COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1963/114

NARROMINE AND BATHURST AIRBORNE MAGNETIC AND RADIOMETRIC SURVEYS, NSW 1961

by

G.A. YOUNG

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ILLUSTRATIONS

SUMMARY

An airborne magnetic and radiometric survey of the major parts of the Narromine and Bathurst standard map areas was flown during the period October to December 1961. The operations are described and an analysis is made of the magnetic and radiometric results.

The results show that considerable correlation exists between anomalous magnetic trends and known geological structure. This correlation indicates that the aeromagnetic data will provide valuable information on the regional geology in areas of alluvium cover. The data may also be expected to delineate areas amenable to a more detailed search for metalliferous deposits.

1. INTRODUCTION

At the request of the Department of Mines, New South Wales, a programme of airborne magnetic and radiometric surveys was commenced by the Bureau of Mineral Resources, Geology and Geophysics in 1957 with the object of assisting in the search for mineral deposits and providing information related to problems of regional geological structure. The areas selected for survey are known to contain metalliferous deposits; some have considerable areal extent of soil mantle obscuring the rock surface. The Bureau of Mineral Resources has so far completed airborne surveys of the following standard map areas (scale 1:250,000):

Cobar, Nymagee, and Cargelligo (Spence, 1961)

Bourke and Forbes (Carter, 1960)

During October to December 1961, a further stage in the programme was completed with the flying of the major parts of the Narromine and Bathurst standard map areas (scale 1:250,000).

Some previous geophysical work has been done in the Narromine and Bathurst areas. The airborne magnetic and radiometric survey of Forbes standard map area (Carter, 1960) was extended to include the southern part of the Narromine standard map area and the western part of the Bathurst standard map area.

The discovery of uranium minerals in the Carcoar district stimulated a series of ground radiometric surveys by the Bureau of Mineral Resources (Daly, Dyson, and Pearce 1951; Matheson, 1952; Daly, 1955) and by the Department of Mines, New South Wales (Rayner and Ralph, 1954).

The Bureau of Mineral Resources made further ground surveys in this area during 1955 using magnetic, electromagnetic, self-potential, and geochemical techniques (Horvath and Rowston, 1957).

Results from this work indicate that in the Carcoar district radioactivity is associated with slate near its contact with a hornblende-diorite intrusion, and magnetic anomalies of intensity ranging from 250 to 2000 gammas are associated with the hornblende-diorite igneous mass. It also appears that troughs of low magnetic activity in the area of the hornblende-diorite mass outline major shears. The diorite dykes crossing the area show no appreciable magnetic influence.

2. GEOLOGY

Regional geological maps of the Narromine and Bathurst standard map areas shown in Plates 3 and 5 are based on information supplied by the Department of Mines, New South Wales and the Department of Geology and Geophysics, University of Sydney.

Palaeozoic sediments and metasediments, extensively intruded by granite, comprise the geology of these areas. Silurian rocks, consisting mainly of quartzite, sandstone, shale, and slate, form the larger part of the Palaeozoic outcrops. They overlie the Ordovician rocks, which are mainly shale and slate with some andesite, quartzite, and chert. These Ordovician rocks have been subject to considerable folding and, in some areas, considerable regional and local metamorphism.

Ordovician outcrops are in the form of ill-defined meridional belts which alternate with Silurian or younger beds or are separated by igneous intrusions, the Silurian rocks being preserved for the most part in north-trending synclines.

Devonian sandstone, quartzite, and volcanic rocks unconformably overlie the Lower Palaeozoic beds north-east and north-west of the Bathurst area and in the southern part of the Narromine area.

Narromine area

The geology for most of this area is not well known owing to an extensive alluvial cover, particularly in the north. Moderate igneous activity which occurred during, and prior to, Middle Devonian times is the main source of mineralisation in this area. The most extensive igneous outcrop extends southwards from Narromine to east of Parkes.

West of this igneous mass, gold has been mined in the Peak Hill district (Anderson, 1890), the mineralisation occurring as pyritic quartz reefs in Silurian slate. A considerable quantity of alluvial gold has also been mined in this locality.

In the region about Trundle bauxite has been derived from the laterisation of a felspathic rock, probably a tuff. (Hanlon, 1944).

Except for these minerals and gold obtained from the Tottenham district, few ore deposits of economic significance have been located in the Narromine area.

North and east of the Narromine area, Jurassic rocks are exposed, these being mainly sandstone.

Bathurst area

The area was subject to many periods of igneous activity during the Palaeozoic era, the first period of major importance occurring at the end of the Silurian. Mineralisation attributed to this Bowning epoch of granitic intrusion are the gold at Trunkey and Rockley and the copper at Cow Flat (Browne, 1949).

The Kanimblan igneous epoch at the close of Lower Carboniferous times produced the majority of the plutonic rocks now exposed in this area. The most notable is the Kanimblan batholith, mainly composed of biotite granite, which extends from Hartley through Rydal, Oberon, and Bathurst, towards Orange and Newbridge.

Associated with these intrusions is a wide variety of minerals which are of economic importance including the gold, silver-lead, and iron ores of Hill End, Orange, Bathurst, Blayney, and Lyndhurst and the molybdenum of Yetholme (Browne, 1949).

Mineralisation occurs in many places as contact metamorphic deposits, the invaded rocks being entirely pre-Carboniferous and predominantly Silurian. Such deposits are the molybdenum and tungsten ores at Yetholme, and the chalcopyrite at Bathurst, Molong, and Cadia (Voisey, 1953).

At Cadia and Carcoar small iron orebodies appear to be metasomatic replacement deposits consisting mainly of haematite, limonite, magnetite, and manganese oxide in Silurian slate (David, 1950).

Uranium ores of torbernite, autunite, and uraninite associated with cobalt ores have also been found at Carcoar (Rayner and Ralph, 1954). This mineralisation is found in zones of shearing in an environment of interbedded sedimentary and volcanic rocks, probably Silurian, adjacent to an intrusive diorite mass.

Silurian rocks are also the host rocks for mineralisation at Hill End where auriferous saddle reefs occur as fissure fillings (Voisey 1953, Harper 1918).

A large part of the area west and south of Bathurst is covered by Tertiary basalt which contributes to the Central Highland plateau surface and has preserved deep leads in the Orange, Lucknow, Bathurst, and Rockley localities, which were worked for tin and gold (Voisey, 1953).

3. INTERPRETATION

Magnetic

Magnetic results from the Narromine and Bathurst standard map areas are given in Plates 2 to 5. Total magnetic intensity profiles produced by a low-sensitivity curvilinear recorder have been adjusted to an exact overall scale of 1:250,000 by controlling the positions of the flight traverse lines at the eastern and western boundaries of the survey areas. These profiles are drawn with a probable error of $\pm$ 100 gammas and are presented solely for descriptive purposes in this Record.

Plates 2 and 4 show the magnetic profiles related to idealised grids of flight traverse lines in the Narromine and Bathurst areas. These grids, for convenience of presentation, have scales of 1:250,000 east-west and 1:62,500 north-south. Plates 3 and 5 show every fourth profile superimposed on regional geological maps of the survey areas. The probable error in positioning this magnetic data is estimated to be $\pm \frac{1}{4}$ mile east-west and $\pm \frac{1}{2}$ mile north-south.

Narromine area. The magnetic profiles shown on Plates 2 and 3 indicate the correlation that exists between anomalous magnetic trends and regional geological structure in this area. The magnetic disturbance is mainly associated with Silurian rocks, anomalies being generally elongated in a direction trending N10°W, which reflects the regional geological strike. This general magnetic trend differs from that observed to the south in the Forbes standard map area (scale 1:250,000) where anomalies are elongated in a direction trending N30°E (Carter, 1960, Maps G324-8, 9, 11, 12), but is similar to those observed in the Cobar and Nymagee standard map areas (Spence, 1961, Maps G290-3, 4, 5, 6 and G338-5, 6, 7, 8).

Many anomalies have a very limited east-west extent and a pronounced north-south elongation which occasionally exceeds 20 miles. Such anomalies, for example those about Narromine, have a form generally associated with near-surface vertical tabular bodies commonly produced either by mineralisation along shear zones or by dykes. Spence (1961) reports similar anomalies in the Cobar standard map area and postulates that they may mark shear zones similar to that which runs through Cobar.

Another form of magnetic disturbance occurs in the area west of Peak Hill and extends southwards into the Forbes standard map area (Carter, op.cit, Map G324-9). The disturbed zone, which has an east-west extension of approximately 15 miles, is characterised by anomalies of a complex nature whose amplitudes rarely exceed 500 gammas and whose forms indicate their sources to be near surface level. The anomalies originate from Silurian rocks. Linear magnetic trends located on the eastern flank of the zone correspond to outcrops of Silurian volcanics. In the region about Parkes, similar anomalies (Map G324-9) correspond to outcrops of intrusive and extrusive andesite, which are associated with the auriferous mineralisation of the Forbes-Parkes gold field (Andrews, 1910).

Another magnetic zone, located 15 miles S40°W of Narromine, indicates a northerly continuation of the Silurian rocks at a shallow depth beneath the alluvium cover and may also indicate further areas of auriferous mineralisation.

The region of greatest magnetic disturbance is that situated west of the granite outcrop of the Gobondry Mountains. From the limited geological information available, the sources of the localised anomalies possibly lie within Silurian rocks. Similar anomalies have been observed in the south-eastern part of the Cobar standard map area (Spence, op.cit., Map G290-6) over outcrops of serpentine. It is possible therefore that the anomalies west of the Gobondry Mountains are related to the occurrence of serpentine, and the intense isolated anomaly located 12 miles S50°W of Tottenham probably has a similar source. These areas of intense magnetic disturbance lie in a zone trending N30°W, paralleling the general trend of the individual anomalies.

Slight magnetic activity was recorded over the main granitic mass of the Gobondry Mountains. However, the periphery of the granite is defined by anomalies of about 300 to 400 gammas, which may arise from magnetic mineral concentrations. These anomalies are considered to warrant further investigation. A high-grade haematite deposit in highly-altered sedimentary rocks (slate, epidote, and marble) is known to exist along the eastern boundary of the granite (Griffin and Wynn, 1961).

The north-eastern part of the Narromine standard map area includes the southern margin of the Coonamble Basin. However, most of the anomalies here indicate that the magnetic basement is very close to the surface and nowhere is the estimated thickness of sediments greater than 1500 ft.

Bathurst area. The magnetic profiles presented in Plates 4 and 5 show correlation between the anomalous magnetic trends and the regional geological structure. To some extent, Plate 5 also indicates correspondence of magnetic anomalies with known areas of mineralisation.

The magnetic anomalies appear to be associated with Ordovician rocks, areas of disturbance having a distinct northerly extension which reflects the regional geological strike. The northerly elongation of localised magnetic anomalies common in the Forbes and Narromine standard map areas is not so apparent in this area. Slight magnetic activity is associated with Silurian or Devonian rocks; outcrops of Devonian volcanics north of Bathurst show no magnetic activity.

Although magnetic disturbance is apparent in various degrees throughout almost the entire area, the more intense magnetic anomalies are mainly confined to the region defined by the townships of Molong, Canowindra, Cowra, Blayney, and Orange. Within this area many intrusive and extrusive rocks have been mapped (Stevens, 1948 and 1950). Ordovician andesite and Tertiary basalt appear to be predominantly the sources of the magnetic anomalies. Stevens places the andesites in the Lower Silurian (Cargo Andesite Series) and notes the presence of trachyandesites and basalts in the series. The magnetic anomalies associated with these rocks are similar to those recorded over outcrops of andesite in the Forbes-Parkes gold field (Carter, 1960, Map G324-9; Andrews, 1910).

North of Woodstock, the north-trending fault (Stevens, 1948 and 1950) which marks the contact of the andesitic rocks with younger strata is reflected by changes in the character of the magnetic profiles. An area of limestone exposure (Stevens, 1948) located seven miles west of Black Rock Range (shown in Plate 5 as occurring in Ordovician outcrops) typically show no magnetic disturbance. Outcrops of quartz porphyry and granite west of the fault have no associated magnetic anomalies.

The periphery of the granitic mass located south of Woodstock is defined by magnetic anomalies of amplitudes ranging up to 600 gammas. It is possible that these anomalies result from contact metamorphism and associated mineralisation, but they may be related to exposures of andesite about the intrusion. No magnetic anomalies are associated with the granite or Ordovician rocks exposed east and south-east of Woodstock.

An intense magnetic anomaly at Cadia probably corresponds to mineralisation produced by a monzonite intrusion. Iron ore deposits associated with this intrusion (Griffin and Wynn, 1961) contain magnetite and are the probable source of the intense magnetic anomaly. In other areas of known iron mineralisation, viz. Woodstock, Blayney, Orange, and Carcoar (Griffin and Wynn, op. cit), no similar anomalies were observed which may be due either to the small size of the orebodies or to the iron being mainly in the form of haematite.

Slight magnetic disturbance is apparent in the area of granitic outcrop between Carcoar and Blayney. The western boundary of the intrusion is defined by magnetic anomalies apparently associated with the Ordovician rocks. East of the intrusion similar anomalies are recorded in a region of Ordovician outcrops but the eastern boundary of the intrusion is not delineated. Magnetic anomalies in the area of a reported hornblende-diorite outcrop (not shown) at the southern extremity of this intrusion (Plate 4, Flight-lines 45 and 46, longitude 149°09') have amplitudes ranging up to 500 gammas. This intensity accords with anomaly amplitudes of 2000 gammas measured in the ground magnetic survey (Horvath and Rowston, 1957).

Slight magnetic disturbance is associated with the main mass of the Kanimblan batholith about Bathurst. To the south, intense anomalies appear to be associated with the Ordovician rocks. The character of these anomalies is similar to that of the Canowindra locality and may therefore represent another northerly-trending belt of rocks with a high andesite content.

At the southern boundary of the survey area, due south of Blayney, a pronounced linear magnetic trend is defined. It is similar in character to those occurring in the region about Narromine. The geological significance of this anomaly is unknown.

Radiometric

Radiometric results from the Narromine and Bathurst areas are presented in Plates 6 and 7. Profiles of radioactive intensity recorded by the inboard scintillograph have been adjusted to an exact overall scale of 1:250,000, using a process similar to that adopted for the preliminary profiles of total magnetic intensity. Plates 6 and 7 present the radioactive profiles recorded on alternate lines, superimposed on regional geological maps of the two survey areas. Areas where the radioactive intensity level increases significantly are indicated on these plates.

Discrete radiometric anomalies, assessed from both the inboard and outboard scintillographs as resulting from localised sources, are also shown on these plates.

The probable error in positioning of this radiometric data is estimated to be $\pm \frac{1}{4}$ mile east-west and $\pm \frac{1}{2}$ mile north-south.

Narromine area. The radiometric profiles on Plate 6 show that areas of increased level in radioactive intensity are elongated in a northerly direction and are predominantly associated with areas of igneous outcrop. Two such areas are those located about the Gobondry Mountains, and the Sappa Bulga and Herveys Ranges, both areas corresponding to outcrops of Ordovician granite. A third area is that located east of Peak Hill, which lies on the extension of the axis of the Forbes-Parkes gold field, and may therefore indicate the presence of andesite in this locality.

Four radiometric anomalies were recorded and their positions are shown in Plate 6. The amplitude of these anomalies is not large; a ground investigation will be necessary to complete the assessment and determine the source of the anomalies.

Radiometric results illustrated south of Flight-line 63 are based on data from a previous survey (Carter, 1960).

Bathurst area. Three localities where pronounced increases in the level of radioactive intensity are evident are those about Bathurst, south and south-east of Woodstock, and northwards from Cowra. The most notable of these is that about Bathurst which corresponds to the exposure of the Kanimblan batholith. The area of increased radioactive intensity extending northwards from Cowra strongly reflects the regional geological structure and is primarily controlled by exposures of granite and quartz porphyry; the area to the south and south-east of Woodstock is probably a southerly continuation of this although primarily controlled by granite outcrop.

In general, Ordovician rocks in the Bathurst area are characterised by low radioactive intensity, although one notable exception is apparent west of Blayney and Carcoar. This area shows a moderate increase in radioactive level. At its south-eastern extremity ground radiometric surveys have shown uranium mineralisation to be associated with slate near a hornblende-diorite intrusion (Daly et al., 1951; Matheson 1952; Rayner and Relph, 1954; Daly, 1955).

Nine radiometric anomalies were recorded; their positions are shown on Plate 7. The amplitude of these anomalies is not large; a ground investigation will be necessary to complete the assessment and determine the source of the anomalies.

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APPENDIX

OPERATIONAL DETAILS

STAFF:

Party Leader	:	G.A. Young
Geophysicists	:	J.M. Mulder M.E.M. Lilley
Senior radio-technicians	:	P.B. Turner J. Smith
Geophysical assistants	:	K.A. Mort D. Park
Photographer	:	O. Scherl
Draughtsman	:	E. Kram-Stein
Pilots	:	Capt. G. Close First Officer D. Baker } TAA
Aircraft maintenance engineer	:	A. Smith } TAA

EQUIPMENT:

Aircraft	:	DC.3, VH-MIN
Magnetometer	:	MFS-4, saturable core fluxgate, coupled to 'Speedomax' recorder and to low-resistivity (curvilinear) profile recorder. Output also recorded on punched tape.
Scintillographs	:	Two, inboard and outboard (the latter suspended from a cable 200 ft below aircraft.)
Camera	:	'Aeropath', 35-mm strip
Radio-altimeter	:	STR30B, with coupled recorder
Air position indicator	:	Coupled to a recorder

SURVEY SPECIFICATIONS:

Altitude	:	500 ± 100 ft above ground level
Line spacing	:	One mile
Line orientation	:	East-west
Tie system	:	Single lines spaced 15 miles apart
Sensitivity (MFS-4)	:	Approx. 50 gammas/in.

PLATE I

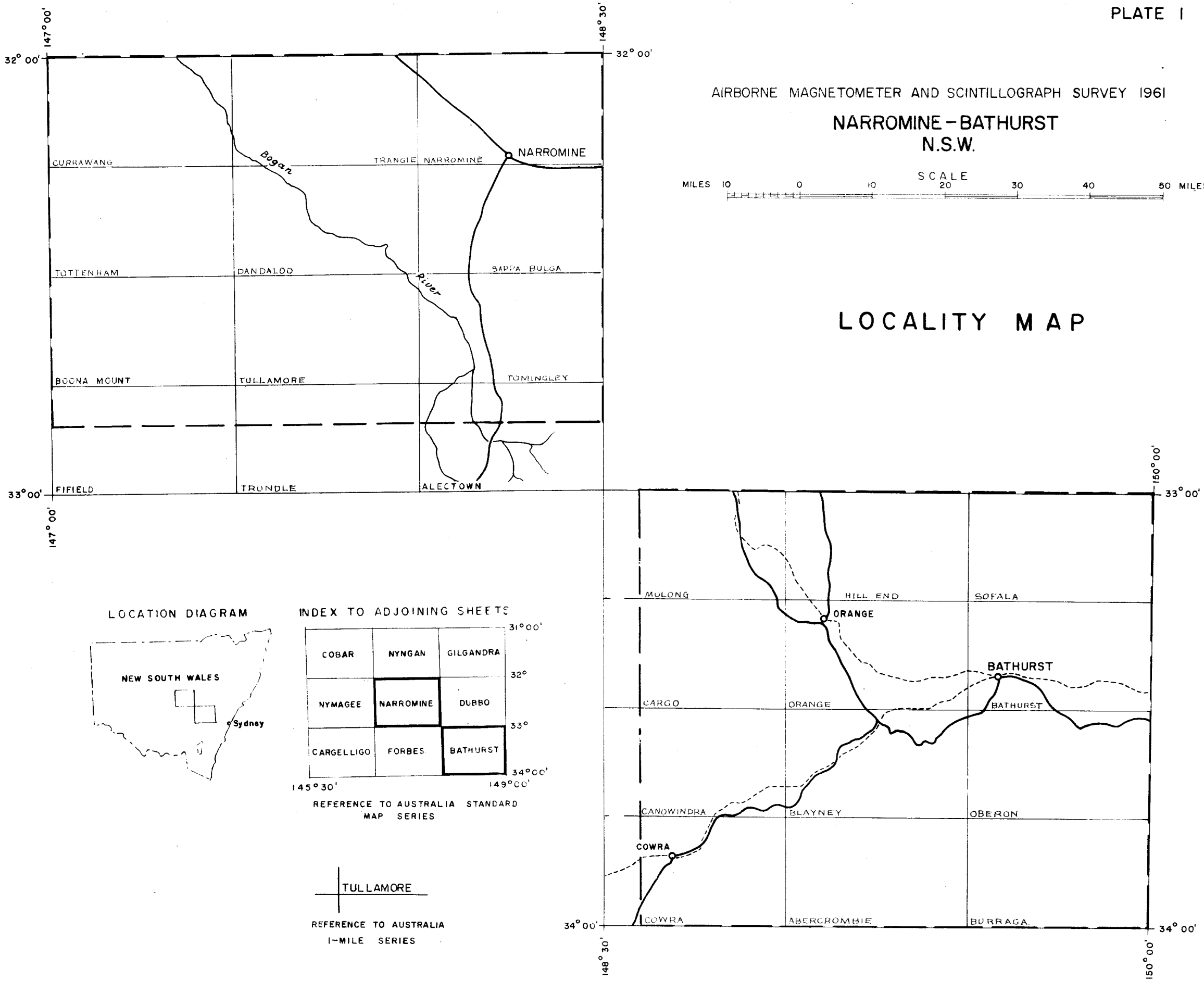
AIRBORNE MAGNETOMETER AND SCINTILLOGRAPH SURVEY 1961

NARROMINE – BATHURST
N.S.W.

SCALE

MILES 10 0 10 20 30 40 50 MILES

LOCALITY MAP



TO ACCOMPANY RECORD NO. 1963/114

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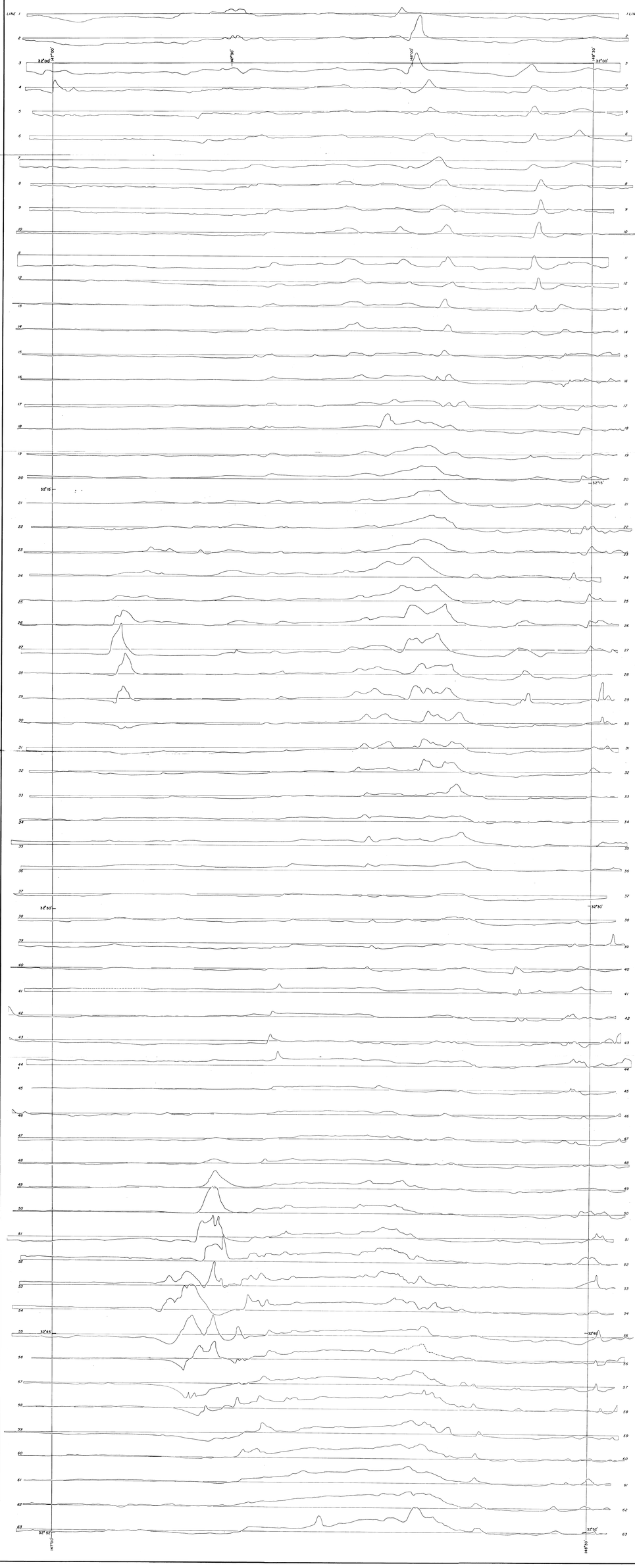


NARROMINE

TOTAL MAGNETIC INTENSITY PROFILES

AIRBORNE SURVEY, NARROMINE - BATHURST N.S.W., 1961

LOCATION DIAGRAM

GRATICULE SCALES

EAST-WEST SCALE

NORTH-SOUTH SCALE

APPROX. PROFILE SCALE

INDEX TO ADJOINING SHEETS

COBAR	WYNDAM	KILLANOOLA
WINGELLO	NARROMINE	DUBBO
CARCOLLOG	FORBES	BATHURST

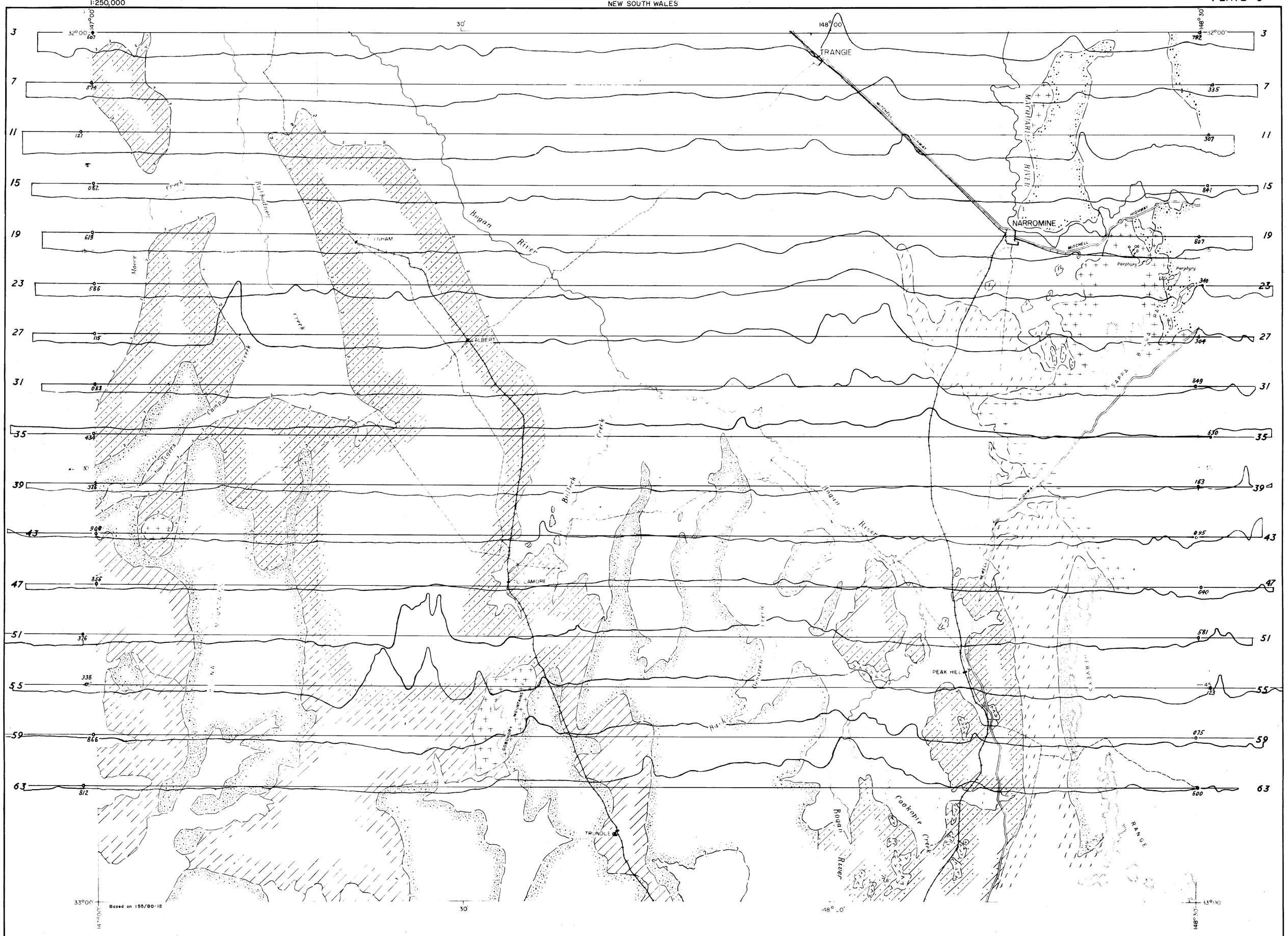
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
TO ACCOMPANY RECORD No. 1965/114

1:55/81-6

NARROMINE

NEW SOUTH WALES

PLATE 3



GEOLOGICAL LEGEND

QUATERNARY	ALLUVIUM	SILURIAN	UNDIFFERENTIATED SLATE, QUARTZITE, LAVA
JURASSIC	SANDSTONE	ORDOVICIAN	SLATE
UPPER DEVONIAN	SANDSTONE, QUARTZITE ETC.	IGNEOUS	
SILURIAN	COBAR SERIES QUARTZITE, SANDSTONE, AND SLATE	ORDOVICIAN	GRANITE
	OOTHA SERIES		ULTRABASIC
	VOLCANICS	ORDOVICIAN	PORPHYRY INDICATED ON MAP

GEOLOGY AFTER DEPARTMENT OF MINES, N.S.W.

NARROMINE

TOTAL MAGNETIC INTENSITY PROFILES AND GEOLOGY

AIRBORNE SURVEY 1961

10°00' True North Mag. North

SCALE

MILES 5 0 5 10 MILES

KILOMETERS 5 0 5 10 15 20 KILOMETERS

2000 gammas

1000

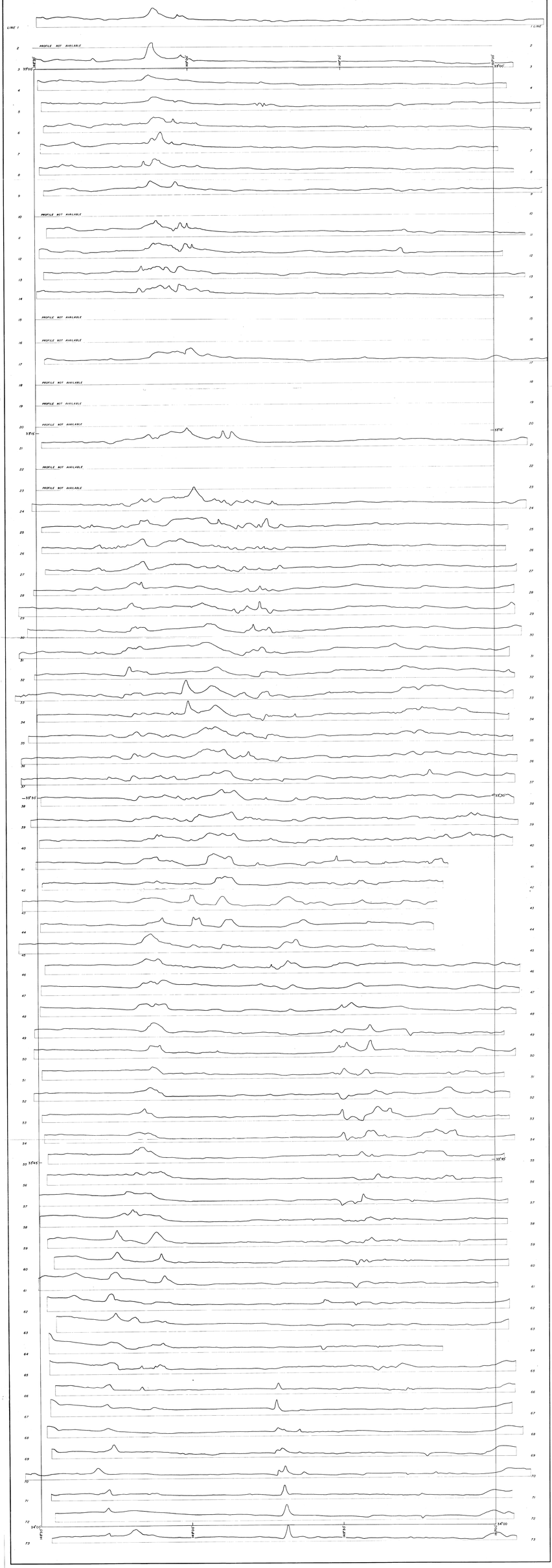
0

MAGNETIC PROFILE SCALE

TO ACCOMPANY RECORD No 1963/114

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

155/BI-4



BATHURST

TOTAL MAGNETIC INTENSITY PROFILES

AIRBORNE SURVEY, NARROMINE-BATHURST, N.S.W., 1961

LOCATION DIAGRAM

GRATICULE SCALES

EAST-WEST SCALE

NORTH-SOUTH SCALE

APPROX. PROFILE SCALE

INDEX TO ADJOINING SHEETS

NARROMINE	DUBBO	GULGONG
FORBES	BATHURST	LITHGOW
COOTA-MUNDA	GOULBURN	WOLLONGONG

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
TO ACCOMPANY RECORD No. 1961/71

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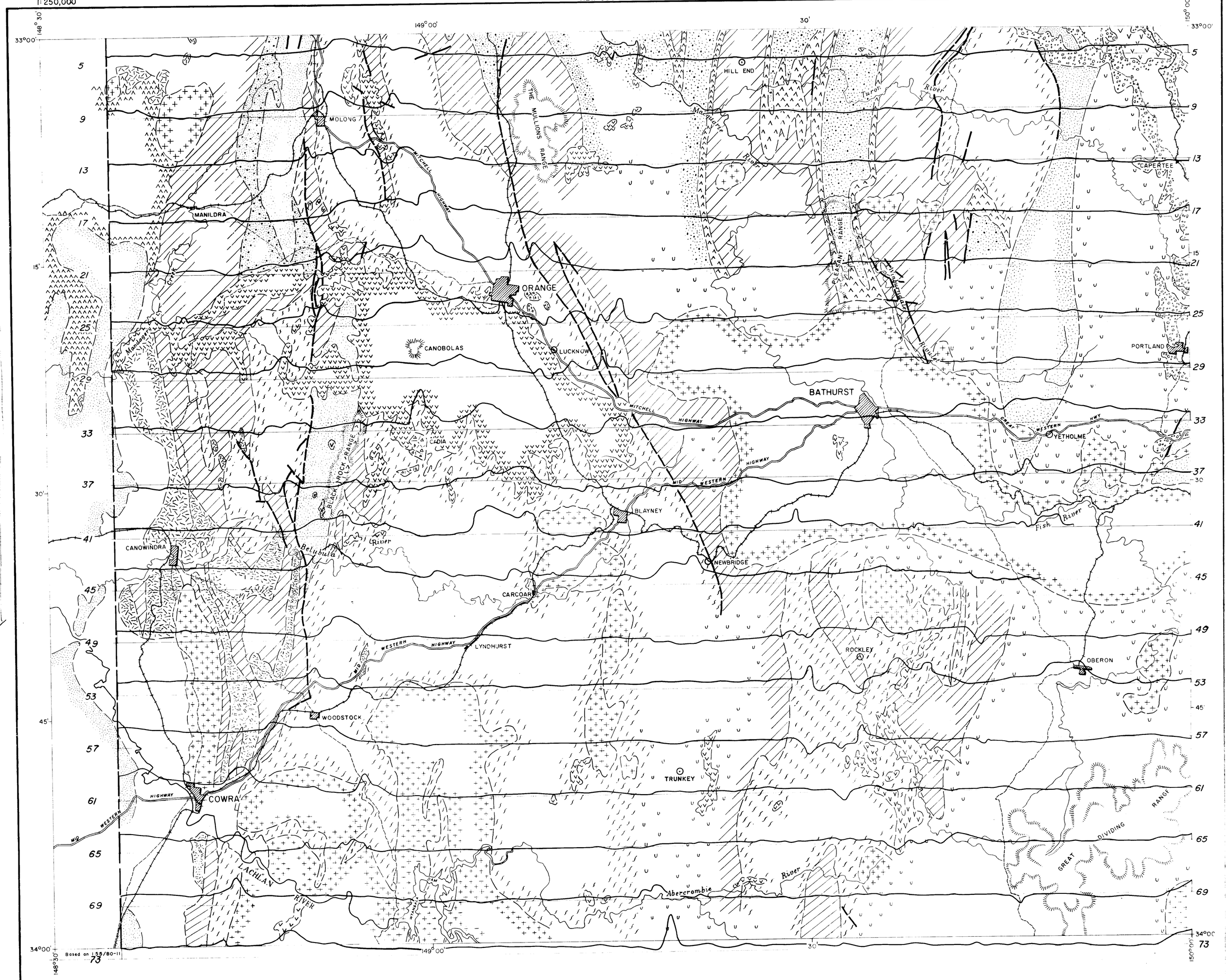
G4021-4

BATHURST

NEW SOUTH WALES

PLATE 5

1:250,000



GEOLOGICAL LEGEND

UPPER TERTIARY TO RECENT		ALLUVIUM
TERTIARY		BASALT, TRACHYTE, ETC. AND RELATED INTRUSIVES
PERMIAN MESOZOIC		SANDSTONE, SHALE, AND CONGLOMERATE
DEVONIAN — UPPER		QUARTZITE, CONGLOMERATE, AND SHALE
DEVONIAN — MIDDLE IN PART LOWER		LIMESTONE, SHALE, CONGLOMERATE, GREYWACKE, AND TUFF
DEVONIAN — LOWER ? IN PART UPPER SILURIAN		DACITE, RHYOLITE, AND TUFF
SILURIAN ? IN PART LOWER DEVONIAN		LIMESTONE, SHALE, TUFF, DACITE, RHYOLITE, GREYWACKE, AND SUBGREYWACKE
ORDOVICIAN		ANDESITE, TUFF, LIMESTONE, SHALE, GREYWACKE, RADIOLARIAN CHERT, AND SUBGREYWACKE
INTRUSIVES		GRANITE
INTRUSIVES		QUARTZ PORPHYRY
INTRUSIVES		SYENITE
INTRUSIVES		MONZONITE
ORDOVICIAN TO DEVONIAN PRINCIPALLY		UNDIFFERENTIATED
		FAULT

11°00' True North Mag. North

Geology after G.H. Packham, December 1957
Department of Geology and Geophysics, University of Sydney

BATHURST
TOTAL MAGNETIC INTENSITY PROFILES AND GEOLOGY

AIRBORNE SURVEY 1961

SCALE

MILES 5 0 5 10 MILES

KILOMETERS 5 0 5 10 15 20 KILOMETERS

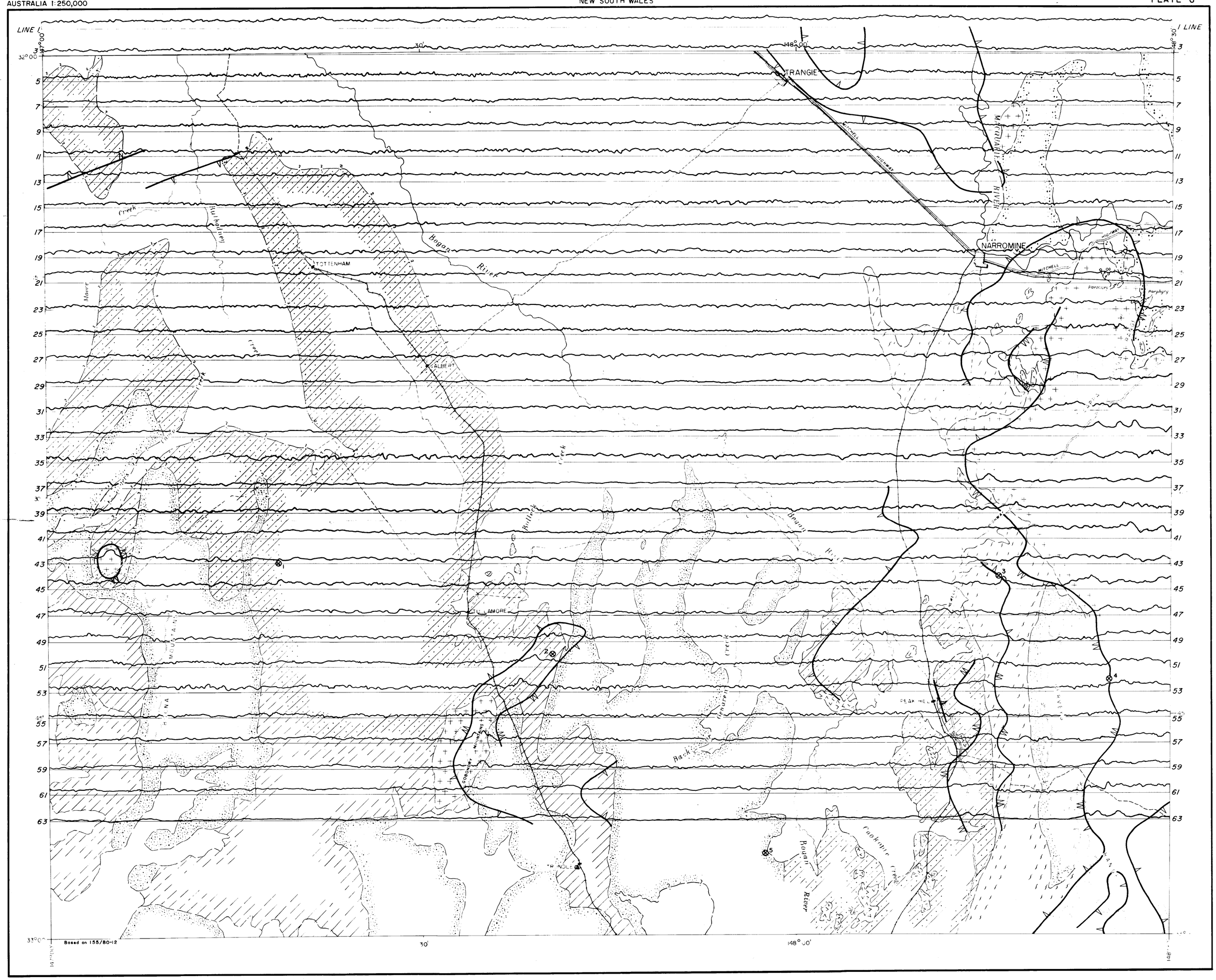
2000 gammas
1000 MAGNETIC PROFILE SCALE
0

To accompany Record No. 1963/114

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

155/BI-3

NARROMINE
NEW SOUTH WALES



GEOLOGICAL LEGEND

QUATERNARY		ALLUVIUM
JURASSIC		SANDSTONE
UPPER DEVONIAN		SANDSTONE, QUARTZITE ETC.
SILURIAN		COBAR SERIES QUARTZITE, SANDSTONE, AND SLATE
		OCTHA SERIES
		VOLCANICS
SILURIAN		UNDIFFERENTIATED SLATE, QUARTZITE, LAVA
ORDOVICIAN		SLATE
IGNEOUS		
ORDOVICIAN		GRANITE
		ULTRABASIC
ORDOVICIAN	PORPHYRY	INDICATED ON MAP

GEOLOGY AFTER DEPARTMENT OF MINES, NSW

10°00' True North Mag North

NARROMINE

RADIOMETRIC RESULTS

AIRBORNE SURVEY, NARROMINE - BATHURST, NSW 1961

APPROX. PROFILE SCALE

500 Counts/sec

0

MILES 5 0 5 10 MILES

KILOMETERS 5 0 5 10 15 20 KILOMETERS

LOCATION DIAGRAM

NEW SOUTH WALES

Sydney

INDEX TO ADJOINING SHEETS

COBAR	NYNGAN	GILGANDRA
NYMAGEE	NARROMINE	DUBBO
CARGELLIGO	FORBES	BATHURST

GEOPHYSICAL LEGEND

RADIOMETRIC PROFILE

⊗ 3 RADIOMETRIC ANOMALY (ANOMALIES ARE NUMBERED FOR REFERENCE ONLY)

RADIOACTIVE INTENSITY CHANGE EXCEEDING ½ x BACKGROUND

RADIOACTIVE INTENSITY CHANGE EXCEEDING 1 x BACKGROUND

THE BARBED EDGE IS ON THE SIDE OF LOWER INTENSITY

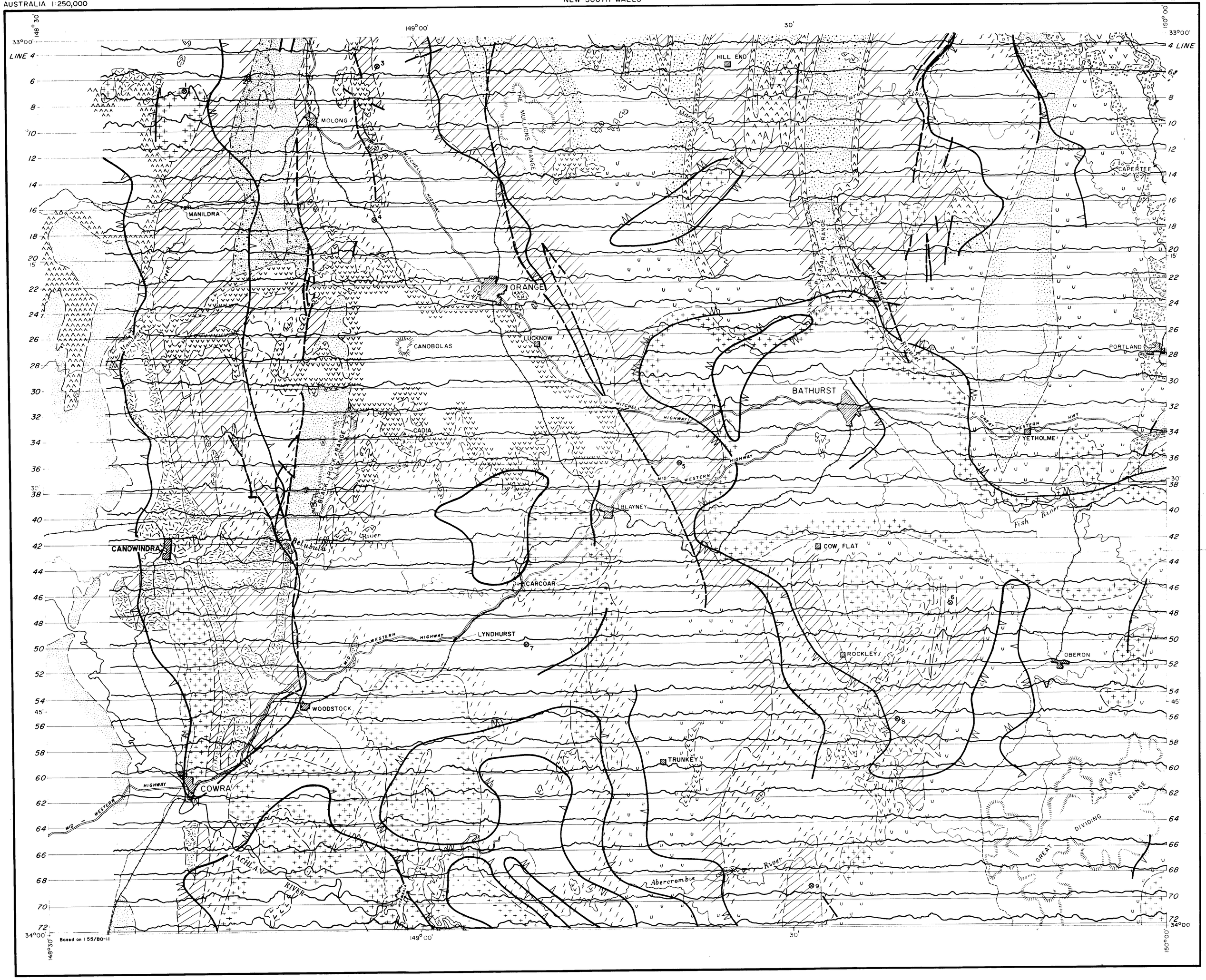
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics 155/B 1-17
TO ACCOMPANY RECORD No 1963/114

BATHURST

NEW SOUTH WALES

AUSTRALIA 1:250,000

PLATE 7



GEOLOGICAL LEGEND

UPPER TERTIARY TO RECENT		ALLUVIUM
TERTIARY		BASALT, TRACHYTE ETC. AND RELATED INTRUSIVES
PERMIAN MESOZOIC		SANDSTONE, SHALE, AND CONGLOMERATE
DEVONIAN — UPPER		QUARTZITE, CONGLOMERATE, AND SHALE
DEVONIAN — MIDDLE IN PART LOWER		LIMESTONE, SHALE, CONGLOMERATE, GREYWACKE, AND TUFF
DEVONIAN — LOWER ? IN PART UPPER SILURIAN		DACITE, RHYOLITE, AND TUFF
SILURIAN ? IN PART LOWER DEVONIAN		LIMESTONE, SHALE, TUFF, DACITE, RHYOLITE, GREYWACKE, AND SUBGREYWACKE
ORDOVICIAN		ANDESITE, TUFF, LIMESTONE, SHALE, GREYWACKE, RADIOLARIAN, CHERT, AND SUBGREYWACKE
INTRUSIVES		GRANITE
INTRUSIVES		QUARTZ PORPHYRY
INTRUSIVES		SYENITE
INTRUSIVES		MONZONITE
ORDOVICIAN TO DEVONIAN PRINCIPALLY		UNDIFFERENTIATED
		FAULT

GEOLOGY AFTER G.H. PACKHAM, DECEMBER 1957
DEPARTMENT OF GEOLOGY AND GEOPHYSICS, UNIVERSITY OF SYDNEY

11°00'
True North
Mag. North

BATHURST

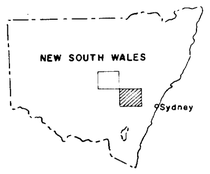
RADIOMETRIC RESULTS

AIRBORNE SURVEY, NARROMINE-BATHURST, NSW 1961

500 counts/sec
0

MILES 5 0 5 10 MILES
KILOMETERS 5 0 5 10 15 20 KILOMETERS

LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

NARROMINE	DUBBO	SINGLETON
FORBES	BATHURST	SYDNEY
COOTAMUNDRA	GOULBURN	WOLLONGONG

GEOPHYSICAL LEGEND

- RADIOMETRIC PROFILE
- ⊗ 3 RADIOMETRIC ANOMALY (ANOMALIES ARE NUMBERED FOR REFERENCE ONLY)
- RADIOACTIVE INTENSITY CHANGE EXCEEDING ½ × BACKGROUND
- RADIOACTIVE INTENSITY CHANGE EXCEEDING 1 × BACKGROUND
- RADIOACTIVE INTENSITY CHANGE EXCEEDING 1½ × BACKGROUND

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TO ACCOMPANY RECORD No. 1963/114