)}$$

where C_{100} , C_h are the count rates at heights of 100 and h metres respectively and μ is the attenuation coefficient. $\mu = 0.00656, 0.00755, 0.00557, 0.00557$ for Total count, Potassium, Uranium and Thorium respectively.

Compton scattering corrections were applied using the formulae,

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

$$K_{\text{stripped}} = K - \beta \text{ Th} - \delta U_{\text{stripped}}$$

where $\alpha = 0.7$, $\beta = 0.75$, $\delta = 1.1$

These values of α , β , δ have not been properly determined and may be in error.

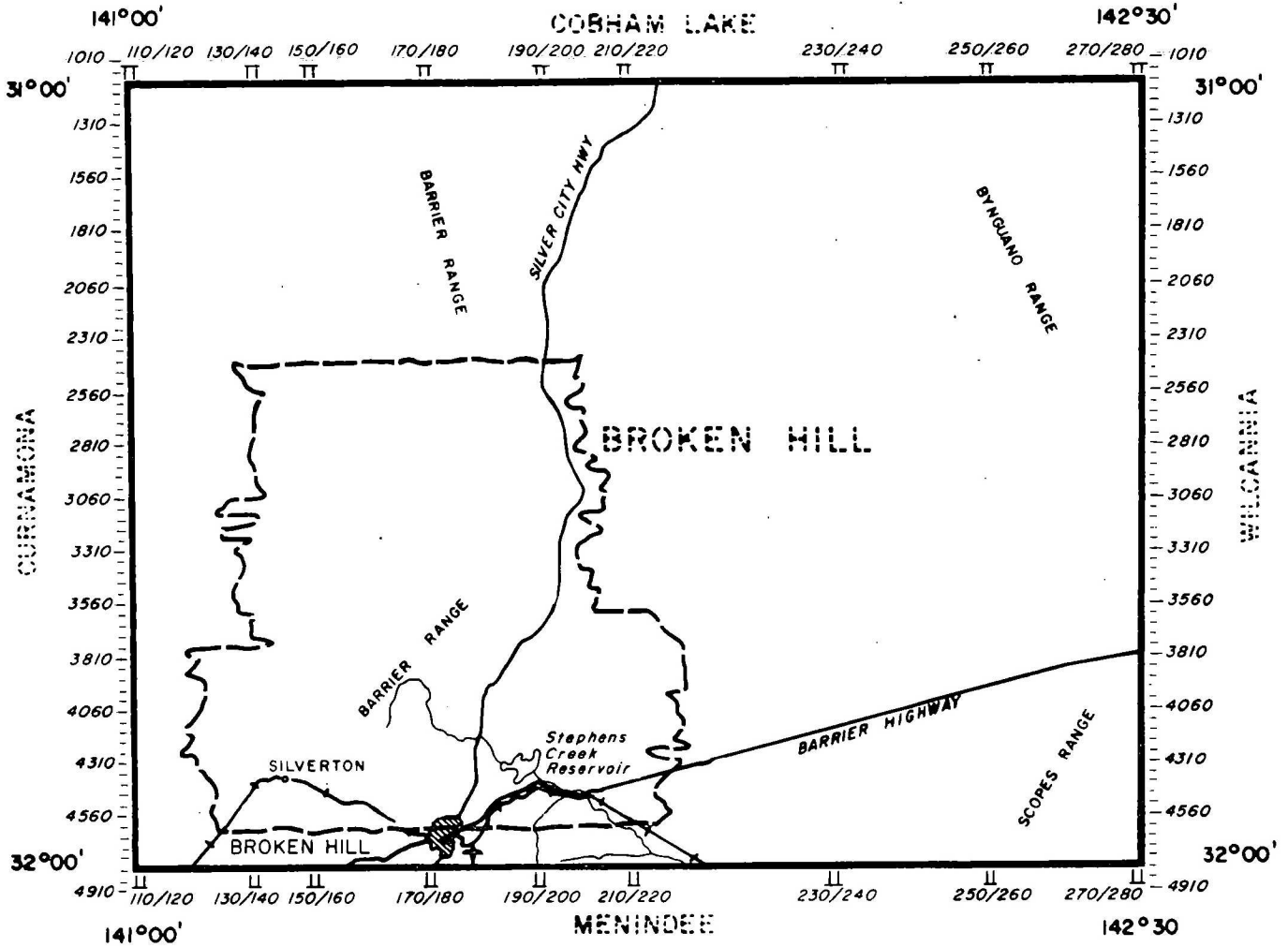
The four spectrometer channels were filtered using the low pass filter with coefficients 0.0099, 0.0389, 0.0812, 0.1255, 0.1589, 0.1713, 0.1589, 0.1255, 0.0812, 0.0389, 0.0099.

All four spectrometer channels and altimeter have been presented as stacked profiles at a scale of 1:250 000 (Plates 6-10).

The total count data have been contoured manually by projecting contour cuts from the profiles onto the flight lines. Darker shading of the higher count rate areas has been used to emphasize areas of high radioactivity.

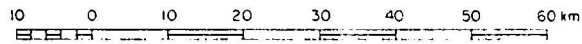
REFERENCE

WYATT, B.W., 1978 - Operational Report on Broken Hill Detailed Airborne Magnetic and Gamma-Ray Spectrometer Survey, 1975. Bureau of Mineral Resources, Australia - Record 1978/114 (unpublished).



AIRBORNE SURVEY, BROKEN HILL, NSW 1975

LOCALITY MAP AND FLIGHT-LINE SYSTEM



LOCATION DIAGRAM



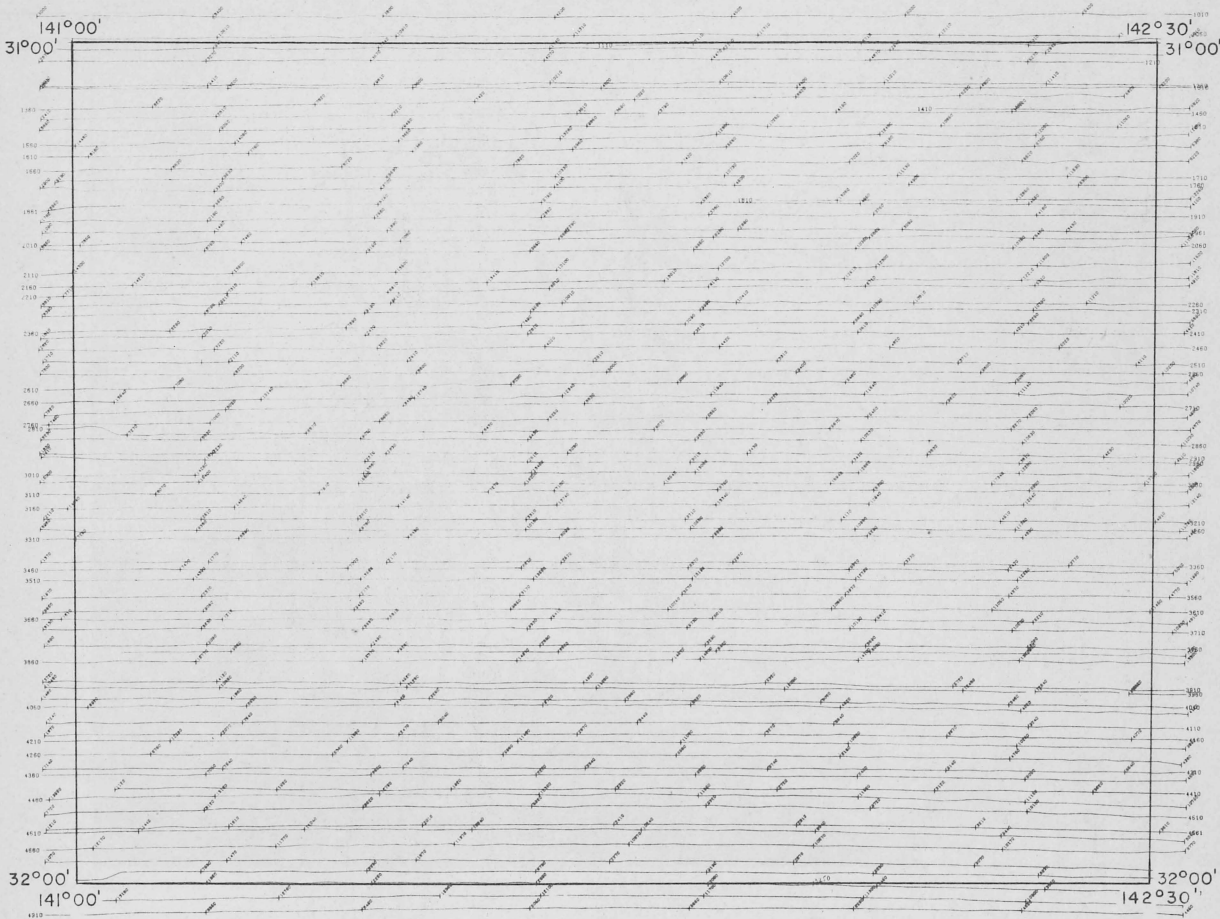
LEGEND

- Regional survey boundary
- Detailed survey boundary
- 1010 Flight-line
- 110 Tie line

REFERENCE TO 1:250 000 MAP SERIES

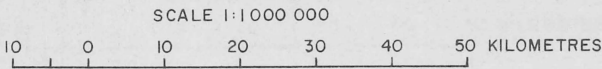
FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA

BROKEN HILL



AIRBORNE SURVEY, BROKEN HILL, NSW 1975

FLIGHT-LINE SYSTEM

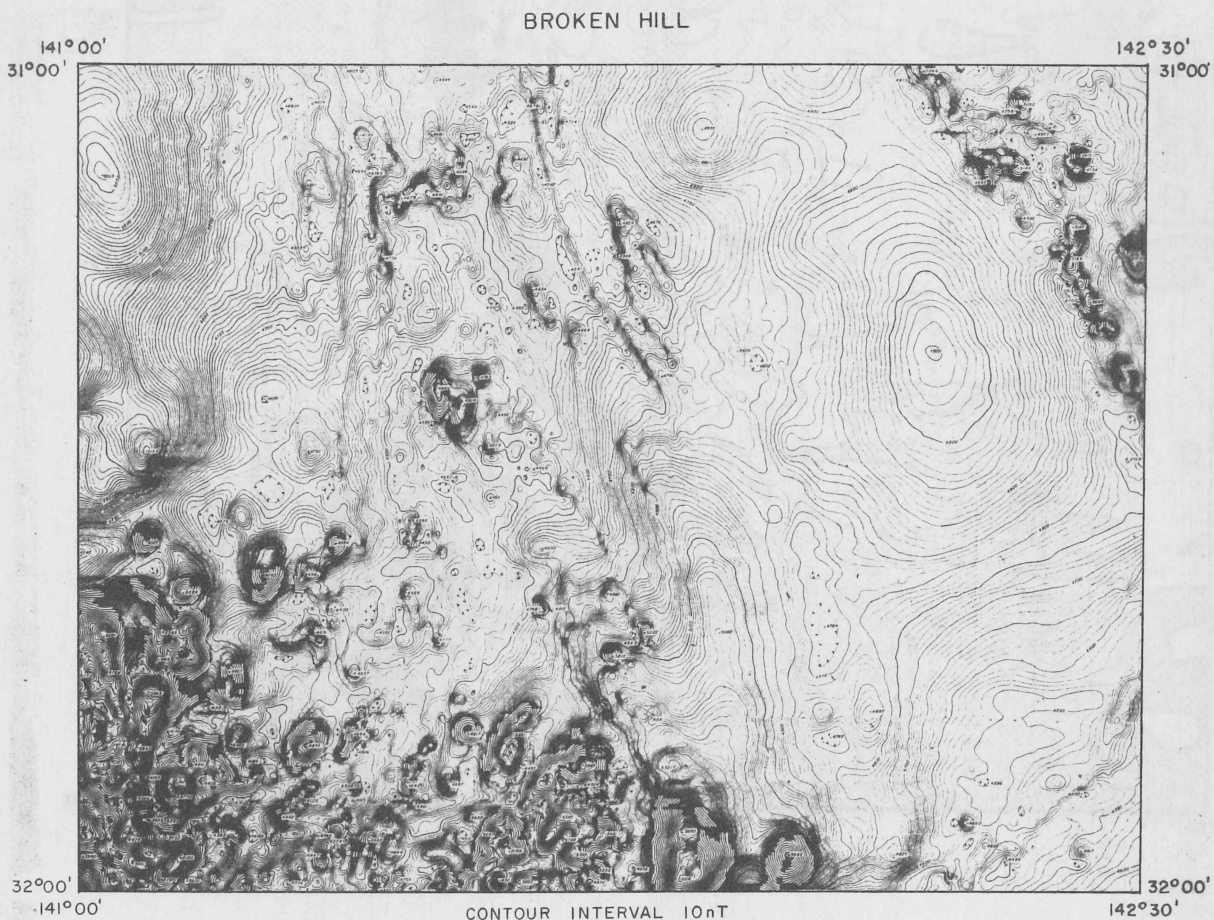


LOCATION DIAGRAM



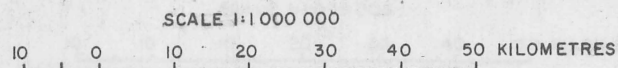
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CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA

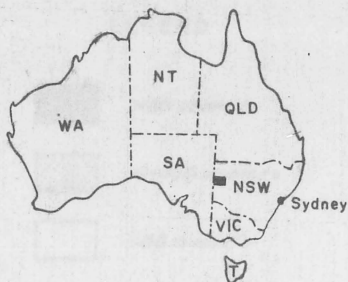


AIRBORNE SURVEY, BROKEN HILL, NSW 1975

TOTAL MAGNETIC INTENSITY

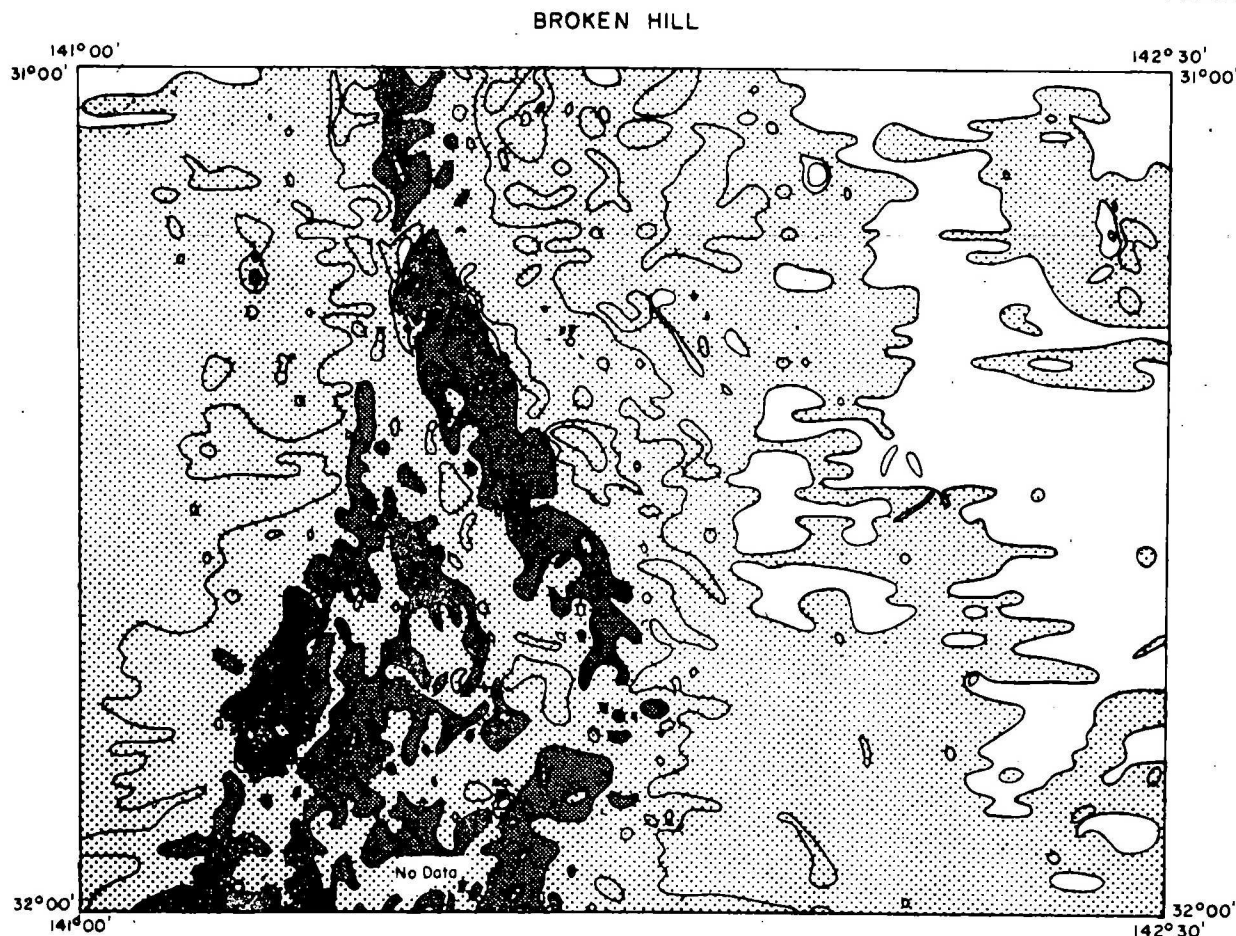


LOCATION DIAGRAM

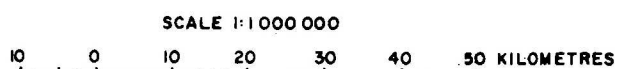


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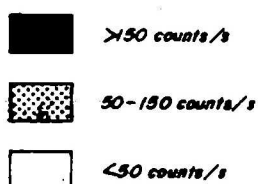
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CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA



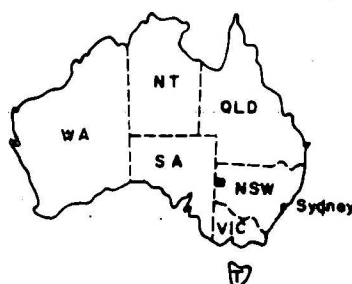
AIRBORNE SURVEY, BROKEN HILL, NSW 1975
RADIOMETRIC CONTOURS
TOTAL COUNT



LEGEND



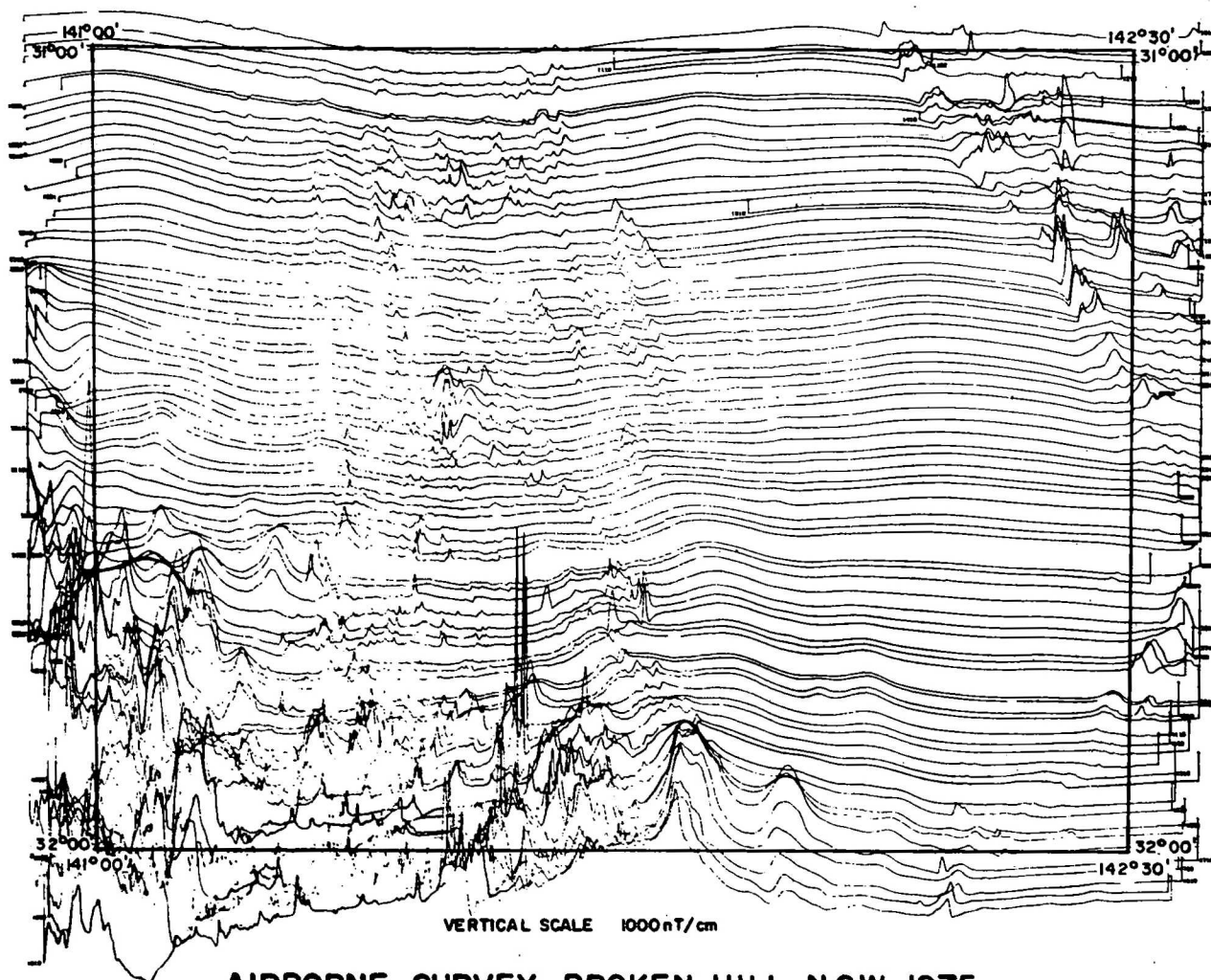
LOCATION DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

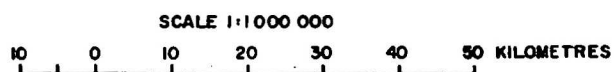
PRIME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA

BROKEN HILL



AIRBORNE SURVEY, BROKEN HILL, NSW 1975

TOTAL MAGNETIC INTENSITY PROFILES

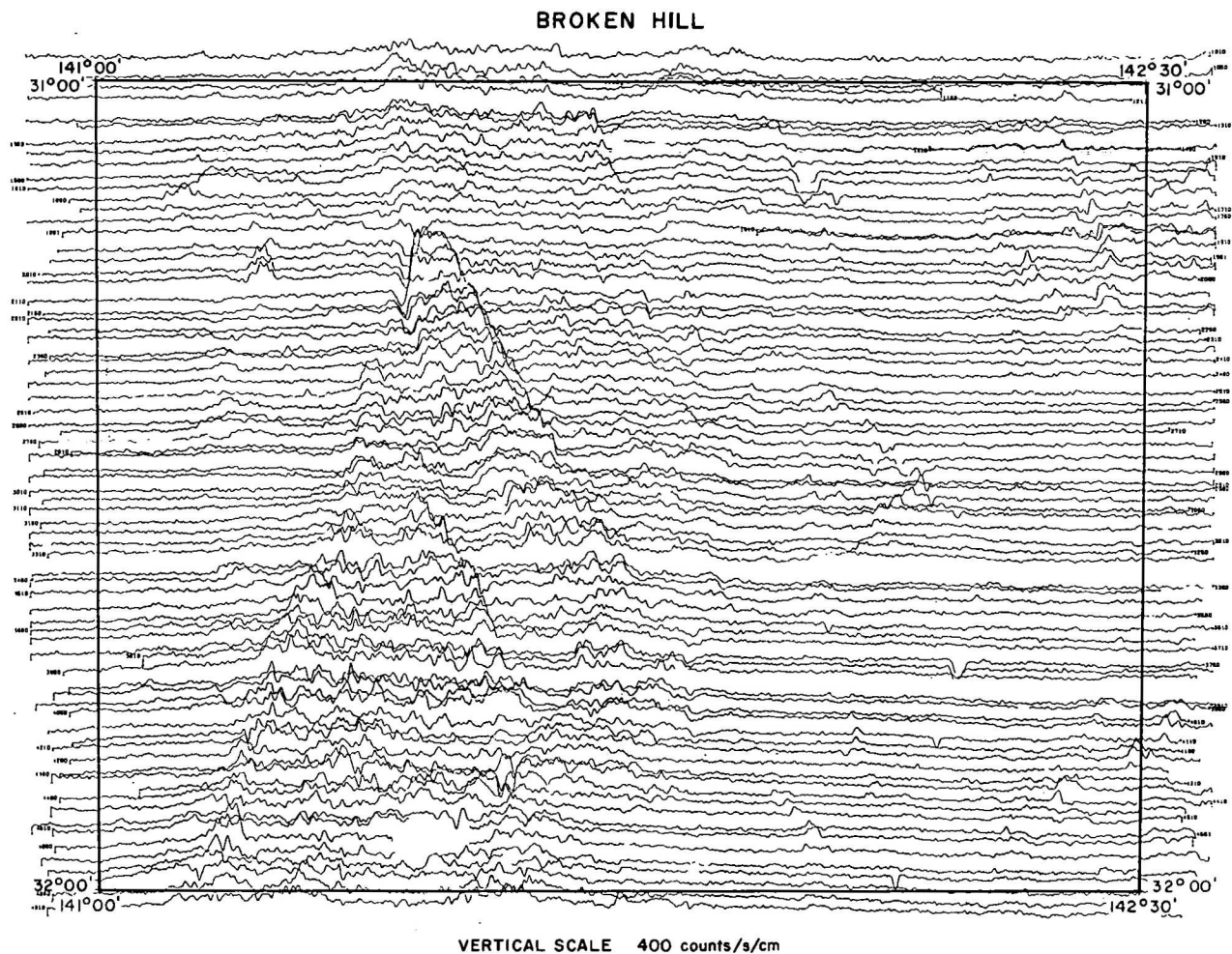


LOCATION DIAGRAM

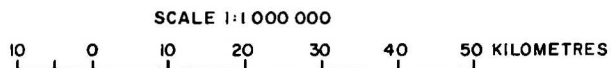


REFERENCE TO 1:250 000 MAP SERIES

FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA



AIRBORNE SURVEY, BROKEN HILL, NSW 1975
RADIOMETRIC PROFILES, TOTAL COUNT



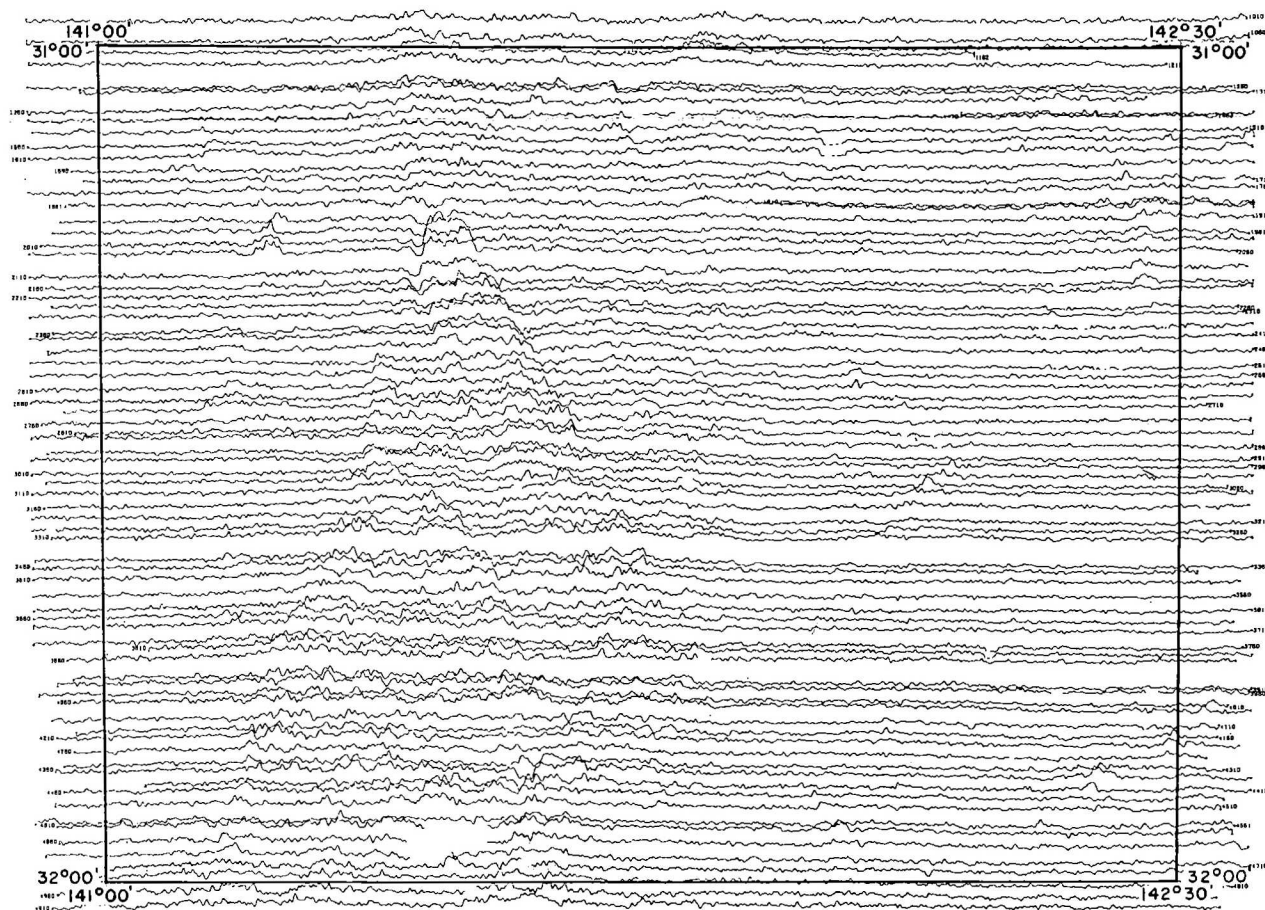
LOCATION DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA

BROKEN HILL



VERTICAL SCALE 160 counts/s/cm

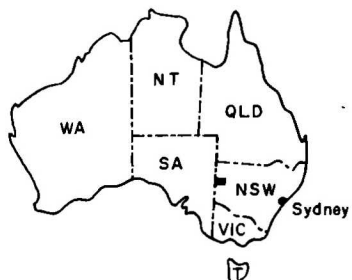
AIRBORNE SURVEY, BROKEN HILL, NSW 1975

RADIOMETRIC PROFILES, POTASSIUM

SCALE 1:1 000 000

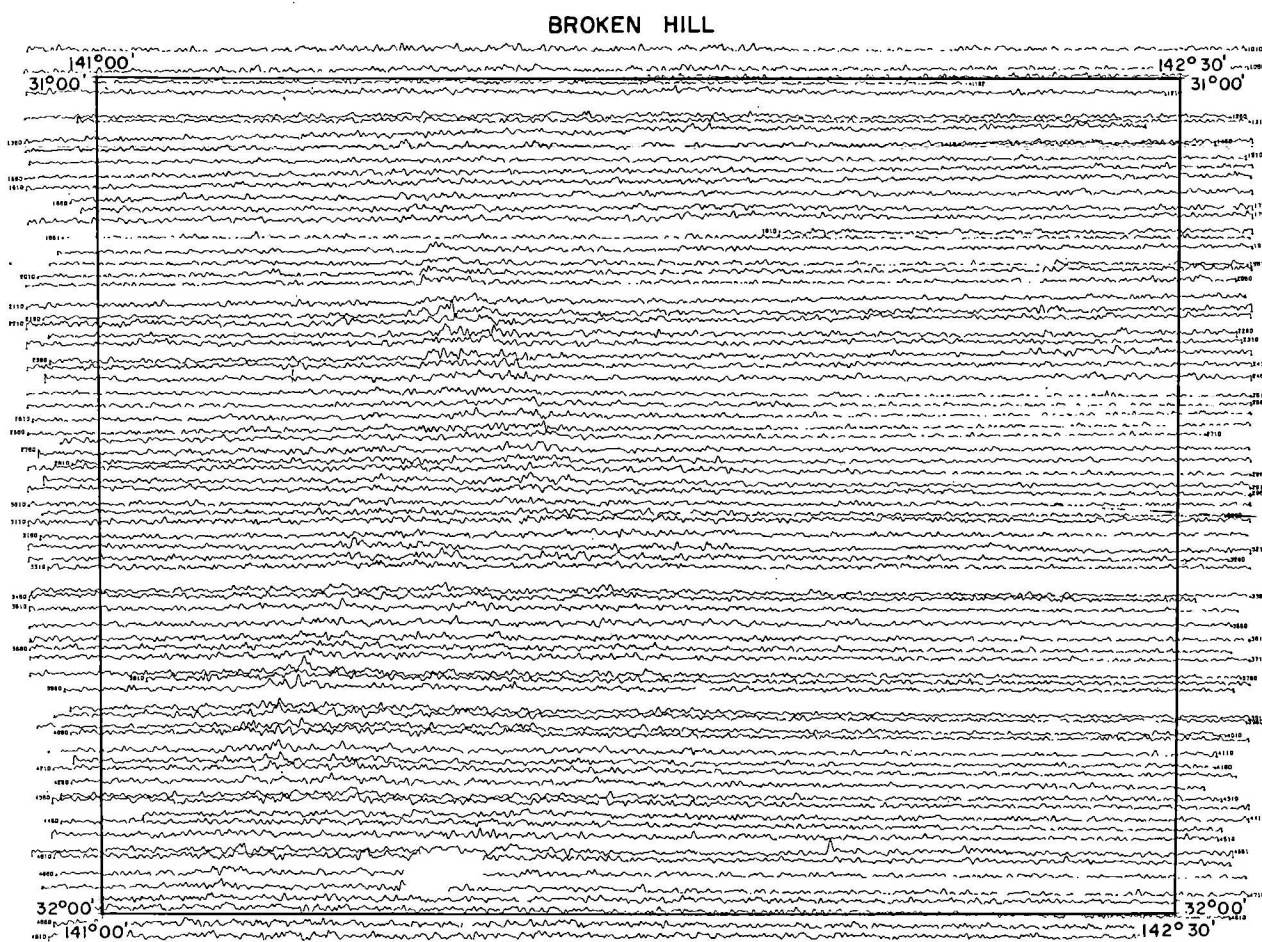
10 0 10 20 30 40 50 KILOMETRES

LOCATION DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA



VERTICAL SCALE 80 counts/s/cm

AIRBORNE SURVEY, BROKEN HILL, NSW 1975
RADIOMETRIC PROFILES, URANIUM

SCALE 1:1000 000
10 0 10 20 30 40 50 KILOMETRES

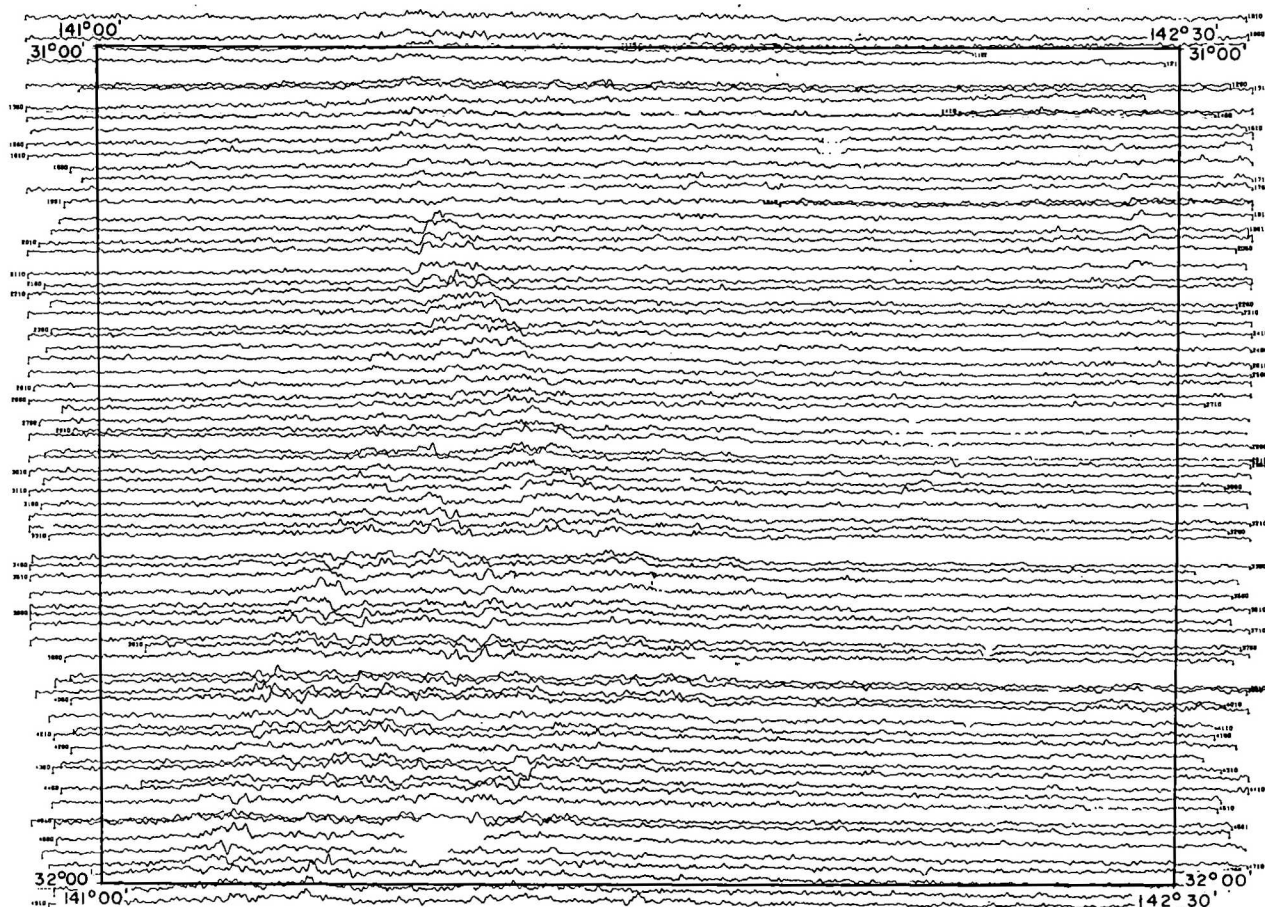
LOCATION DIAGRAM



REFERENCE TO 1:250000 MAP SERIES

FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA

BROKEN HILL



VERTICAL SCALE 80 counts/s/cm

AIRBORNE SURVEY, BROKEN HILL, NSW 1975

RADIOMETRIC PROFILES, THORIUM

SCALE 1:1 000 000

10 0 10 20 30 40 50 KILOMETRES

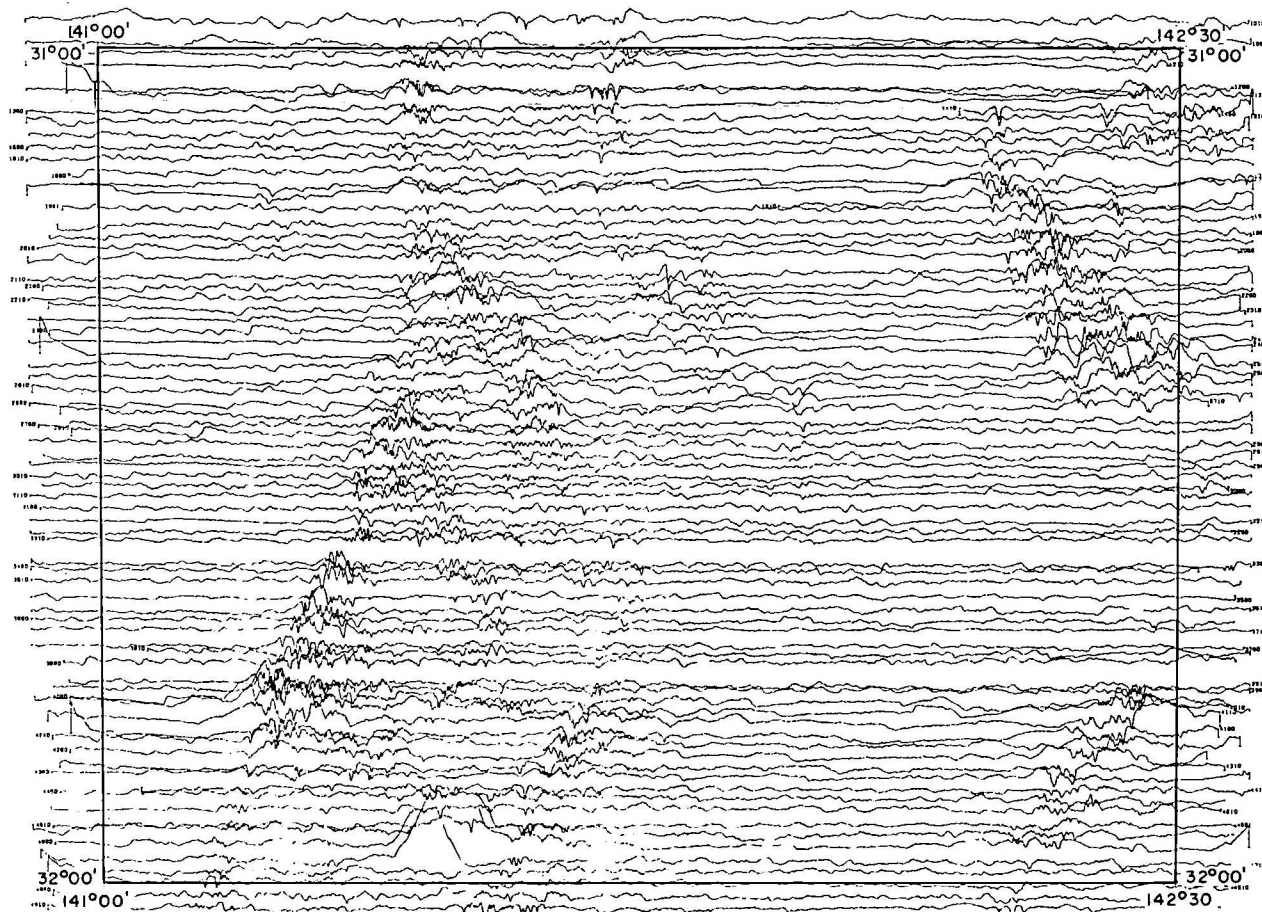
LOCATION DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA

BROKEN HILL



VERTICAL SCALE 400m/cm
BASE 100m

AIRBORNE SURVEY, BROKEN HILL, NSW 1975

RADIO-ALTIMETER PROFILES

SCALE 1:1 000 000

10 0 10 20 30 40 50 KILOMETRES

LOCATION DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA