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Record 1978/114



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

by

B.W. Wyatt

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ABSTRACT

In 1975, to obtain data to assist geological mapping by the Geological Survey of New South Wales and mineral exploration by mining companies, the Bureau of Mineral Resources flew a detailed airborne magnetic and radiometric survey of most of the area of Willyama Complex outcrop in the Broken Hill 1:250 000 Sheet area. 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 BMR flew two airborne geophysical surveys in the Broken Hill area, NSW. The purpose of the surveys was to obtain magnetic and gamma-ray spectrometer data to assist geological mapping by the Geological Survey of NSW and mineral exploration, carried out by mining companies in the Broken Hill area.

From 26 June to 29 July, a regional survey was made over the Broken Hill 1:250 000 Sheet area with 1.5 km line spacing and ground clearance 100 m (Wyatt, 1978). Following this from 31 July to 29 August a detailed survey was flown, which covered most of the area of Willyama Complex outcrop on the Broken Hill sheet (Plate 1). This report deals with the detailed survey which was flown along east-west lines 300 m apart at 100 m ground clearance. The 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 was used for this work.

Table 1 lists the preliminary maps released at scales of 1:250 000 to 1:100 000 which are available from Copy Service, Australian Government Printer (Production), Wentworth Avenue, Kingston, ACT(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 11 illustrate a representative sample of 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
Flight-line system	1:100 000	H54/B1-71
Radio-altimeter profiles	1:25000 N-S 1:100 000 E-W	72
Total count profiles	" "	73
Potassium profiles	" "	74
Thorium profiles	" "	75
Uranium profiles	" "	76
Total Magnetic Intensity profiles	" "	77
Total Magnetic Intensity contours (1)	1:25 000	78
" " " " (2)	"	79
" " " " (3)	"	80
" " " " (4)	"	81
" " " " (5)	"	82
" " " " (6)	"	83
" " " " (7)	"	84
" " " " (8)	"	85
" " " " (9)	"	86
" " " " (10)	"	87
" " " " (11)	1:100 000	88
U/Th ratio profiles	1:25 000 N-S 1:100 000 E-W	89
Total count contours	1:100 000	92

DATA ACQUISITION

Aircraft:	Twin Otter VH-BMG
Ground speed:	55 m/sec
Altitude:	100 m above ground level
Line spacing:	300 m
Line orientation:	East-west
Tie system:	5 north-south double tie pairs
Doppler:	Marconi AD-560 system

Camera:	BMR 35 mmstrip camera										
Altimeter:	Collins ALT 50										
Spectrometer:	Hammer-Harshaw modules 3700 cc NaI detector involving 2 crystals each 15.24 cm diameter, 10.16 cm thick										
Gamma spectrometry:	<table border="0"> <tr> <th><u>Channel</u></th> <th><u>Energy range</u></th> </tr> <tr> <td>"Total count"</td> <td>0.84 - 3.0 MeV</td> </tr> <tr> <td>"Potassium"</td> <td>1.3 - 1.6 MeV</td> </tr> <tr> <td>"Uranium"</td> <td>1.6 - 1.9 MeV</td> </tr> <tr> <td>"Thorium"</td> <td>2.4 - 2.8 MeV</td> </tr> </table>	<u>Channel</u>	<u>Energy range</u>	"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
<u>Channel</u>	<u>Energy range</u>										
"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										
Timer:	BMR NZA1										
Magnetometers:	BMR Fluxgate MFS-7 (airborne) BMR Proton MNS-2 (ground station)										
Acquisition system:	Hewlett Packard 2114B Computer Kennedy MT Recorder NCR Thermal printer and keyboard										
Sampling period:	Magnetic field 0.2 second Altimeter 1.0 second Spectrometer 1.0 second Doppler 10 seconds										
Chart recorders:	Geometrics MARS-6 H.P. Moseley 2100B										

Staff

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

DATA PROCESSING AND PRESENTATION

All digital data tapes were merged and processed in Canberra using BMR's Hewlett Packard 2100 and CSIRO's CDC CYBER 76 computers. All profiles, flight path maps and contour maps were drawn using BMR's Calcomp drum and flatbed plotters.

The digital data are available as five magnetic tape files containing:

1. Unedited field tapes
2. Edited unprocessed data.
3. Position and processed magnetic data.
4. Position and processed radiometric data.
5. Position and radiometric ratios.

Flight Path Recovery

Four control points on each flight line were plotted on airphotos, transferred to 1:25 000 scale planimetric maps, digitised and then used to position absolutely the doppler coordinates recorded digitally during flight.

Flight line plots were produced at scales of 1:100 000 (Plate 2) for use with all stacked profiles, and at 1:50 000 for superposition with magnetic contours issued at that scale.

The baseline for each profile in plates 5 to 11 is the straight line being the best least squares fit to the actual flight path.

Magnetic Data

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

The edited magnetic data were levelled to the Broken Hill regional survey using the five common double tie pairs. No subtraction of recorded diurnal changes was attempted. Drift, as approximated by third order polynomials, was removed from each flight.

The regional gradient was removed using the IGRF model for 1965.0 at 300 m above sea level and a constant of 5000 nT was added for presentation purposes.

Discrete data values were used at intervals of 3 seconds along flight lines to interpolate grid values spaced 60 m in the east-west direction and 50 m in the north-south direction from which the magnetic field was contoured. Preliminary total magnetic intensity contours have been produced as ten sheets at 1:25 000 scale and as a composite at 1:100 000 scale (Plate 3). Final contours are to be published at 1:50 000 scale with superimposed flight path and topographic information at a future date.

The magnetic field using 1-second values has also been displayed as a set of stacked profiles (plate 5) expanded four times in the north-south direction for clarity.

Gamma-ray Spectrometer Data

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

The data set was normalized to 100 m above ground level using the formula

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

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

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

$$K \text{ stripped} = K - \beta \cdot Th - \delta U \text{ stripped}$$

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

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

The four spectrometer channels were filtered using a low pass filter with the following coefficients:

0.03512, 0.1236, 0.2148, 0.2531, 0.2148, 0.1236, 0.03512

Ratios of the corrected and filtered data were taken as follows:

U/Th, U/K, Th/K, U.U/Th, U.Total/Th with an additional low pass filter applied to the

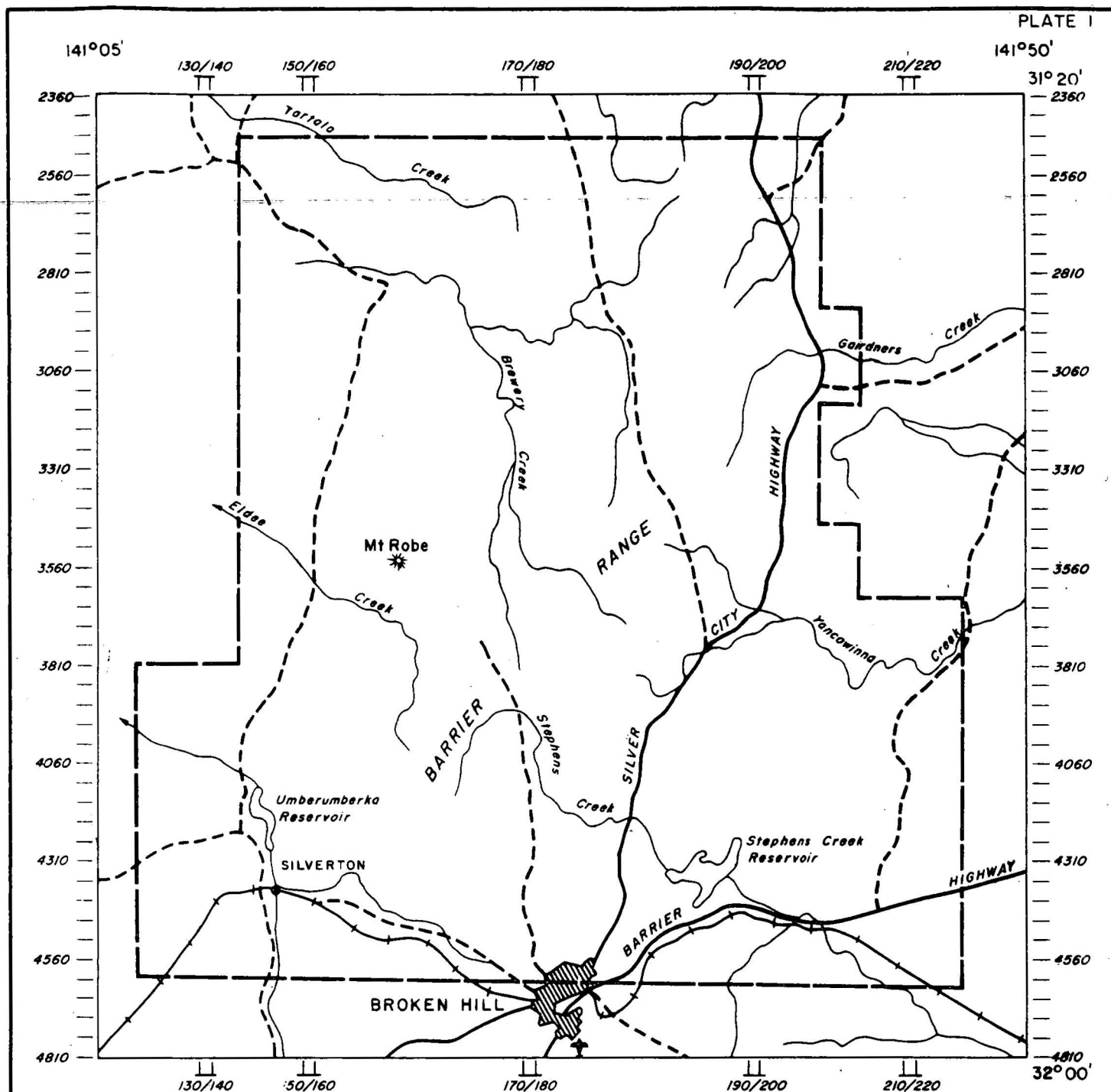
U/Th, U/K, Th/K data.

Discrete data values were used at intervals of 5 seconds along flight lines to interpolate grid values spaced 100 m in the east-west direction and 85 m in the north-south direction from which the total count data have been contoured (Plate 4). The discontinuity between adjacent lines 3015 and 3020 at latitude $31^{\circ}31'S$ may be due to markedly different ground clearances on these two lines.

Total count, Potassium, Uranium, Thorium, U/Th Ratio, and Altimeter channels have been presented as stacked profiles expanded four times in the north-south direction (Plates 6 to 11).

REFERENCE

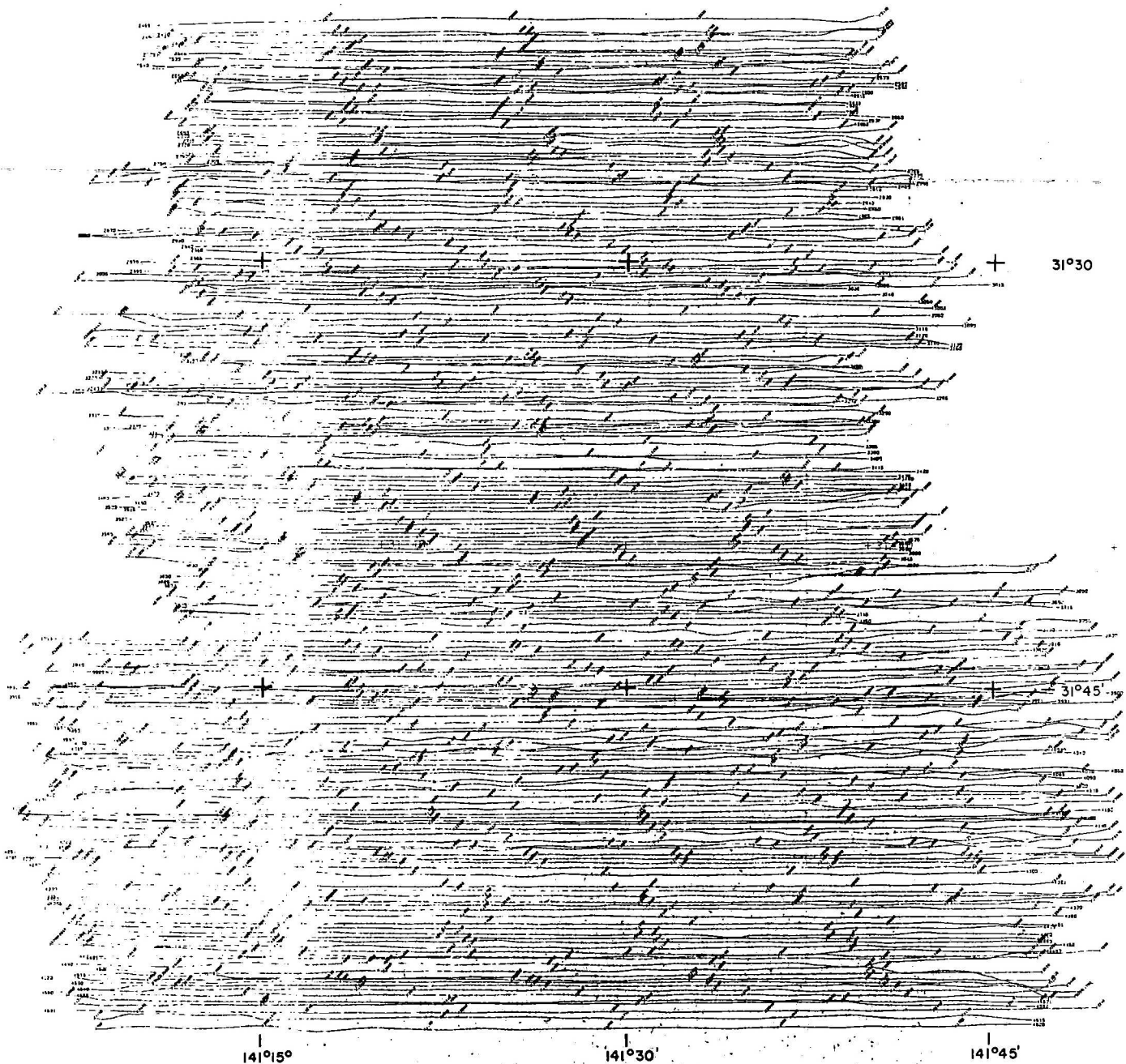
WYATT, B.W., 1978 - Operational Report on Broken Hill Regional Airborne Magnetic and Gamma-Ray Spectrometer Survey, 1975. Bureau of Mineral Resources, Australia, Record 1978/116 (unpublished).



DETAILED AIRBORNE SURVEY, BROKEN HILL, NSW 1975
FLIGHT-LINE SYSTEM

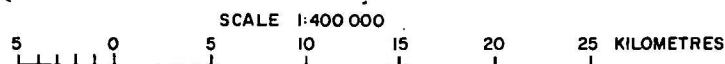


- Detailed survey boundary
- - - - Road, highway
- + + + + Railway

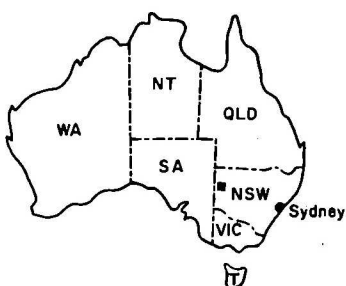


AIRBORNE SURVEY, BROKEN HILL (DETAIL), NSW 1975

FLIGHT-LINE SYSTEM

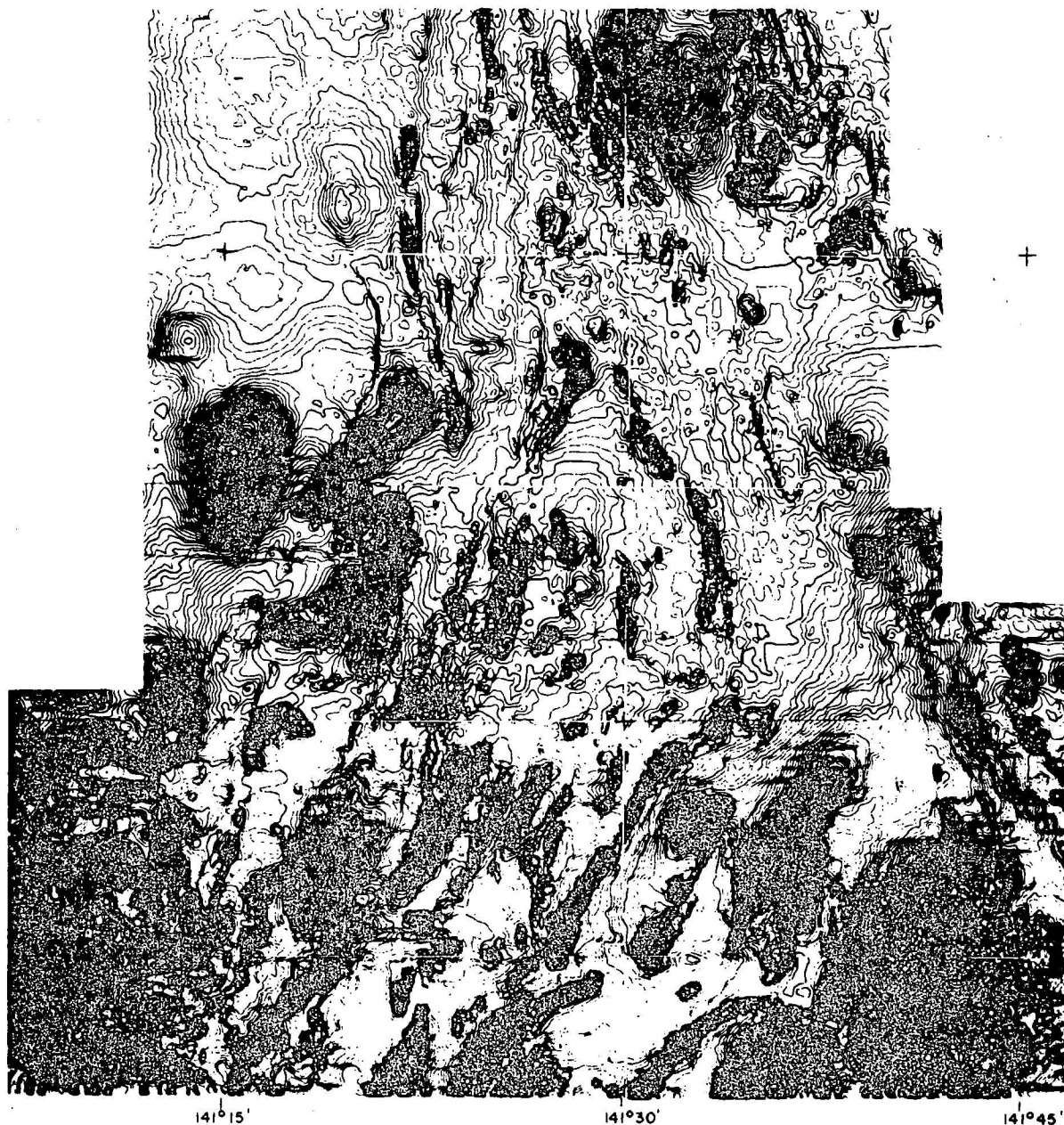


LOCATION DIAGRAM



REFERENCE TO 1:250000 MAP SERIES

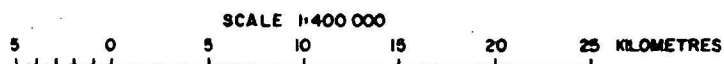
FROME	COBHAM LAKE	WHITE CLIFFS
CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA



CONTOUR INTERVAL 10mT

AIRBORNE SURVEY, BROKEN HILL (DETAIL), NSW 1975

TOTAL MAGNETIC INTENSITY

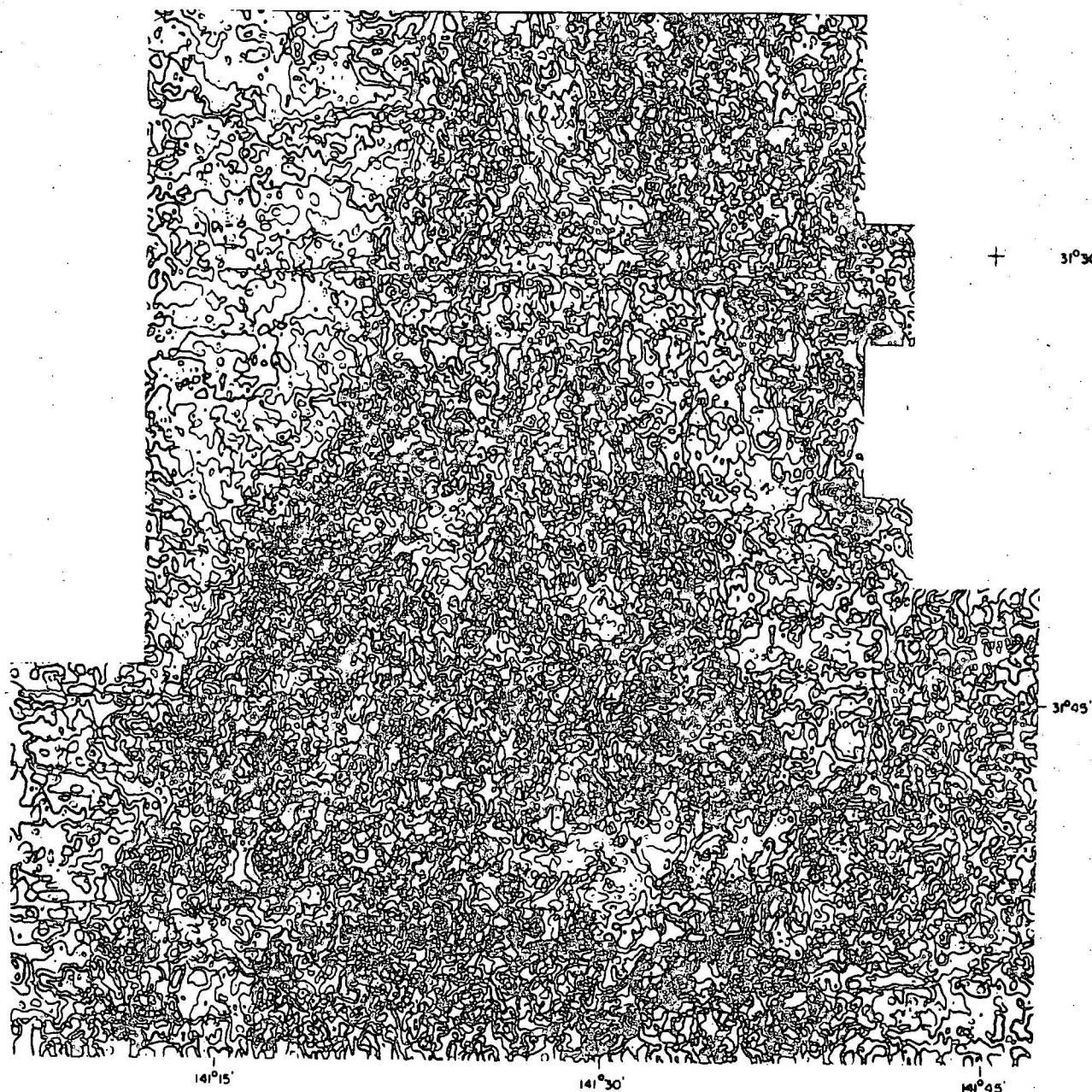


LOCATION DIAGRAM



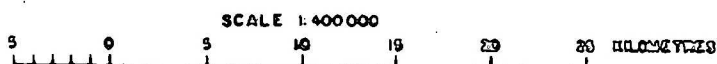
REFERENCE TO 1:250 000 MAP SERIES

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

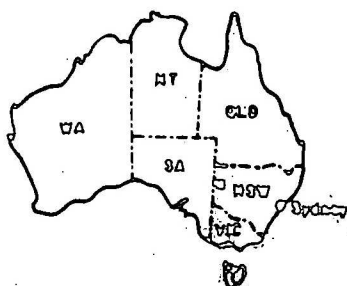


AIRBORNE SURVEY, BROKEN HILL (DETAILED), NSW 1975
RADIOMETRIC CONTOURS, TOTAL COUNT

CONTOUR INTERVAL: 10 counts/s



LOCATION DIAGRAM

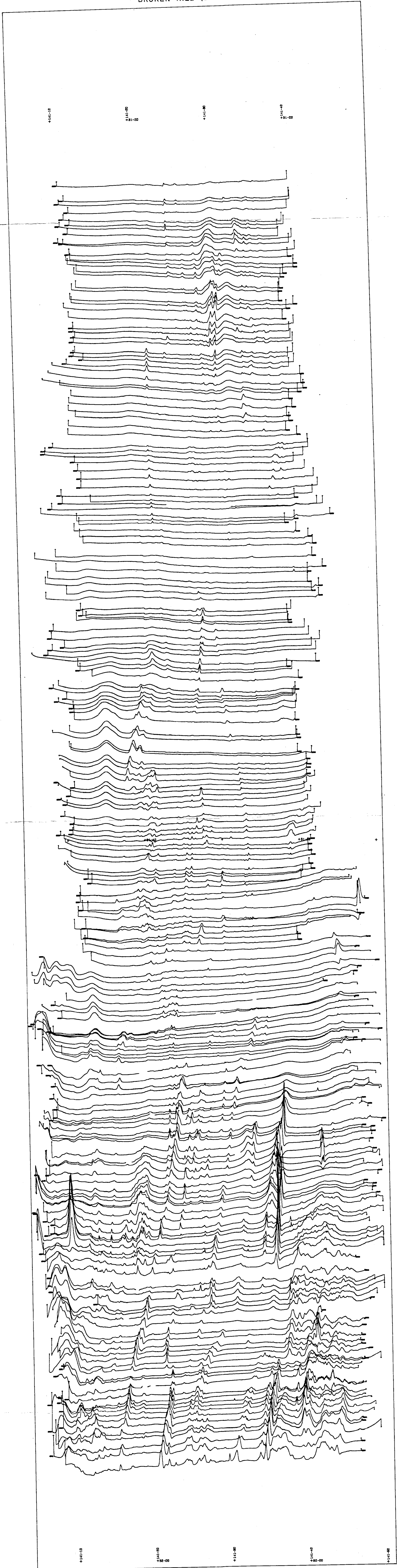


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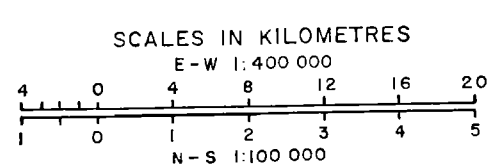
ORANGE	COOMAN LAKE	WHITE CLIFFS
COOMAN	BROKEN HILL	VULCANIA
OLARY	WINDGEE	MANARA

13

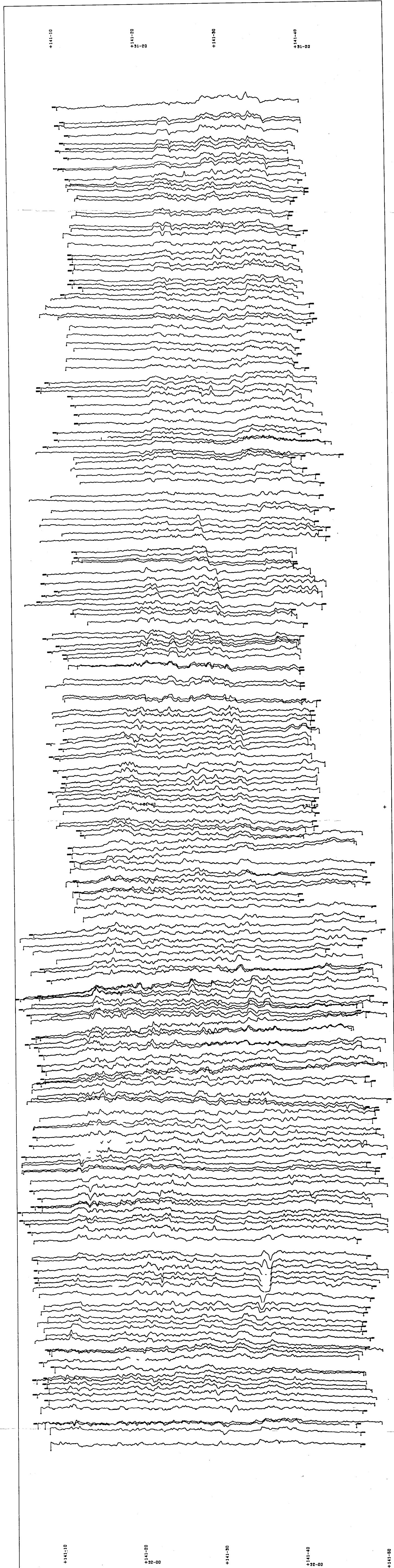
BROKEN HILL (DETAIL)



TOTAL MAGNETIC INTENSITY PROFILES



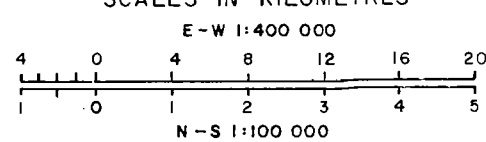
BROKEN HILL (DETAIL)



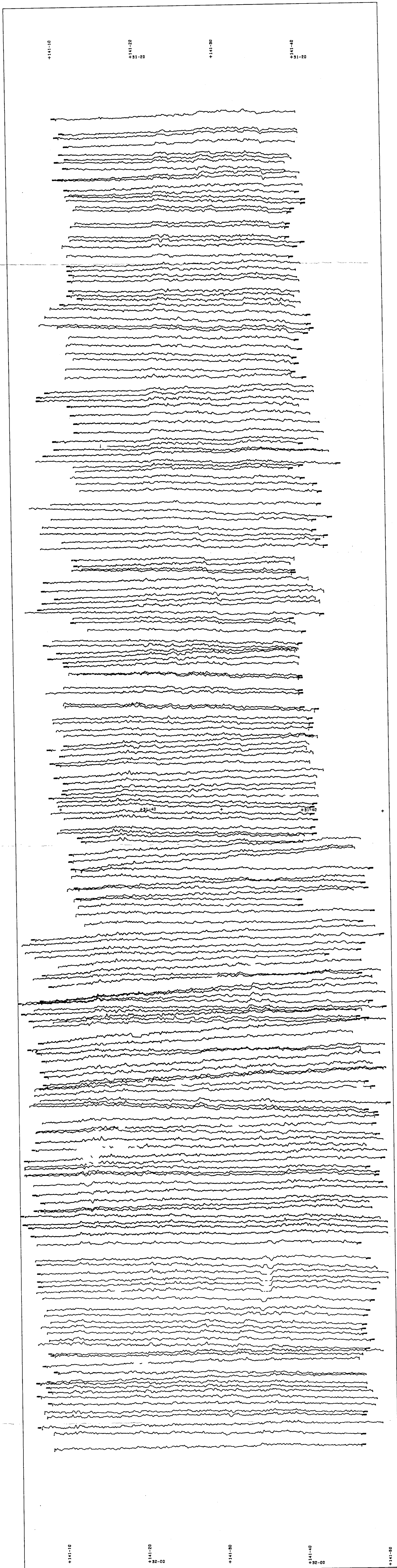
PROFILE VERTICAL SCALE 400 counts/s/cm
BASE 50 counts/s

RADIOMETRIC PROFILES
TOTAL COUNT

SCALES IN KILOMETRES



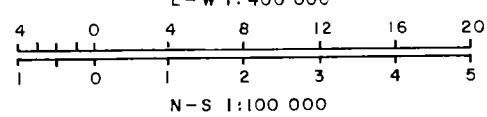
BROKEN HILL (DETAIL)



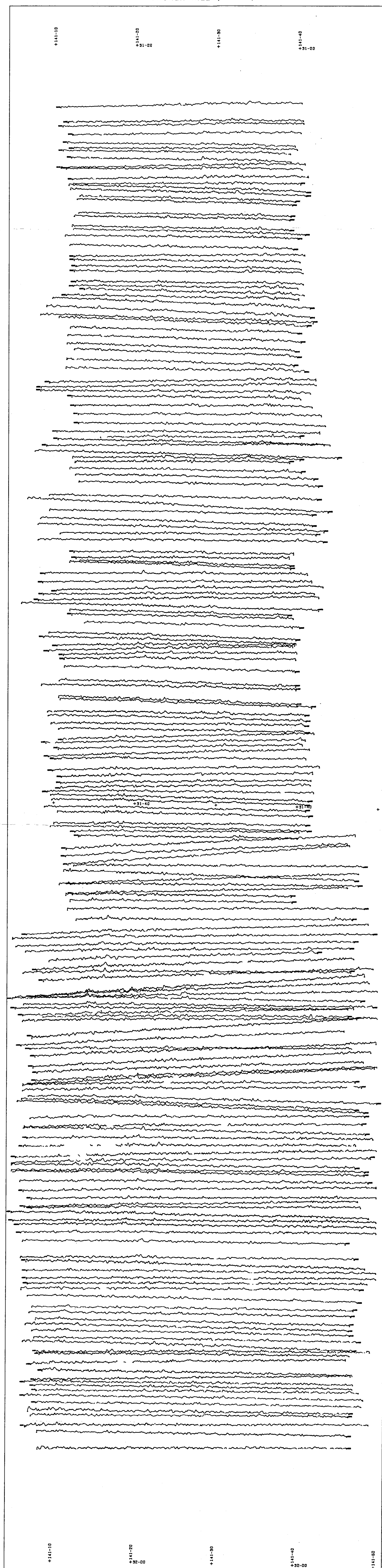
PROFILE VERTICAL SCALE 160 counts/s/cm
BASE 10 counts/s

RADIOMETRIC PROFILES, POTASSIUM

SCALES IN KILOMETRES
E-W 1:400 000



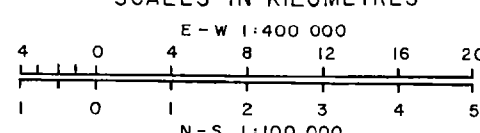
BROKEN HILL (DETAIL)



PROFILE VERTICAL SCALE 80 counts/s/cm
BASE 0 counts/s

RADIOMETRIC PROFILES, URANIUM

SCALES IN KILOMETRES



+141-10

+141-20

+141-30

+141-40

+141-50

+141-10

+141-20

+141-30

+141-40

+141-50

PROFILE VERTICAL SCALE 80 counts/s/cm
BASE 0 counts/s

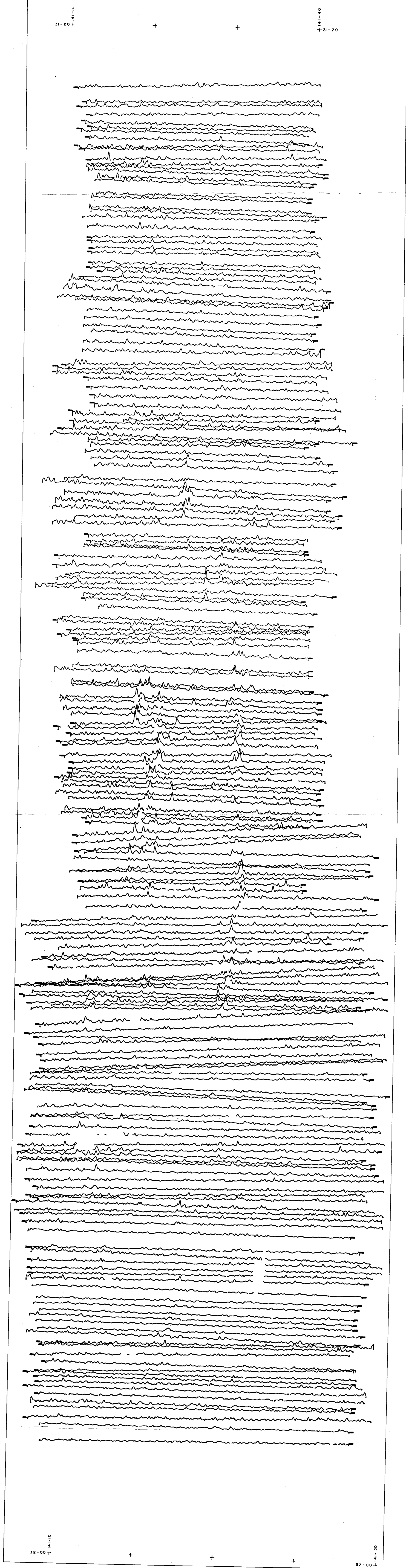
SCALES IN KILOMETRES

E - W 1 : 400 000

N - S 1 : 100 000

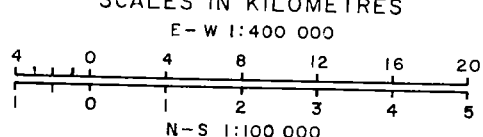
The image shows two horizontal scale bars. The top bar is labeled 'E - W 1 : 400 000' and has markings at 0, 4, 8, 12, 16, and 20. The bottom bar is labeled 'N - S 1 : 100 000' and has markings at 0, 1, 2, 3, 4, and 5. Both bars have smaller tick marks between the main numbers.

BROKEN HILL (DETAIL)



RADIOMETRIC PROFILES
URANIUM/THORIUM RATIO

SCALES IN KILOMETRES

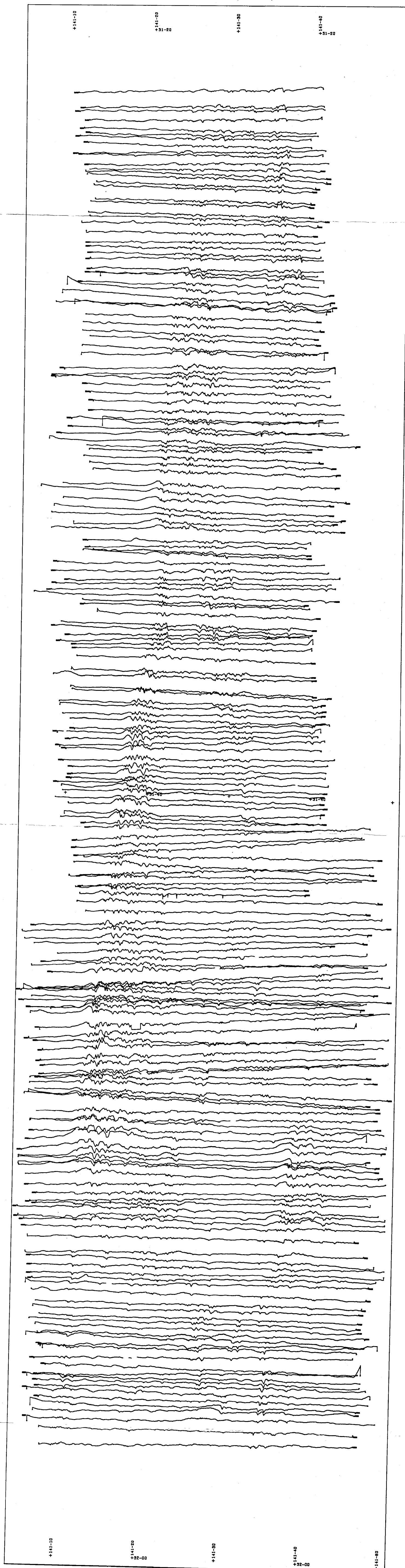


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PLATE 10

BROKEN HILL (DETAIL)



PROFILE VERTICAL SCALE 400 m/cm
BASE 100 m

RADIO-ALTIMETER PROFILES

