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Record 1972/110

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CLONCURRY DETAILED AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, QUEENSLAND 1970

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S.S. Lambourn and E.P. Shelley

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CONTENTS

ILLUSTRATIONS

SUMMARY

This Record describes the results of a detailed airborne magnetic and radiometric survey made in the Mount Isa/Cloncurry region of Queensland during 1970. The magnetic data are presented as contours and the radiometric data as stacked profiles. Interpretation of the magnetic data reveals good correlation with the Leichhardt Metamorphics, Magna Lynne Basalt, Argylla Formation, Soldiers Cap Formation, Corella Formation, Deighton Quartzite, and the granites. The magnetic response of the basic rocks is rather varied. Uranium anomalies were recorded over the Mary Kathleen and Milo mines, some copper mines, other prospects, and some shear zones. Thorium anomalies could not be correlated with the geology but appear to be related to drainage systems. Potassium anomalies were not delineated as they were invariably caused by topographic features.

1. INTRODUCTION

From mid-April to July 1970 a detailed airborne magnetic and radiometric survey was made over two areas in the Mount Isa/Cloncurry region, Queensland. The location of these areas is shown in Plate 1.

The survey was made to complement the program of detailed geological mapping undertaken by BMR in 1970 and 1971.

A proton magnetometer was used to record variations in the earth's magnetic field, and radiometric coverage was obtained with a four-channel gamma-ray spectrometer. The east-west survey lines were spaced 300 m apart and flown at a nominal height of 80 m above ground level. Full equipment specifications and operational details are listed in the Appendix.

To facilitate flying and data reduction the two areas were subdivided into seven smaller areas as shown in Plate 1.

A test scintillograph survey made in 1955 (Parkinson, 1956) recorded a strong anomaly over the Mary Kathleen area. A radiometric survey by Mulder (1961) covered an area just west of the present area, and a detailed magnetic survey by Dockery & Tipper (1965) also to the west of the present area recorded strong anomalies over the Eastern Creek Volcanics.

A regional gravity survey of the area was made in 1966, by BMR. Other geophysical surveys within the survey area have been made by private companies, but the results are not available.

2. GEOLOGY

The area has been the subject of numerous geological investigations, mainly of individual mines and prospects. The geology of the Cloncurry 1:250 000 map area has been described by Carter (1959) and the geology of the northwest Queensland mineral belt by Carter, Brooks & Walker (1961).

A program of detailed mapping of the Mary Kathleen, Marraba, and Cloncurry 1:100 000 map areas by BMR and the Queensland Geological Survey was carried out from 1968 to 1971 (Derrick, 1969; Glikson & Derrick, 1970; Derrick, Wilson, Hill & Mitchell, 1971; Derrick, Wilson, Hill, Glikson & Mitchell, in prep.).

Stratigraphy

A description of the local rock types and their stratigraphic relation appears in Table 1, prepared by G.M. Derrick. The relations of the Lower Proterozoic units are shown in diagrammatic form in Figure 1.

Structure

The primary isoclinal folds in the survey areas generally strike north except southwest of Cloncurry, where they strike northeast. Cross-folding occurred after regional metamorphism.

Faults are widespread and most belong to two conjugate strike-slip fault systems with major strike directions of 030°-150° and 045°-130° (Carter et al., 1961).

Mineralization

Copper mineralization is widespread and occurs in most Lower Proterozoic rocks, although the quartzites and acid lavas are generally unfavourable. The copper orebodies are almost invariably in, or close to, faults or shears. Gold is mainly associated with the copper, but some reef gold occurs in the Soldiers Cap Formation east of Cloncurry.

A large number of uranium prospects have been located. The most important deposit is at Mary Kathleen, where the orebody occurs in the axial zone of a syncline in the Corella Formation. Granite is exposed to the east and west, and Hughes & Munro (1968) believe that the orebody is metasomatic and related to the eastern granite. Similar mineralization occurs in neighbouring localities. The Milo torbernite deposit is the only other uranium prospect of note in the survey area. Brooks (1960) reports that the main structural controls of uranium mineralization are faults, shears, and joints.

3. MAGNETIC RESULTS AND INTERPRETATION

Contours of total magnetic intensity for each of the areas 1 to 7 are shown in Plates 2 to 8 respectively at a scale of 1:50 000. The contour interval is 100 gammas in areas 1 to 6 and 25 gammas in area 7.

Each plate also displays the geology taken from the recent BMR detailed mapping, and magnetic interpretation for that area. Each area was subdivided into zones of high and low magnetic activity. Individual anomalies of interest have been delineated and numbered for reference.

Area 1

In zone A magnetic trends parallel the north-northwest geological strike. Anomalies 1 and 2 may be correlated with Magna Lynne Basalt and anomaly 3 with the Argylla Formation. Anomalies 4 and 5 occur over quartzite and may be related to underlying rocks of the Argylla Formation. There is no magnetic expression of the dolerite bodies within this zone.

Zone B is one of low magnetic relief associated entirely with Leichhardt Metamorphics, whose faulted boundary to the west is reflected by high magnetic gradients on the flanks of anomalies 1 and 3.

In zone C the strong linear anomalies 6, 7, and 8 can be correlated with Magna Lynne Basalt. The broad anomalies 9, 10, and 11 correspond to the Argylla Formation. The magnetic gradient west and south of anomaly 10 appears to be related to the faulted contact between the Argylla Formation and the Ballara Quartzite. The gradient on the western side of magnetic low 12 may also correspond to a fault.

Zone D is magnetically quiet apart from the circular anomaly 13, which has an amplitude of 1000 gammas. This zone covers an area of metasedimentary rocks and anomaly 13 itself is located over Corella Formation and Deighton Quartzite. A depth estimate on this anomaly places the source between 800 m and 900 m below ground level. There is no apparent magnetic expression of the Wonga Fault or associated faults.

Zone E is magnetically quiet and corresponds very well to the Kalkadoon Granite. The numerous basic intrusions within the granite are not reflected in the magnetic results.

Zone F is a rather intense magnetic zone with anomalies up to 2000 gammas in amplitude. Anomaly 14 is located over Ballara Quartzite, but is rather broad and hence is probably due to some deeper seated feature.

Anomaly 15 has an amplitude of 1000 gammas and follows quite closely the western edge of the Kalkadoon Granite. As there are a number of mines and prospects along the contact between the granite and the Corella Formation, the anomaly has been interpreted as representing a contact mineralization zone. It may also have some association at depth with a dolerite/amphibolite body which occurs to the southwest but which otherwise has no magnetic expression. The Magna Lynne Basalt is reflected in anomaly 16.

Anomalies 17, 18, and 19 occur over Argylla Formation. The latter anomaly is in a region where the Argylla Formation is strongly faulted; the two axes of the anomaly parallel faults shown on the geological map.

Zone G is rather undisturbed and covers the Wonga and Burstall Granites and various members of the Corella Formation. Zone H appears to be associated with an area of Argylla Formation which occurs between the Wonga Granite and Corella Formation. There is no magnetic expression of the Cameron Fault.

In Zone I, the sources of anomalies 20 and 21 are rather obscure. Anomaly 20 occurs over Corella Formation, but the trend of the anomaly parallels a dolerite body some 500 m to the west and may be associated with it. Anomaly 21 may be due to the Kuta Gabbro although in Zone G this intrusion does not appear to be magnetic. The trend of anomaly 22 correlates well with the Fountain Range Fault.

Area 2

Zone A is rather disturbed with anomalies ranging up to 2000 gammas. Anomaly 1 appears to be correlated with the Kuta Gabbro. The rest of the zone is almost entirely Corella Formation and there are no apparent surface geological features which could be attributed to the other anomalies. Anomalies 2 and 3 have sources at approximate depths of 450 m and 700 m respectively.

Zone B contains a series of broad anomalies trending northeast to east and with amplitudes up to 700 gammas. The zone is occupied by rocks of the Corella Formation, Chumvale Breccia, Overhang Jaspilite, and Mitakoodi Quartzite. No anomalies appear to be associated with the jaspilite, and only anomaly 4 can be correlated with the Wakeful Basalt Member.

Zone C is highly magnetically disturbed; anomalies range up to about 4000 gammas in amplitude. Anomaly 5 in the northeast of the zone has been correlated with dolerite. Anomaly 7 was drilled to a depth of 27 m in 1971 (Derrick, pers.comm.) and from 9 m to 27 m sheared chlorite schist and metadolerite were recovered. These were not markedly magnetic in that they had no effect on a compass needle. However, the sheared nature of the core indicated a major faulted boundary, and this has been interpreted as a southwesterly extension of a shear zone associated with the northern part of Chinaman Creek in Area 3 (Derrick, pers. comm.). Within the shear zone in this region there are large iron formation at the surface, and hence anomalies 6, 7, and 8 can be interpreted as similar iron formation bodies at depth.

The shear zone extends south into Area 5 but similar magnetic anomalies are not apparent. A number of prospects are located along or close to the shear zone in Areas 2, 3, and 5 and further examination of this region may be warranted.

Zone D is magnetically 'quiet' and can be correlated with Corella Formation. It is continued as Zone B in Area 3.

Area 3

Zone A is a continuation of Zone C in Area 2 and has been interpreted as representing further basic rocks. The area covered by Zone B is largely mapped as Corella Formation, although anomalies 1, 2, and 3 are probably due to dolerite. Anomalies 4 and 5 may represent further areas of metamorphosed gabbro and dolerite which have been mapped in the east of Zone B.

Zone C is generally magnetically undisturbed and covers an area of Weatherly Creek Quartzite. Anomaly 6 is due to an elongate body of gabbro, but further gabbros to the east in this zone do not give rise to any anomalies.

Zone D can be correlated with Weatherly Creek Quartzite and Toole Creek metavolcanics. Anomalies 7, 8, 9, and 10 are due to metabasalt within the quartzite formation.

Zone E has a generally undisturbed magnetic pattern and reflects a deepening basement under the western edge of the Great Artesian Basin.

Area 4

Zone A contains two elongate anomalies, 1 and 2, which can be correlated with the Magna Lynne Basalt. The rest of the area is generally 'quiet' and corresponds to the Leichhardt Metamorphics. There is no magnetic effect from the dolerites, a situation similar to that in Area 1.

In Zone B, anomaly 3, of 1500 gammas maximum amplitude, corresponds to the Magna Lynne Basalt. In the rest of this zone anomalies range up to 1200 gammas in an irregular pattern and are correlated with various members of the Argylla Formation.

The boundaries of Zone C are marked by strong magnetic gradients, but the zone itself contains no pronounced features. Anomalies are broad, ranging in shape from linear to subcircular, and amplitudes range up to only 500 gammas. Rock types are quite varied and no correlations are apparent.

There are two main features in Zone D. Anomaly 4 has an amplitude of 1200 gammas and can be correlated with the Mount Philp Agglomerate. Anomaly 5 along the eastern boundary corresponds to the Overhang Jaspilite and the basalt member of the Mitakoodi Quartzite.

Zone E contains a series of low-amplitude linear anomalies which parallel the geological strike and occur over regions of sedimentary rocks. Areas of basic intrusives and a small area of Marraba Volcanics are not reflected in the magnetic results.

Area 5

Zone A contains a series of linear parallel anomalies striking northwest and ranging up to 1000 gammas in amplitude. Correlation with the Marraba Volcanics is very good.

Zone B covers a region of Argylla Formation and is generally undisturbed except for two low-amplitude anomalies, 1 and 2, which occur over dolerite intrusives. Numerous dolerites elsewhere in this zone, however, exhibit no magnetic effect.

In Zone C the rather weak anomaly trend 3 can be correlated with the Cone Creek Member of the Marraba Volcanics. Eastwards, the other members of the Marraba Volcanics and the Mitakoodi Quartzite have no reflection in the magnetic results. The anomaly trend 4-5-6 is located over the Chumvale Breccia but may be due to the Overhang Jaspilite which dips to the east under the breccia.

Area 6

Zone A is magnetically smooth with a maximum anomaly amplitude of 300 gammas. The zone is almost entirely occupied by the Marimo Slate, and the results indicate that there is no difference in magnetic response between the various members of this formation.

Zone B trends north and contains one major anomaly trend of 1200 gammas maximum amplitude. There is no apparent relation with the mapped geology although several mines including Dodge, Bluebell, and Just Found occur along or close to the trend. Interpretation of anomaly 1 yields a depth estimate of 150 m below ground level.

Zone C is a similar magnetically smooth zone to Zone A and is occupied by various members of the Marimo Slate and Corella Formation.

Zone D contains several linear anomalies of maximum amplitude 1200 gammas. Anomaly 2 is quite broad and a depth calculation places the source 200 m below ground level. A small outcrop of Williams Granite occurs near the anomaly, which may represent the extent of the granite at depth. Anomaly 3 occurs near the contact between the Corella Formation and the Soldiers Cap Formation.

In Zone E, the numerous elongate anomalies can be correlated with basic rocks. Anomalies 4, 5, 7, and 8 are caused by basic sills, and anomaly 6 can be correlated with an outcrop of metabasalt. The central part of Zone E is generally flat and is occupied by the Soldiers Cap Formation.

Area 7

Zone A is largely covered by sedimentary units of the Soldiers Cap Formation with metabasalt and metadolerite intrusives. These latter give rise to anomalies 1, 2, 3, and 4.

In Zone B the basic rocks are much more extensive than in Zone A but the magnetic anomalies are not very pronounced. Anomalies 5, 6, 7, 8, and 9 are probably due to the basic rocks although their amplitude is considerably less than amplitudes recorded over similar rock types in Areas 3 and 6.

Zone C is largely covered by alluvium. Anomalies 10 and 11 are probably due to basic intrusives. The magnetic results indicate that the geological strike is northeast in the centre of this zone and north in the east and west. Analysis of anomalies 12, 13, 14, and 15 indicate sources at depths of 300 to 500 m.

4. RADIOMETRIC RESULTS AND INTERPRETATION

Introduction

The radiometric data are shown in Plates 9 and 10 in stacked profile form for each of the 7 areas at a east-west scale of 1:100 000. The radiometric interpretation has been superimposed on a flight-line plan for each area also at a scale of 1:100 000 beneath each set of stacked profiles. Control points on a given profile correspond to the points on the relevant flight-line.

Four channels of data were recorded along each line. The total gamma radiation count was recorded by Channel 1, which was set to accept all gamma-rays with energies between 1.0 and 3.0 MeV. Channels 2, 3, and 4 were centred on the 1.46, 1.76, and 2.62 MeV gamma-ray peaks of K40, Bi214, and Tl208 respectively. The last two isotopes are members of the U238 and Th232 decay series respectively. It must be assumed that these isotopes are in equilibrium with their parent elements. Details of channel widths and sensitivities are given in the Appendix.

The decay series of Th and U include many radioactive daughter products, several of which have different gamma-ray peaks of only slightly different energy. Because of this, the counts recorded in Channel 3 may include gamma-rays originating from a Th source, and the counts recorded in Channel 2 may include gamma-rays originating from Th and U sources. Channel 4 counts will not be contaminated, as the Tl208 gamma-ray peak at 2.62 MeV is well above the highest-energy gamma-ray peak produced by a U source. Potassium has only one radioactive isotope. Variations from the nominal survey height may be as high as 30% in low-altitude surveys, and this causes spurious anomalies to appear in all Channels. In consequence, the recorded count rates of Channels 2, 3, and 4 are not directly related to the abundance of K, U, and Th. Nevertheless, the terms 'K', 'U', and 'Th' have been used for convenience when referring to the respective channels and to the count rates recorded by those channels.

Total count (Channel 1) has not been included in the stacked profile presentation.

The spectrometer system is at present uncalibrated with respect to actual content of potassium, uranium, and thorium in surface materials. This is due to a lack of suitable broad sources, both natural and artificial. Hence the data have not been 'stripped' of unwanted components, and the profiles shown in Plates 9 and 10 are raw data reduced in scale from the original records.

A digital acquisition system is essential for the efficient recording, processing and interpretation of spectrometer data. Such a system is currently being designed.

Method of interpretation

The data have been interpreted by the visual delineation of anomalies thought to be caused by Uranium and Thorium sources. It is a characteristic of almost all economic uranium deposits that U is preferentially concentrated relative to Th. (Darnley, 1971). For this reason. anomalous areas with a strong contrast between the 'U' and 'Th' profiles were considered to be U anomalies, and anomalous areas of little contrast were considered to be Th anomalies. K anomalies were not delineated, as in every case the large 'K' anomalies correlated closely with topographic features.

Several small anomalies occur on one profile alone, but only the most prominent of these have been plotted in Plates 9 and 10. They are nevertheless much less significant than those anomalies that extend across several flight-lines.

Discussion of results (Plates 9 and 10)

There is no conclusive correlation between the radioactive anomalous areas delinated and the mapped geology. However, several of the U anomalies do correlate with known U deposits of minor economic interest, and several of the Th anomalies have an apparent correlation with drainage systems within the area.

Area 1. The U anomaly to the north of Mary Kathleen correlates with an open-cut uranium mine and the associated spoil heap. The three Th anomalies to the northeast of Mary Kathleen appear to be associated with the drainage systems of the region; in particular, with the low relief areas of the drainage systems. The U anomaly in the east of the area does not correlate with any mapped geological feature although it may be associated with three disused mines in the region.

Area 2. The southernmost of the two central U anomalies within this area correlates closely with the disused Milo mine. This mine once produced U and is the probable source of this anomaly. The more northerly of the two anomalies is associated with a shear zone, but there is no evidence of mining. The three smaller U anomalies within the area have no evident sources, and the Th anomaly in the central north of the area again appears to be associated with a drainage system.

Area 3. The two small U anomalies in the area do not correlate with any mapped features.

Area 4. None of the anomalies within this area correlate with any mapped features.

Area 5. The anomalies within this area are also of doubtful origin. The two small anomalies in the west of the area are possibly associated with disused mines, while the larger U anomaly in the southeast of the area may be correlated with a shear zone. The large central Th anomaly has no evident source; unlike other Th anomalies it is located between two drainage channels.

Area 6. This area contains several prominent U anomalies, most of which are associated with the intensely mined regions in the centre and the west of the area. Those in the centre correlate with numerous disused copper mines and those in the west with two major shear zones. There are several mines associated with these shear zones, and the Heafels mine in the more easterly shear zone once produced uranium. There are no significant Th anomalies within this area.

Area 7. The one small U anomaly delineated in the area has no evident source, and in contrast to Area 6 the intensely mined region in the west of the area has no associated U anomalies. The large Th anomaly correlates well with the Williams River drainage system.

5. CONCLUSIONS AND RECOMMENDATIONS

There is generally good correlation of magnetically disturbed areas with the Magna Lynne Basalt and Argylla Formation. The Leichhardt Metamorphics, Corella Formation, Soldiers Cap Formation, Deighton Quartzite, and the granites can be correlated with magnetically undisturbed regions.

Basic dykes occur in all areas, but their magnetic character is quite variable. In areas 1 and 4 no correlation with recorded anomalies was apparent, but eastwards, in areas 2, 3, 5, and 6, anomalies can be related wot these intrusives. This could be caused by an easterly increase in magnetic mineral content. In the west of area 7 there is come correlation, but farther east it becomes vague.

The magnetic response of the Kuta Gabbro, Overhang Jaspilite, and Marraba Volcanics varies from outcrop to outcrop. No systematic response could be interpreted.

Ground geophysical work is recommended in Zone C of area 2 and Zone A of area 3 along the line of the interpreted shear zone, and also in Zone B of area 6. In both these localities mines and prospects occur along or near the respective magnetic features.

Uranium anomalies were recorded as anticipated over the Mary Kathleen and Milo mines. Anomalies were also recorded over other prospects, and some copper mines in area 6. Copper and uranium are known to be associated in this region (Brooks, 1960). Anomalies have also been located over shear zones, which are favourable locations for uranium mineralization.

Thorium anomalies could not be correlated with any obvious geological feature. In most cases they appeared to be related to drainage systems, but there is no apparent reason for this.

Because of the varied magnetic response of the basic rocks it is recommended that mineralogical and magnetic studies be carried out on samples from the survey area. Soil sampling at the locations of the uranium and thorium anomalies would be useful in determining their sources.

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APPENDIX : Operational Details

Personnel

BMR	R.D. Beattie	Party Leader
	J.E. Rees	Geophysicist
	K.R. Horsfall	Geophysicist (Part time)
	A. Parvey	Draftsman
	H. Alexander	Technical Officer
	C. Carling	Technical Assistant
	J.W. Williams	Technical Assistant
TAA	First Officer	
	B.N. Joel	Pilot

Equipment

Aircraft:	Aero Commander VH-BMR
Magnetometers:	Airborne and ground - Proton precession magnetometer MNS1 of BMR design, output to Moseley 7100B recorder (airborne) and Esterline-Angus recorder (ground)
Gamma-ray spectrometer:	Detector - Two Harshaw 15 cm x 10 cm thallium-activated NaI crystals optically coupled to photomultiplier. Electronics - Hamner modules Stabilization - Cs137 Recorders - DeVar, 3-channel
Ancillary:	Radar altimeter - Bonzer TRN70 Camera - Vinten 35-mm fish-eye

Equipment parameters

Magnetometer:	Airborne sensitivity 1000 gammas f.s.d. and 10 000 gammas f.s.d. Ground station sensitivity 100 gammas f.s.d.
Spectrometer:	Channel settings Ch.1 1.0-3.0 MeV Ch.2 1.3-1.6 MeV Ch.3 1.6-1.9 MeV Ch.4 2.4-2.8 MeV Channel sensitivities Ch.1 500 counts/s f.s.d. Ch.2 200 counts/s f.s.d. Ch.3 100 counts/s f.s.d. Ch.4 100 counts/s f.s.d. Time constant 2 seconds (all channels)

Survey parameters

Flight altitude	80 m above ground level
Aircraft speed	200 km/h
Line orientation	east-west
Line spacing	300 m

TABLE 1

SUMMARY OF STRATIGRAPHY

AGE	ROCK UNIT	SYMBOL	THICKNESS (metres)	DESCRIPTION	RELATIONSHIPS
CAINOZOIC		Cz		Soil, alluvium	
		Czg		Gravel, cobbles	
MESO-ZOIC		M		Laterite	
UPPER PROTERO-ZOIC	Quamby Conglomerate	Ꞓuq	300	Conglomerate, sandstone greywacke	Unconformably overlies Corella Formation
LOWER PROTEROZOIC	White Blow Formation	Ꞓlw$_s$	?200	Black slate, grey slate	Overlies Ꞓld disconformably
		Ꞓlw$_t$	?100	Siltstone, staurolite-garnet schist	
	Deighton Quartzite	Ꞓld	up to 5000	Feldspathic quartzite, pebbly quartzite	Disconformable or Corella Formatior
	Williams Granite	Ꞓgl		Medium-grained leucocratic granite, alkali granite	Intrudes Ꞓlc, Ꞓls
	Burstall Granite	Ꞓgb		Leucocratic medium-coarse grained granite	Intrudes Ꞓlc
		Ꞓgb$_p$		Coarse-grained graphic pegmatite with tourmaline	" "
		Ꞓgb$_h$		Very fine grained microgranite	" "
	Tommy Creek Microgranite	Ꞓgu$_h$		Fine grained leucocratic porphyritic micro-adamellite	Sills in Ꞓlc
	Naraku Granite	Ꞓgu		Medium grained leucocratic massive granite	Intrudes Ꞓlc
	Kuta Gabbro	Ꞓbk	approx	Gabbro, diorite, tonalite	Intruded by Burstall Granite
	Roxmere Quartzite	Ꞓlr	?1,000	Feldspathic quartzite, minor siltstone, conglomerate and calc-sandstone	Conformable and disconformable over Corella Formation; fault against Marimo slate

SUMMARY OF STRATIGRAPHY (contd)

AGE		ROCK UNIT	SYMBOL	THICKNESS (metres)	DESCRIPTION	RELATIONSHIPS
LOWER PROTEROZOIC	Marimo Slate	Undifferentiated	Blm		Siltstone, slate, marl, limestone, calcareous sandstone	Marimo Slate probably correlates with Blc_2
			Blm_2	To 400	Undifferentiated siltstone, marl, calcareous sandstone	Conformably overlies Blm_1
		Mick Creek Sandstone Member	Blm_{2q}	50-380	Quartzite	Conformably overlies Blm_1
			Blm_{1s}	400	Black and grey slate	(?) Conformably overlies Blm_{1a}, Blm_{1t} and Blm_{1q}
			Blm_{1a}	280	'Attenuated' siltstone	Overlies or is gradational to Blm_{1t}
			Blm_{1l}	0-60	Limestone, marl, marly siltstone	Lenses in Blm_1
			Blm_{1t}	380	Phyllite, siltstone	Conformably overlies Blm_{1q}
		Toby Barty Sandstone Member	Blm_{1q}	820	Feldspathic quartzite	Base of sequence exposed east of Overhang mine. May include Blm_{1t} and Blm_{1a}
		Mount Philp Agglomerate	Blp	min 300	Crystal tuff, magnetite bearing lithic tuff, agglomerate, brecciated calc-silicate rocks, altered basic rocks	Origin not definitely known; may be volcanic or brecciated and altered calc-silicate rocks
	Corella Formation	Undifferentiated	Blc		Limestone, sandstone etc	
			$Blc_{\blacktriangle}$		Breccia	Often restricted to Blc_1
			Blc_{3p}		Pyrrhotitic shale	
			Blc_3	300-500	Calcsilicate granofels, limestone, marl	Conformably overlies Blc_2
			Blc_{3q}	0-50	Quartzite	Lenses in Blc_3
			Blc_2	800	Sandstone, shale, etc.	Conformably overlies Blc_1
			Blc_{2s}		Slate, with andalusite, kyanite, garnet	Cross-folded belt in Blc_2

SUMMARY OF STRATIGRAPHY (contd)

AGE		ROCK UNIT	SYMBOL	THICKNESS (metres)	DESCRIPTION	RELATIONSHIPS
LOWER PROTEROZOIC	Corella Formation		Blc_{2q}	-380	Quartzite, feldspathic in part	Discontinuous lenses in Blc_2
			Blc_{2g}		Conglomerate	Boulder beds near Mary Kathleen mine
			Blc_{2r}		Garnetite	Veins in Blc_2
			Blc_1	-1200	Calc-silicate granofels, limestone, marl	(?) Conformably overlies Blj, often associated with breccia.
			Blc_{1q}		Quartzite	Minor lenses in Blc_1
		Chumvale Breccia	Blv		Quartzite breccia (silicified)	Alteration of Blj
		Overhang Jaspilite	Blj	450	Interbedded limestone, shale and jaspilite	Conformably overlies Blt_3
			Blj_q	20-300	Feldspathic quartzite and pebble quartzite	(?) Conformably overlies Blj
	Mitakoodi Quartzite	Undifferentiated	Blt		Quartzite, siltstone etc.	Overlying Bln and Bla but contact faulted
			Blt_3	-190	Silt and slate	Conformably overlies Blt_1
		Wakeful Basalt Member	Blt_2	0-340	Massive and amygdaloidal metabasalt with minor sediments	Several conformable lenses in Blt_1
			Blt_1	1300	Feldspathic Quartzite	Conformably overlies Bla_3
		Ballara Quartzite	Pb_{21}	200	Limestone, calc. quartzite	Overlies Argylla Fmm unconformably
			Blb_2	1000	Quartzite, pebble quartzite	Underlies Corella Format. conformably.
			Blb_1	up to 700	Conglomerate, arkose	
			db, dl		Metabasalt, meta dolerite, ortho-amphibolite, gabbro	Sills and dykes

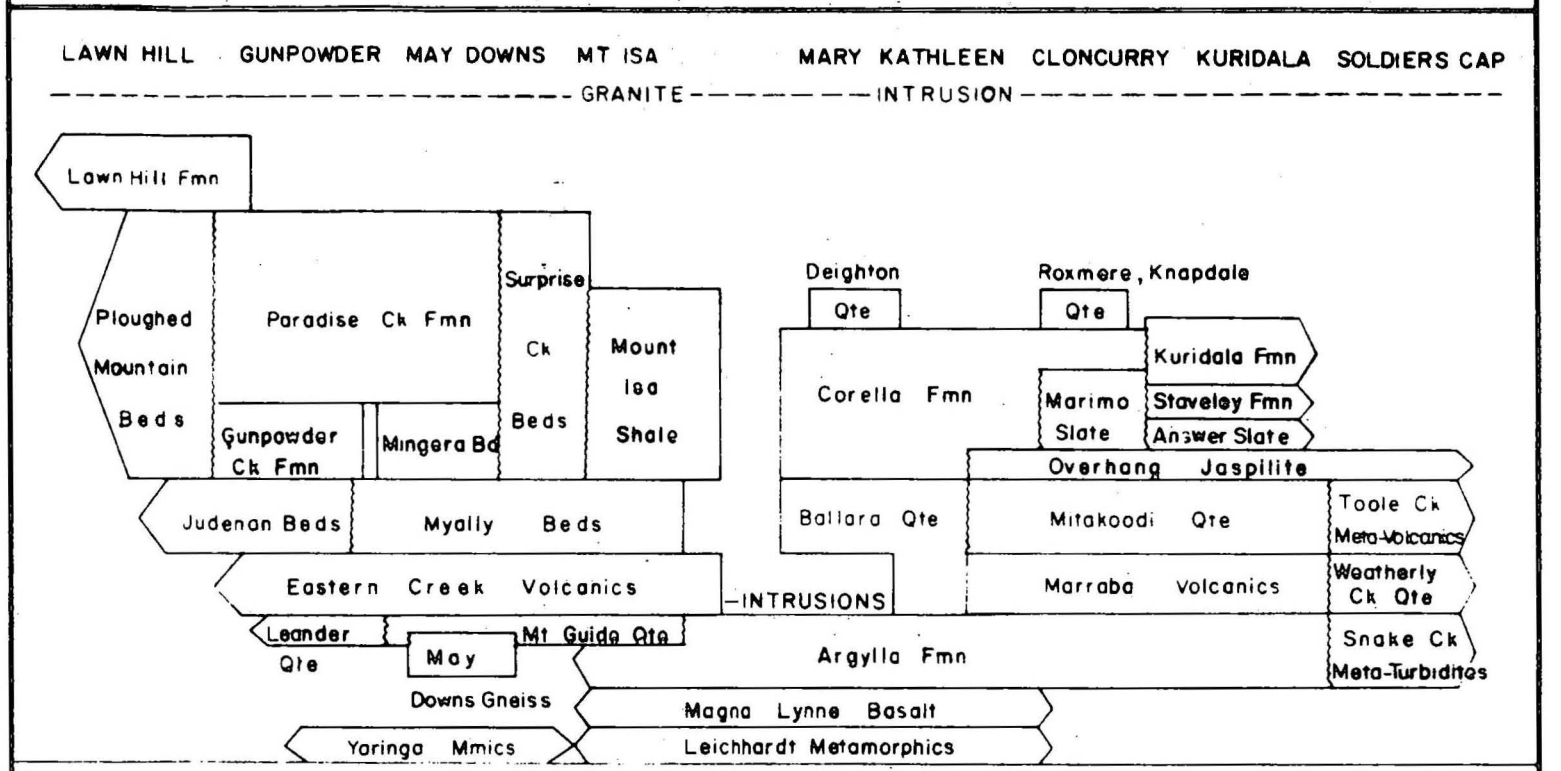
SUMMARY OF STRATIGRAPHY (contd)

AGE		ROCK UNIT	SYMBOL	THICKNESS (metres)	DESCRIPTION	RELATIONSHIPS
LOWER PROTEROZOIC	Soldiers Cap Formation	Toole Creek Metavolcanics	Bls_3	1200-2800	Massive metabasalt & metadolerite with intercalations of pelitic metasediments chert, sandstone and jaspilite	Overlies Bls_2 conformably Overlain unconformably by Corella Formation
		Weatherly Creek	Bls_2	1100-2700	Cross-bedded quartzite, siltstone, felspathic and micaceous sandstone, pelitic sediments	Overlies Bls_1
		Snake Creek Metaturbidites	Bls_1	Minimum 2200	Arenaceous and pelitic schists, metagreywacke; garnet, andalusite and staurolite schist	Oldest unit in the east. Base not exposed.
	Marraba Volcanics	Timberoo Member	Bla_3	50-750	Slate, siltstone, sandstone, limestone, metabasalt, dolerite	Conformably overlies Bla_2
		Mount Start Member	Bla_2	0-120	Laminated silicified fine grained calcareous sandstone, limestone	Conformably overlies Bla_1
		Cone Creek Volcanic Member	Bla_1	900-2800	Massive and amygdaloidal metabasalt, pillow lava, dolerite and minor sediments	Overlies Argylla Formation - no unconformity observed in Marraba Sheet
		Kalkadoon Granite	Bgk_2		Coarse grained porphyritic granite and biotite granite some granodiorite	Probably older than and faulted against Corella Formation.
		Wonga Granite	Bgw		Fine grained granite and aplite intruding coarse grained porphyritic gneissic granite	Intrudes Bln - affected by Regional metamorphism
	Argylla Formation	Undifferentiated	Bln		Acid volcanics and feldspathic quartzite	Poorly exposed sequence low in formation
			Bln_h		Porphyritic microgranite	Sills and dykes in Bln
			Bln_q		Undifferentiated quartzite	Lenses in Bln

SUMMARY OF STRATIGRAPHY (contd)

AGE		ROCK UNIT	SYMBOL	THICKNESS (metres)	DESCRIPTION	RELATIONSHIPS
LOWER PROTEROZOIC	Argylla Formation	Undifferentiated	Bln_5	100-800	Cross-bedded medium-coarse grained feldspathic quartzite/sandstone	Upper part of formation overlain by Bla_1
			Bln_4	0-440	Quartz-rich porphyry, porphyritic rhyolite and rhyodacite	Younger volcanic sequence; restricted to east. At least partly intrusive.
			Bln_3	600	Quartz-poor porphyry, porphyritic dacite and andesite	Dominant volcanic unit. Overlies Bln(?) conformably
			Bln_2	0-300+	Laminated feldspathic quartzite, laminated siltstone, chert, tuffaceous and epidote sandstone	Large lenses in Bln_3
			Bln_1	550+	Sericite quartzite	
		Magna Lynn Basalt	Bll'	600	Metabasalt amphibolite basalt-quartzite breccia	Overlies Leichhardt Metamorphics, possibly conformably
			Bll'_q		Quartzite and calcareous quartzite interbeds	
		Leichhardt Metamorphics	pCl	Minimum	Medium grained dacite, rhyodacite, aphanitic rhyolite, basalt	Oldest unit in area.
		BASIC DYKES OF VARIOUS AGES				
			do		dolerite, metadolerite amphibolite, basic schist	plugs, sills and dykes
			do_6		Dolerite	Post-tectonic
			do_4		Dolerite	Ophitic textures
			do_3		Metadolerite amphibolite	Ophitic texture obscured. Forms sills.

FIG I : RELATIONSHIPS OF LOWER PROTEROZOIC STRATIGRAPHIC UNITS

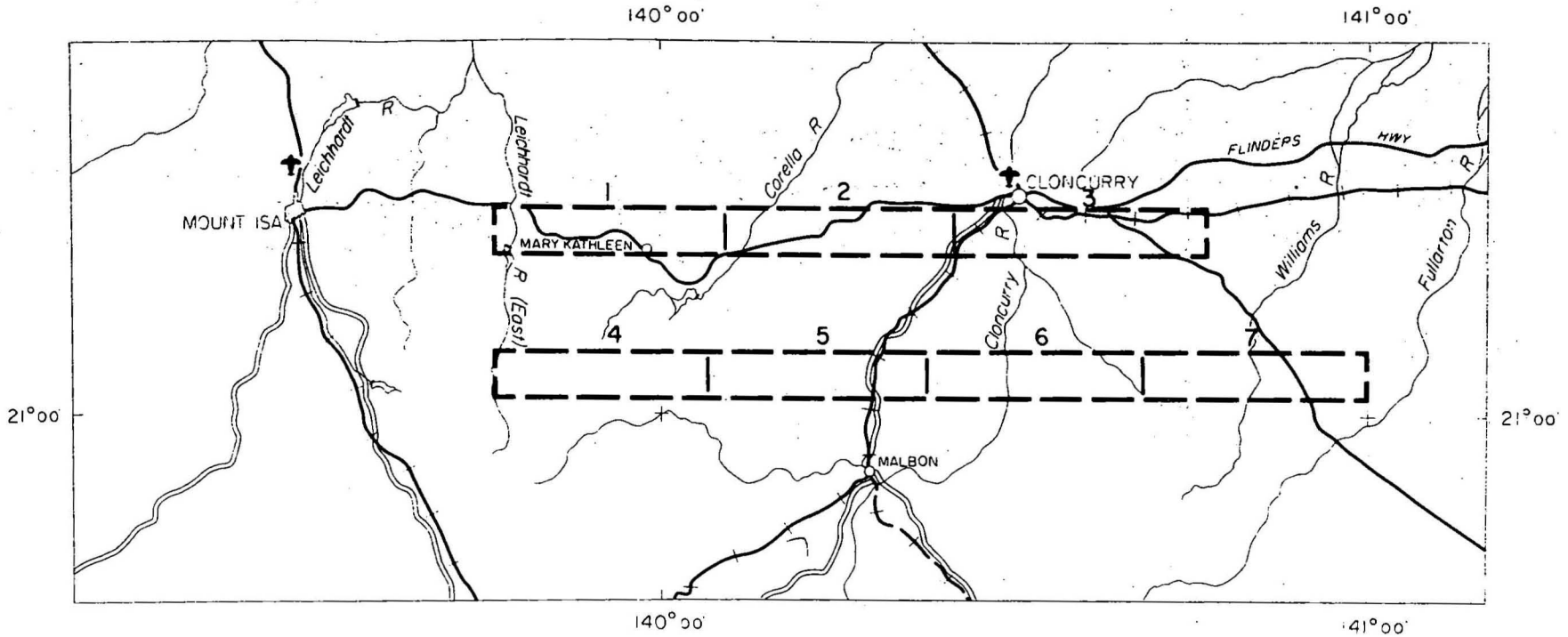


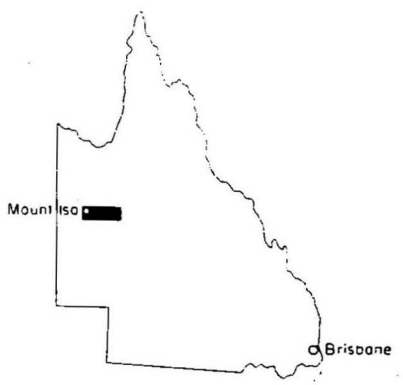
Modified from Carter et al. (1961)

To accompany Record No 1972/110

F54/BI-62A

To accompany Record No 1972/110





DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

LOCALITY MAP

MILES 10 0 10 20 30 40 50 MILES

KILOMETRES 10 0 10 20 30 40 50 60 70 KILOMETRES

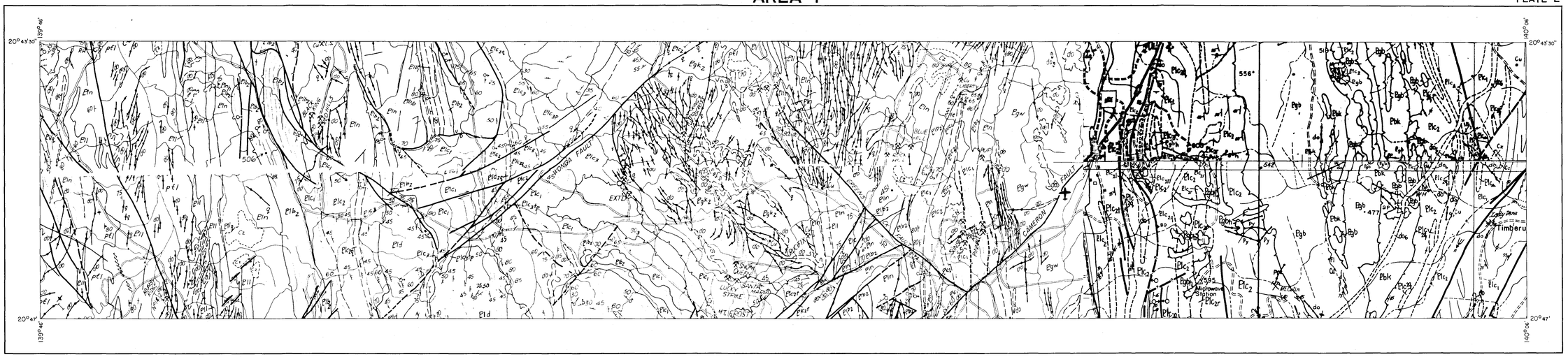
Boundary of survey area.

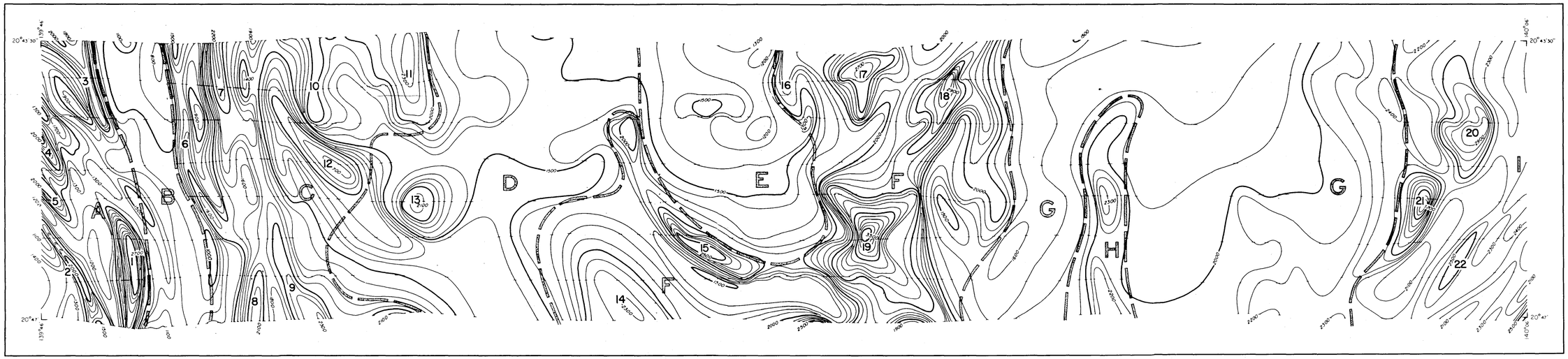
F54/B1-49A

PLATE 1

AREA I

PLATE 2





DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

TOTAL MAGNETIC INTENSITY CONTOURS, MAGNETIC INTERPRETATION AND GEOLOGY

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

MILES 1 0 1 2 3 MILES

CONTOUR INTERVAL 100 GAMMAS

GEOPHYSICAL LEGEND

A — *Zone boundary and reference*

3 — *Anomaly number*

EXPLANATORY NOTES

The survey was flown at a nominal altitude of 80 m above ground level along east-west lines spaced 300 m apart.

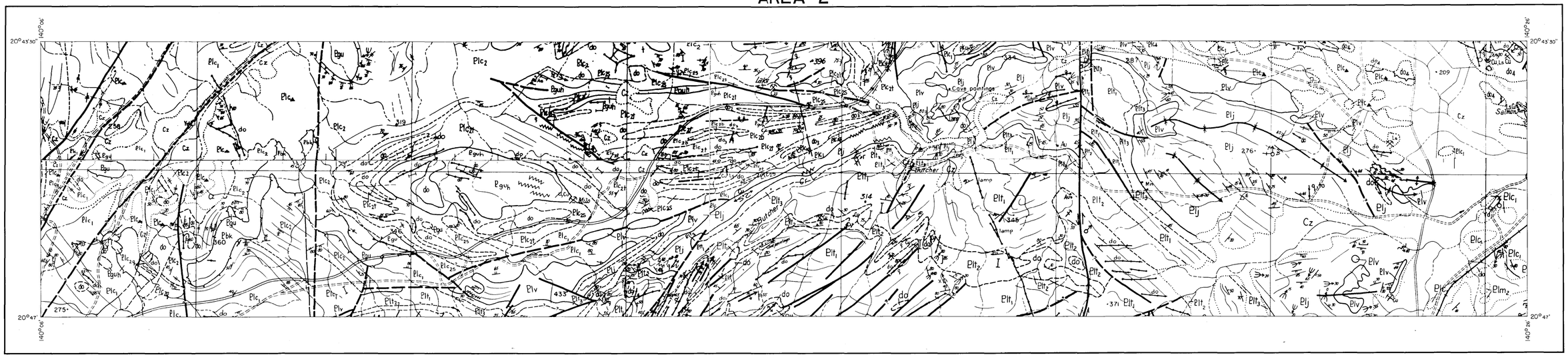
The magnetic contours have been constructed from the data of every third line.

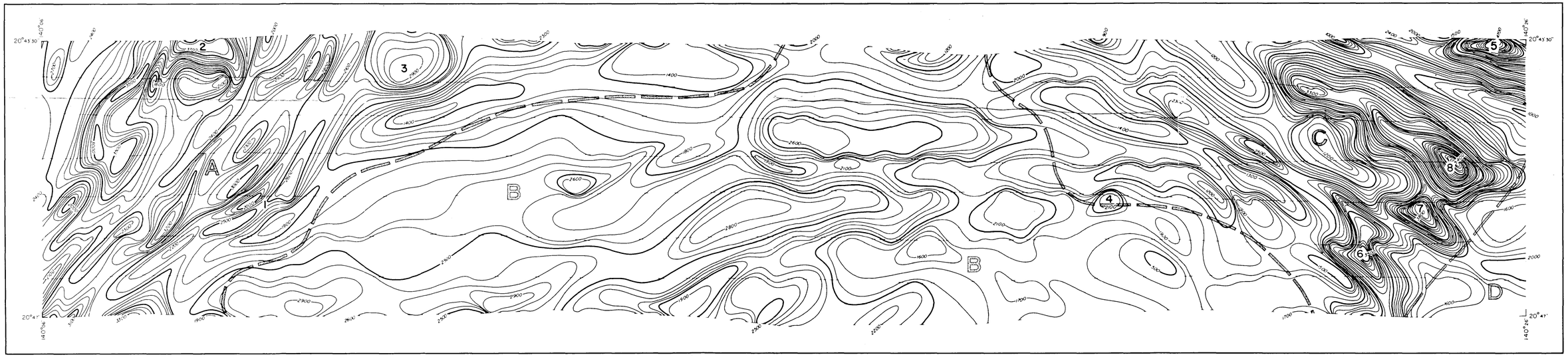
The data have not been corrected for the regional magnetic gradient.

To accompany Record No 1972/110

F54/B1-63

AREA 2





DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

TOTAL MAGNETIC INTENSITY CONTOURS, MAGNETIC INTERPRETATION AND GEOLOGY

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

MILES 1 0 1 2 3 MILES

CONTOUR INTERVAL 100 GAMMAS

GEOPHYSICAL LEGEND

A — *Zone boundary and reference*

3 — *Anomaly number*

EXPLANATORY NOTES

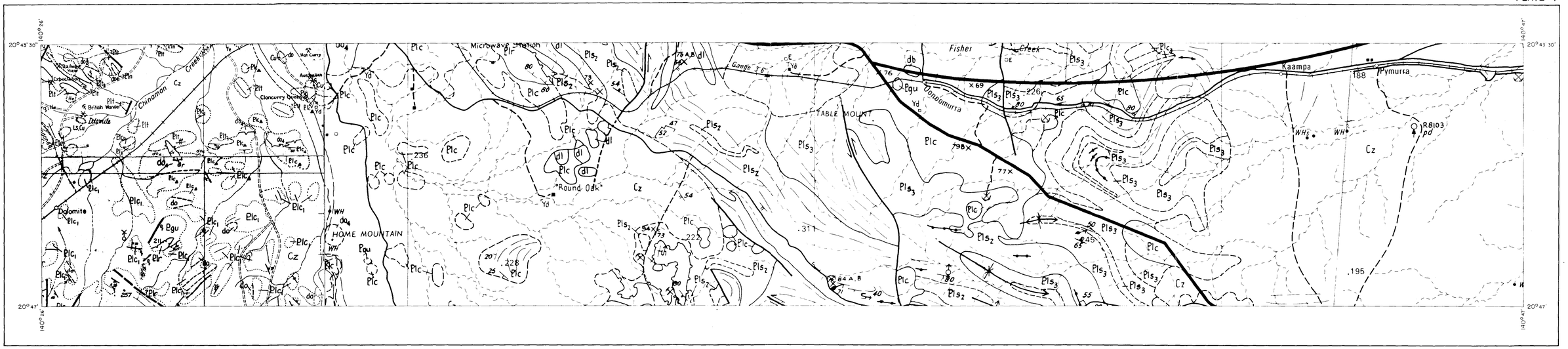
The survey was flown at a nominal altitude of 80 m above ground level along east-west lines spaced 300m apart.

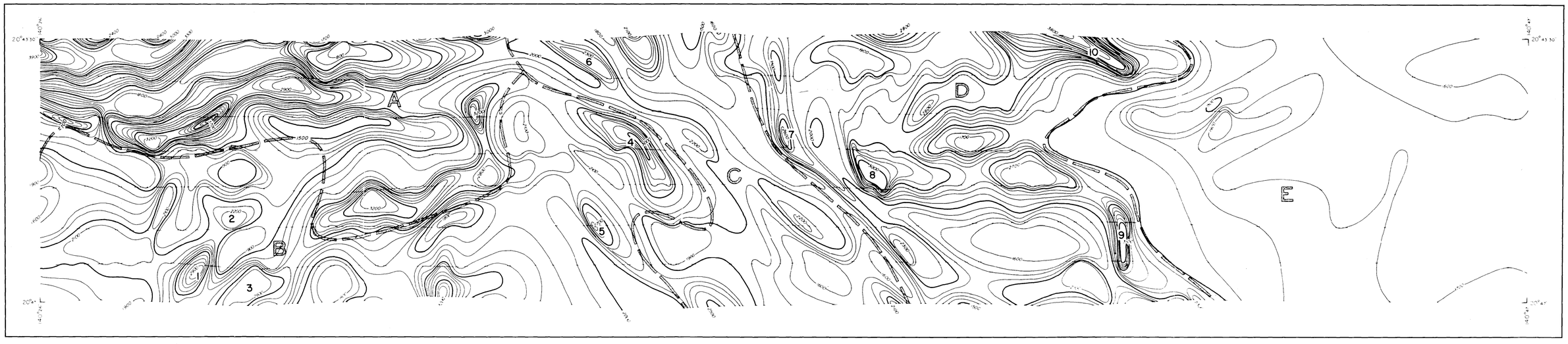
The magnetic contours have been constructed from the data of every third line.

The data have not been corrected for the regional magnetic gradient.

To accompany Record No 1972/110

F54/B1-64





DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

TOTAL MAGNETIC INTENSITY CONTOURS, MAGNETIC INTERPRETATION AND GEOLOGY

GEOPHYSICAL LEGEND

A — *Zone boundary and reference*

3 — *Anomaly number*

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

MILES 1 0 1 2 3 MILES

CONTOUR INTERVAL 100 GAMMAS

EXPLANATORY NOTES

The survey was flown at a nominal altitude of 80 m above ground level along east-west lines spaced 300 m apart.

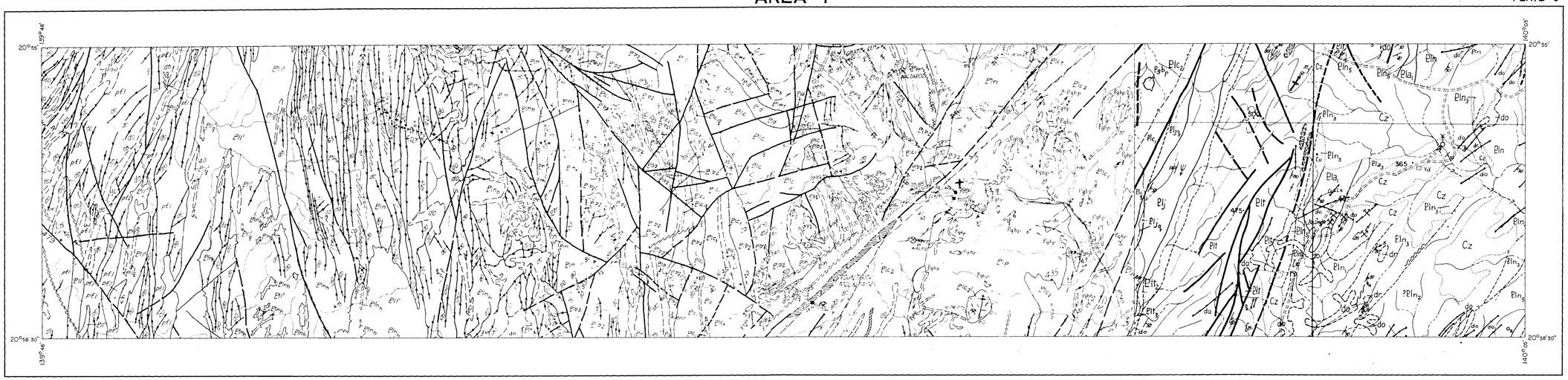
The magnetic contours have been constructed from the data of every third line.

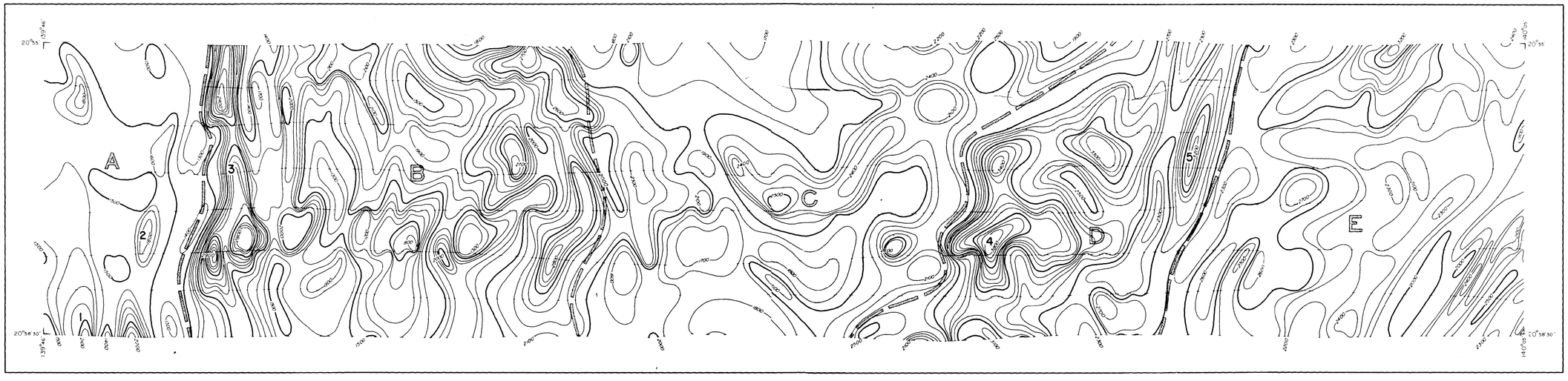
The data have not been corrected for the regional magnetic gradient.

To accompany Record No 1972/110

F54/B1-65

AREA 4





DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

TOTAL MAGNETIC INTENSITY CONTOURS, MAGNETIC INTERPRETATION AND GEOLOGY

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

MILES 1 0 1 2 3 MILES

CONTOUR INTERVAL 100 GAMMAS

GEOPHYSICAL LEGEND

A — *Zone boundary and reference*

3 — *Anomaly number*

EXPLANATORY NOTES

The survey was flown at a nominal altitude of 80m above ground level along east-west lines spaced 300m apart.

The magnetic contours have been constructed from the data of every third line

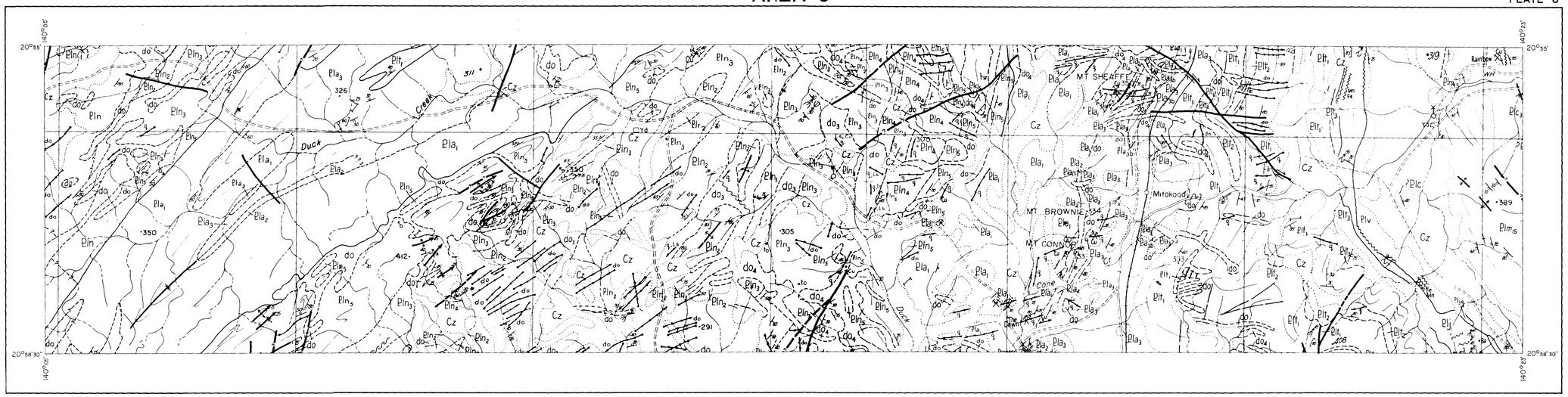
The data have not been corrected for the regional magnetic gradient.

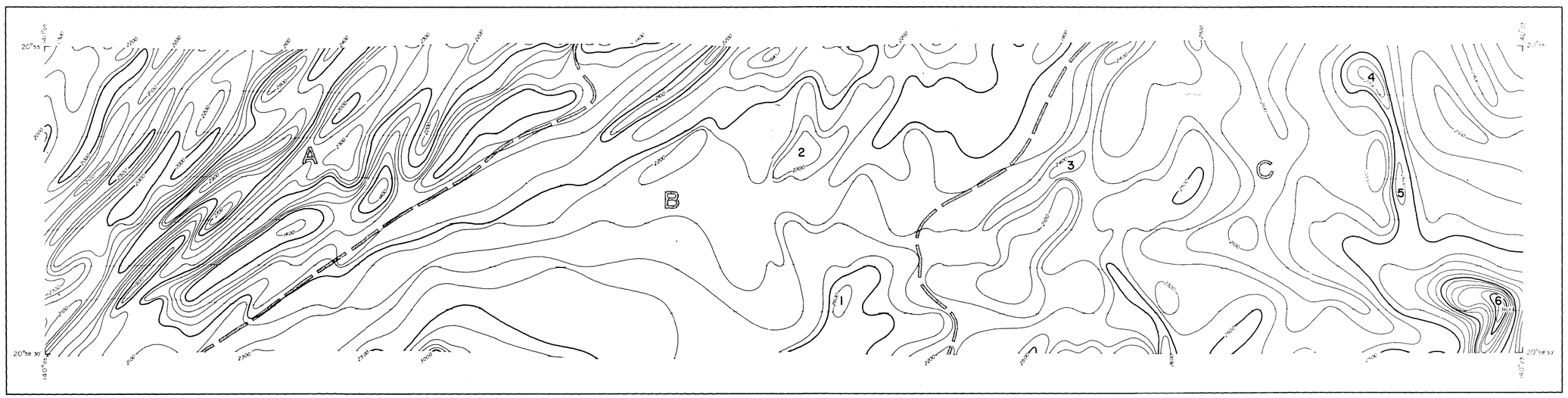
To accompany Record No 1972/110

F54/P1-66

AREA 5

PLATE 6





DETAILED AIRBORNE SUFVEY, CLONCURRY, QLD 1970

TOTAL MAGNETIC INTENSITY CONTOURS, MAGNETIC INTERPRETATION AND GEOLOGY

GEOPHYSICAL LEGEND

A — *Zone boundary and reference*

3 — *Anomaly number*

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

MILES 1 0 1 2 3 MILES

CONTOUR INTERVAL 100 GAMMAS

EXPLANATORY NOTES

The survey was flown at a nominal altitude of 80 m above ground level along east-west lines spaced 300m apart.

The magnetic contours have been constructed from the data of every third line.

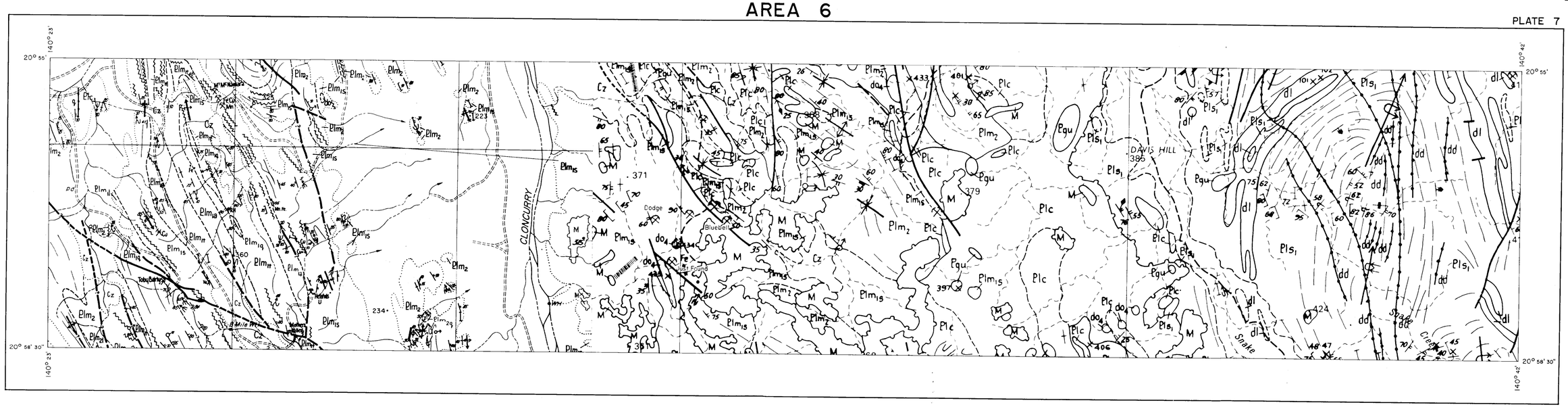
The data have not been corrected for the regional magnetic gradient.

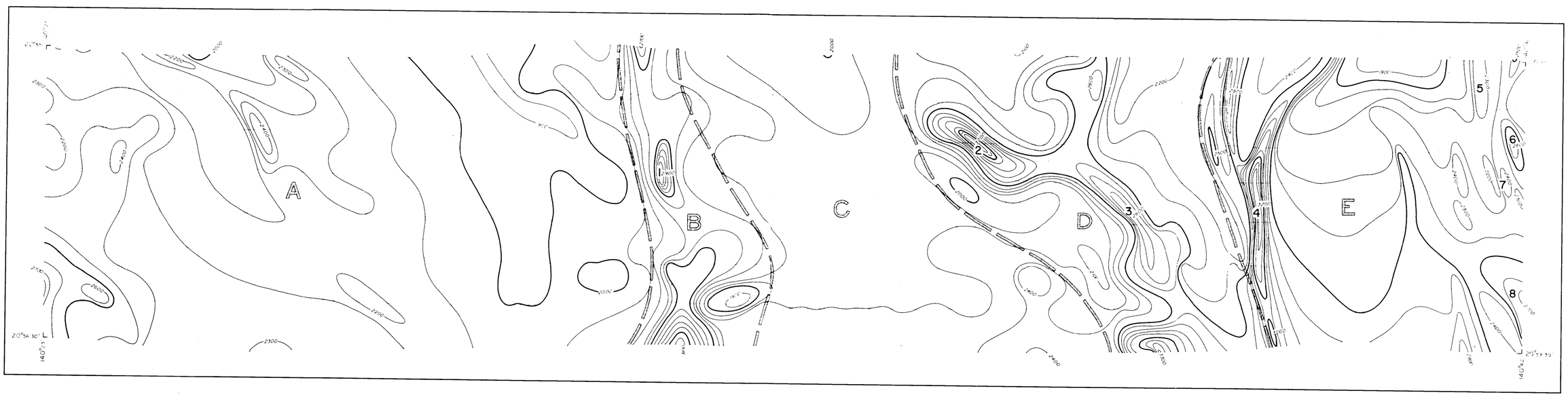
To accompany Record No 1972/110

F54/B1-67

AREA 6

PLATE 7





DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

TOTAL MAGNETIC INTENSITY CONTOURS, MAGNETIC INTERPRETATION AND GEOLOGY

GEOPHYSICAL LEGEND

A — *Zone boundary and reference*

3 — *Anomaly number*

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

MILES 1 0 1 2 3 MILES

CONTOUR INTERVAL 100 GAMMAS

EXPLANATORY NOTES

The survey was flown at a nominal altitude of 60 m above ground level along east-west lines spaced 300m apart.

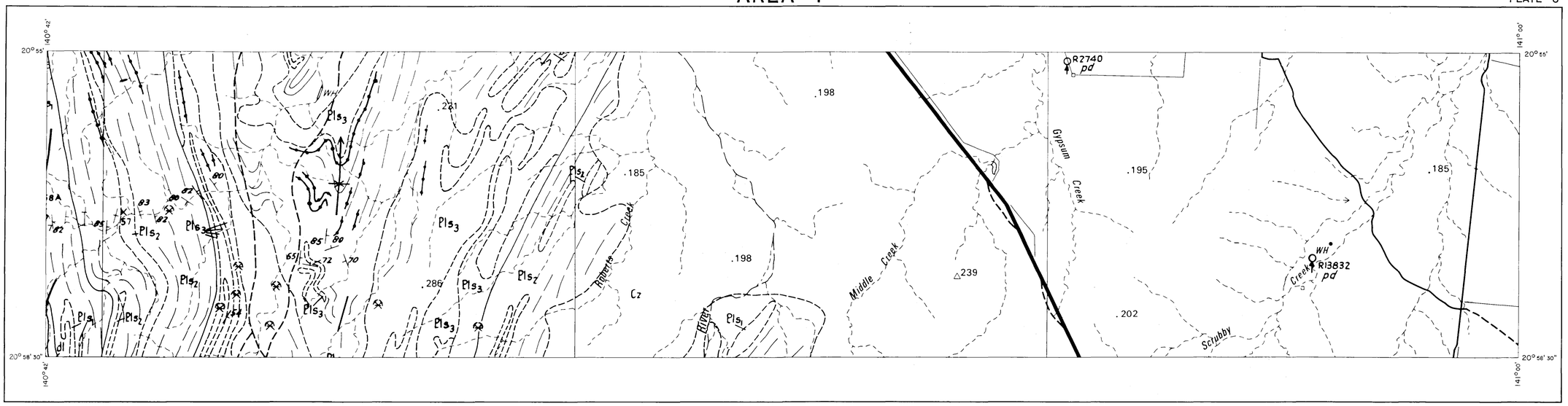
The magnetic contours have been constructed from the data of every third line.

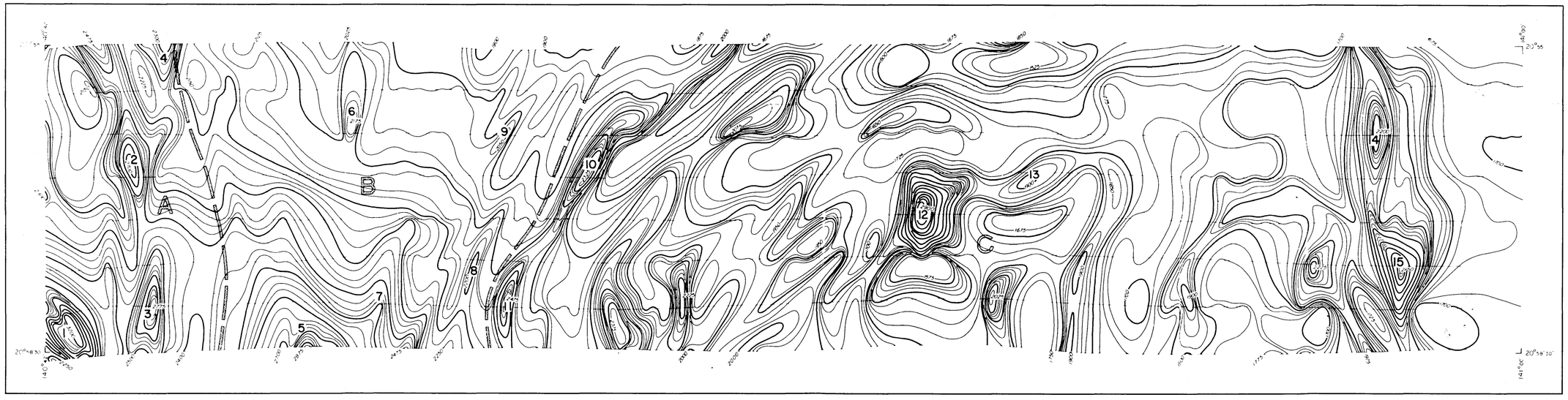
The data have not been corrected for the regional magnetic gradient.

To accompany Record No 1972/110

F54/B1-68

AREA 7





DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

TOTAL MAGNETIC INTENSITY CONTOURS, MAGNETIC INTERPRETATION AND GEOLOGY

GEOPHYSICAL LEGEND

A — *Zone boundary and reference*

3 — *Anomaly number*

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

MILES 1 0 1 2 3 MILES

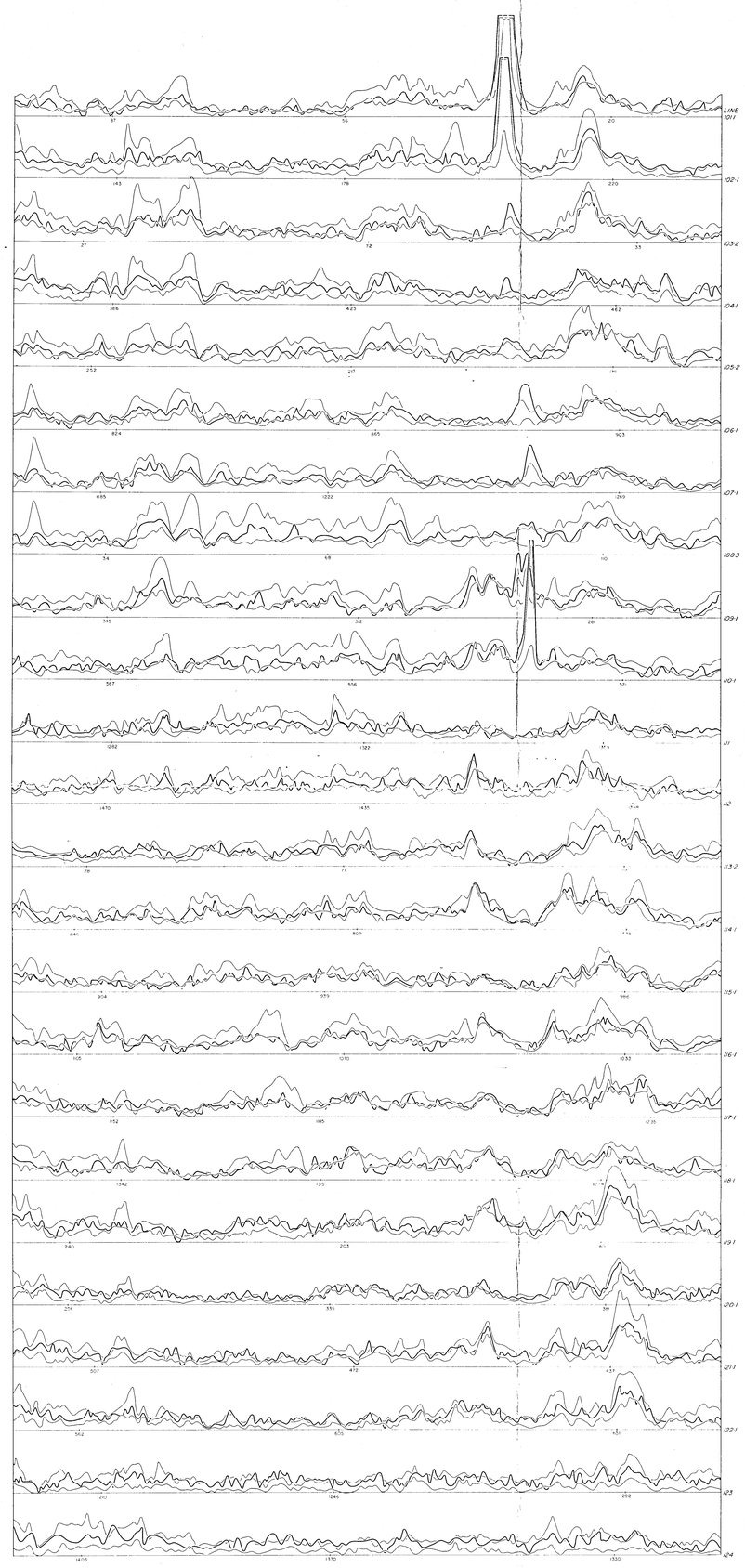
CONTOUR INTERVAL 25 GAMMAS

EXPLANATORY NOTES

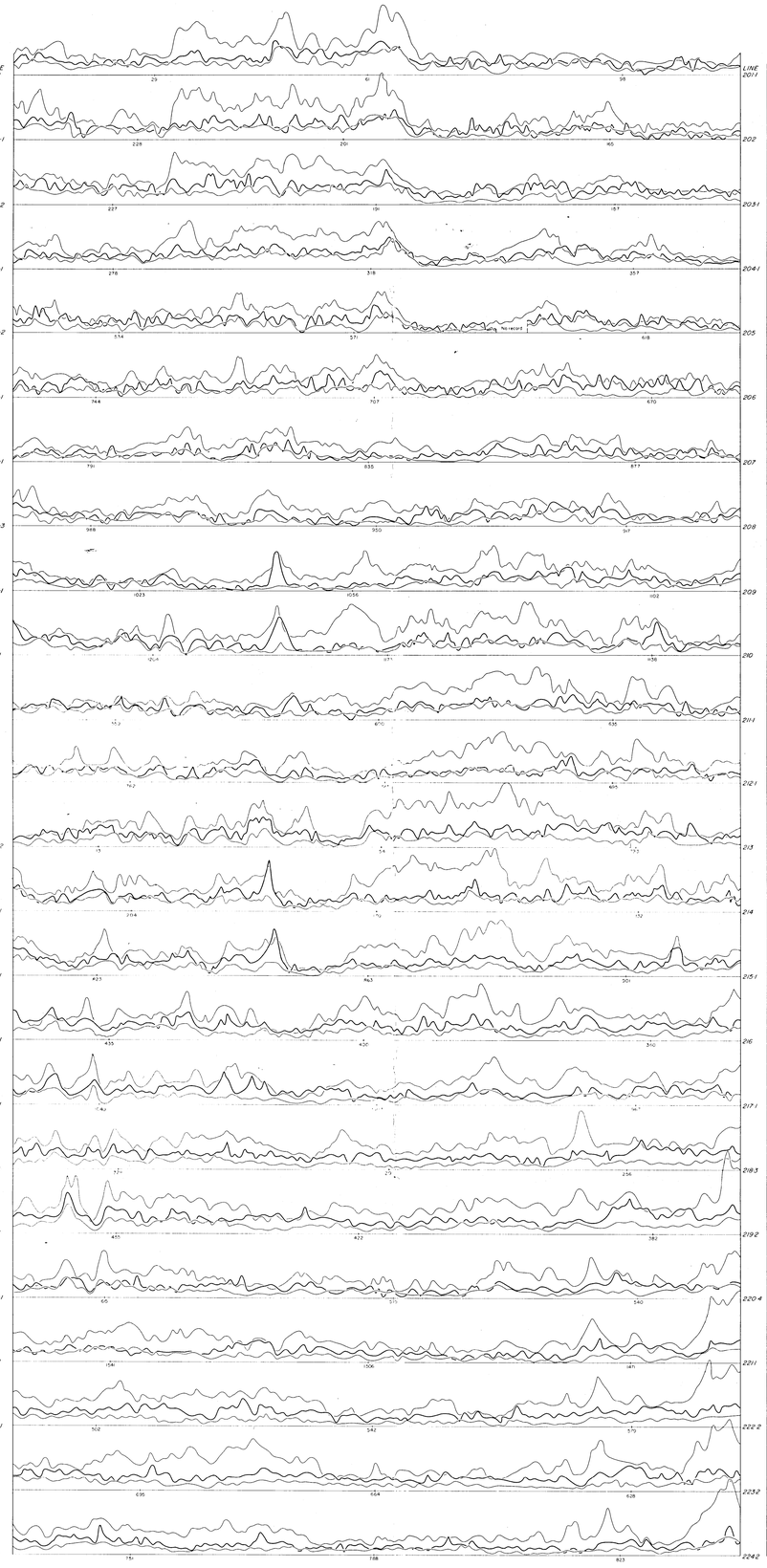
The survey was flown at a nominal altitude of 80 m above ground level along east-west lines spaced 300m apart.
The magnetic contours have been constructed from the data of every third line.
The data have not been corrected for the regional magnetic gradient.

To accompany Record No 1972/110

F54/B1-69



AREA 1



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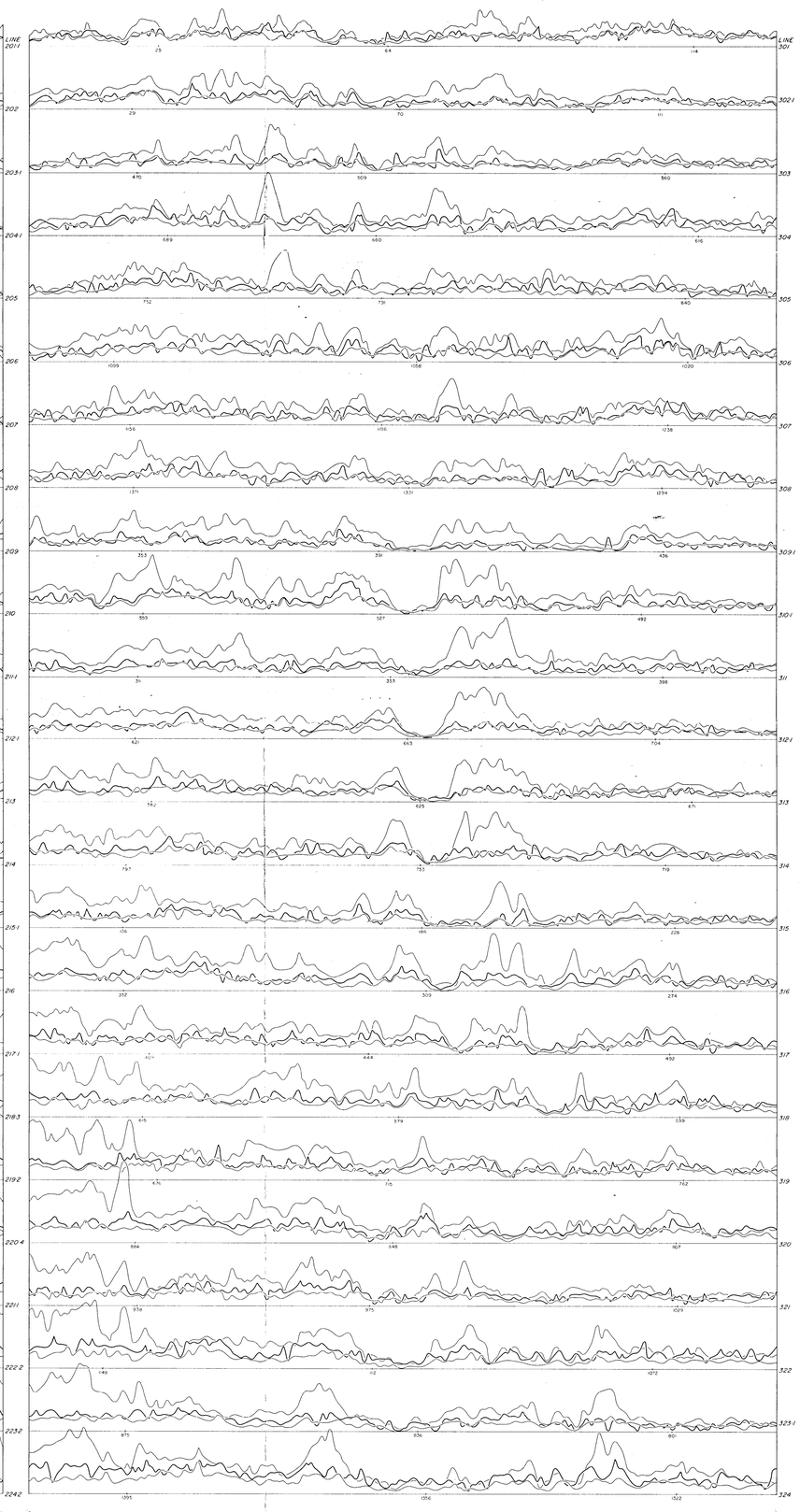
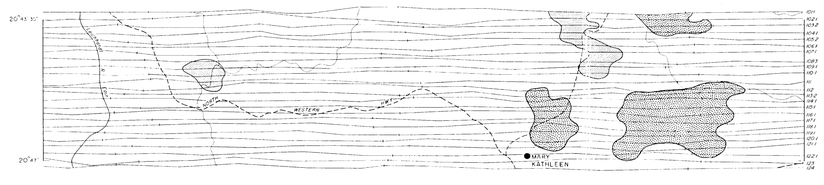
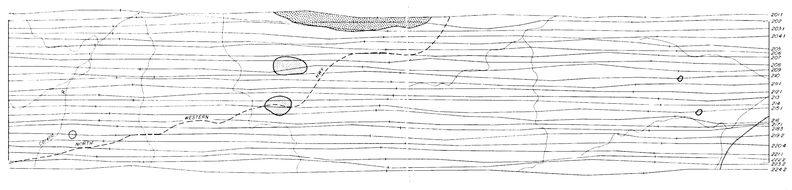
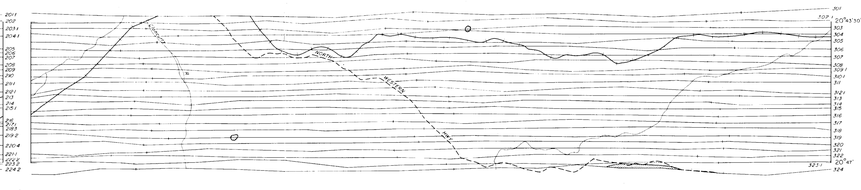


AREA 3







The topographic information is based on 1:48000 scale compilation maps prepared in 1960 by the Royal Australian Survey Corps

GAMMA-RAY SPECTROMETER PROFILES

Channel 2 1·3 – 1·6 MeV

Channel 3 1·6 – 1·9 MeV

Channel 4 2·4 – 2·8 MeV

Baseline with control point and fiducial number

PROFILE SCALES

CHANNELS 3 and 4: 50, 25, 0 Counts per second

CHANNEL 2: 100, 50, 0 Counts per second

DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

GAMMA-RAY SPECTROMETER PROFILES

EAST-WEST SCALE 1:100,000

KILOMETRES 2 0 2 4 6 8 10 12 KILOMETRES

MILES 2 0 2 4 6 MILES

GEOPHYSICAL LEGEND

Anomaly due to Uranium

Anomaly due to Thorium

Flight-line and control point

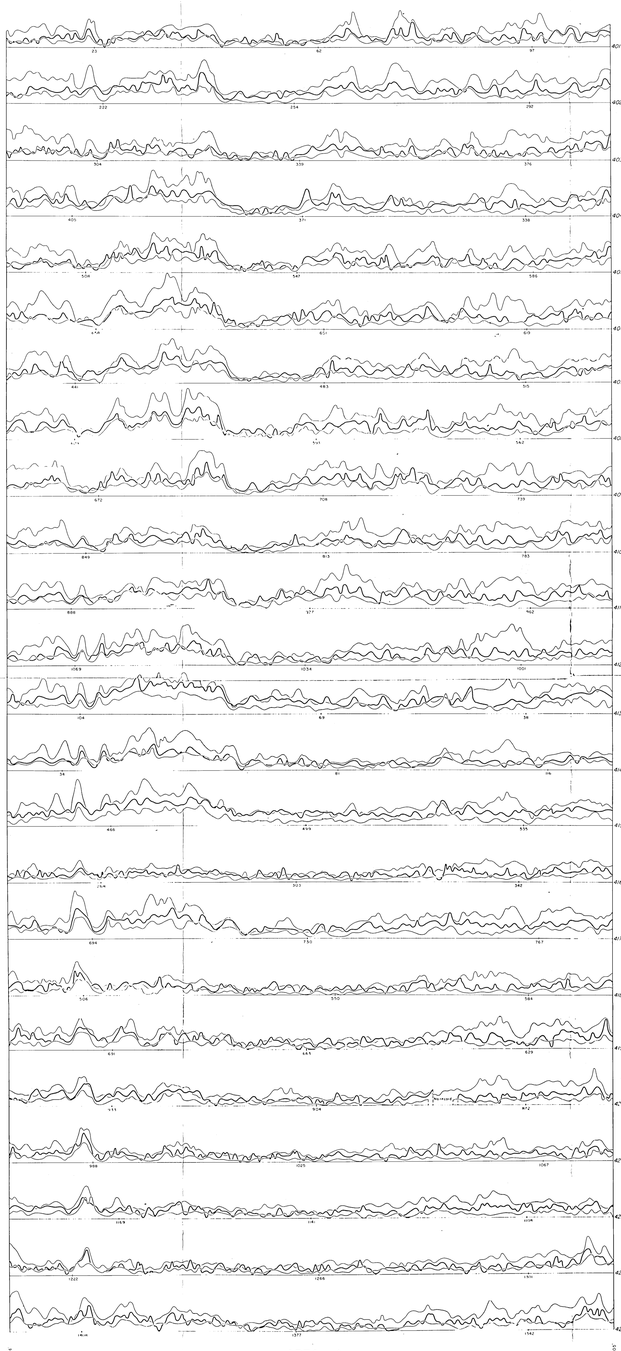
EXPLANATORY NOTES

The survey was flown at a nominal altitude of 80m above ground level along east-west lines spaced 500m apart.

The profiles have not been corrected for changes in count rate caused by variations from the nominal altitude.

To accompany Record No 1972/110

F54/B1-60



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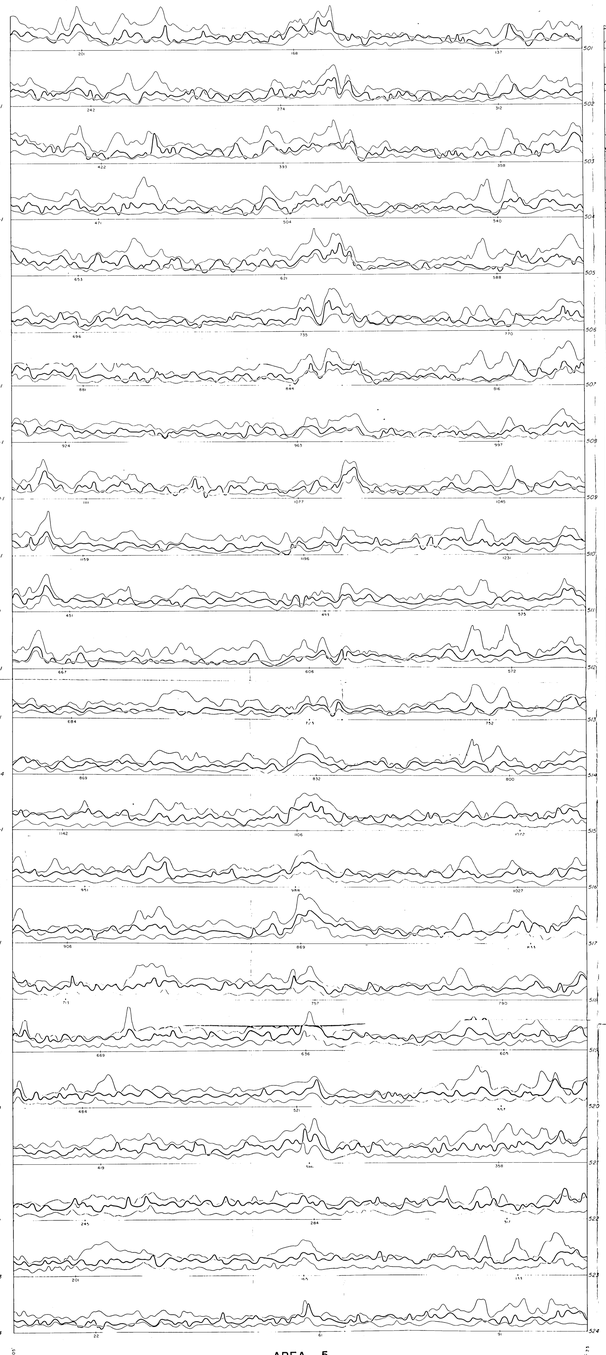
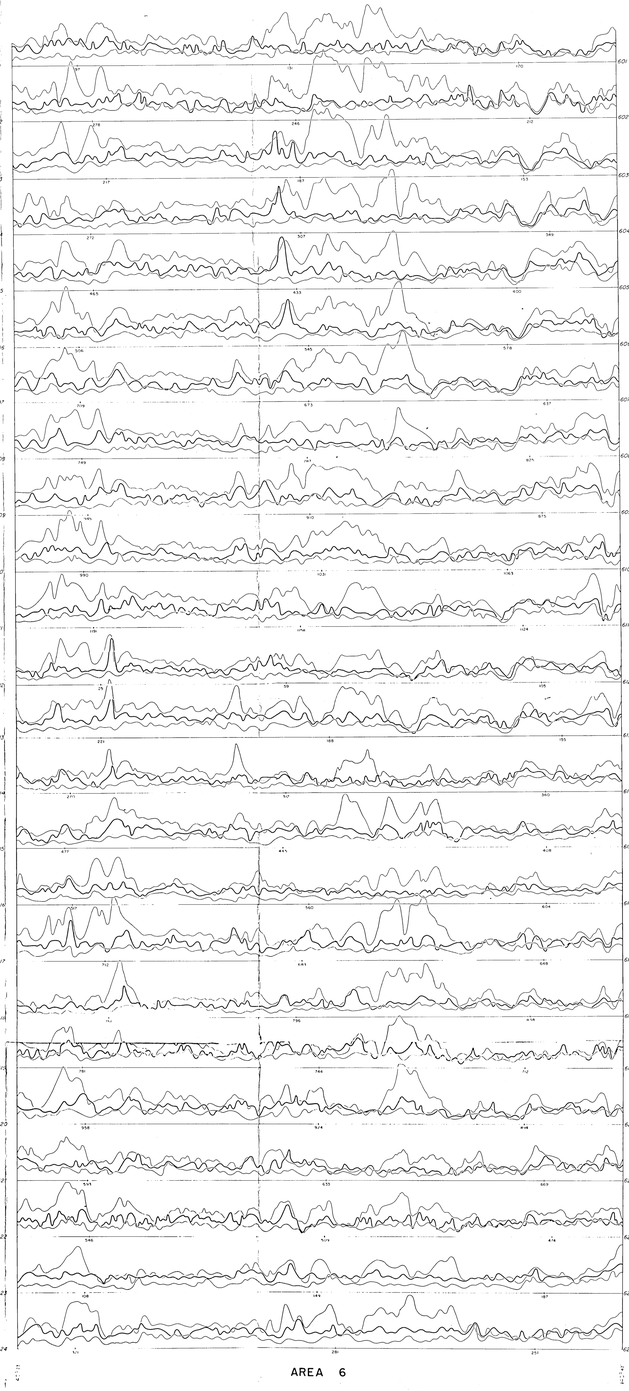
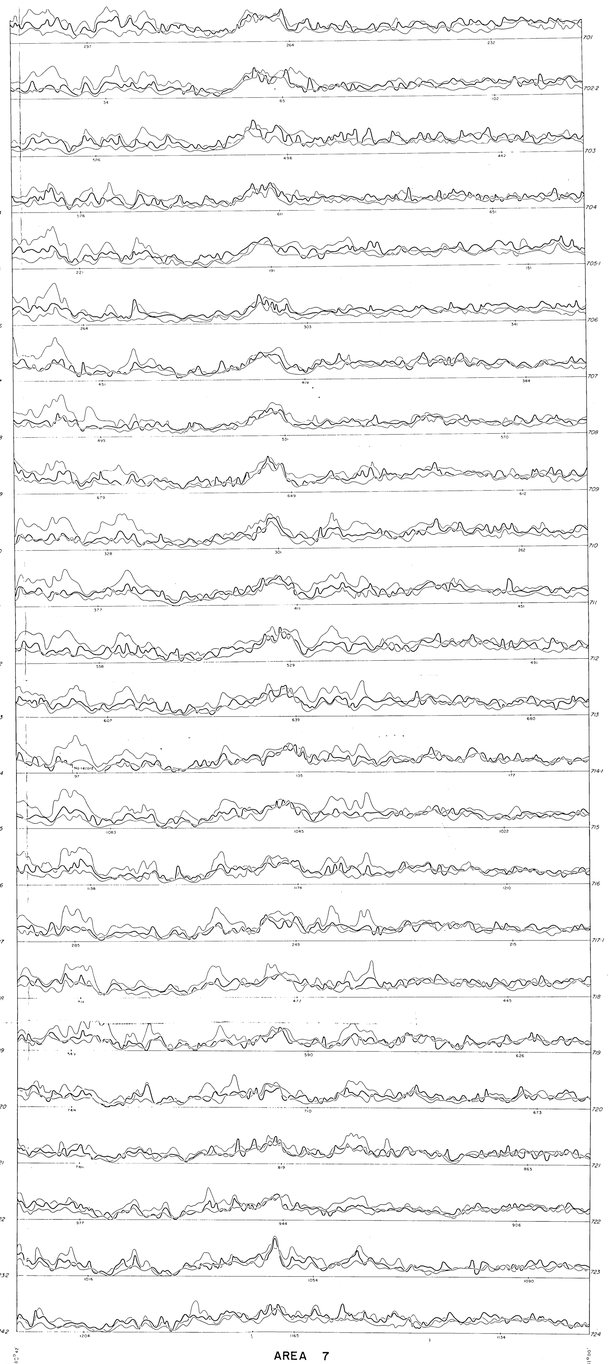


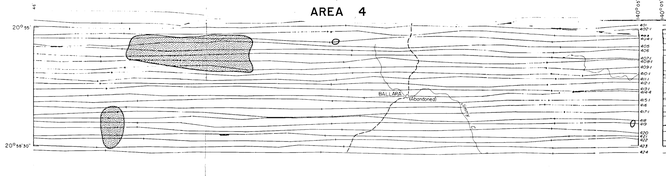
AREA 5

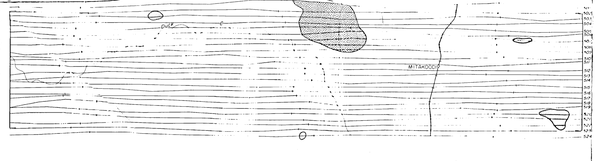


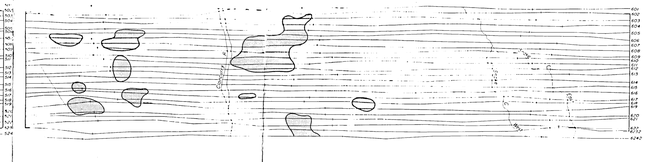
AREA 6

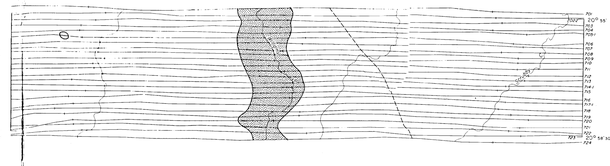


AREA 7









The topographic information is based on 1:48,000 scale compilation maps prepared in 1960 by the Royal Australian Survey Corps

GAMMA-RAY SPECTROMETER PROFILES

Channel 2 1·3 – 1·6 MeV

Channel 3 1·6 – 1·9 MeV

Channel 4 2·4 – 2·8 MeV

Baseline with control point and fiducial number

PROFILE SCALE

CHANNELS 3 and 4 — Counts per second 50, 25, 0

CHANNEL 2 — Counts per second 100, 50, 0

DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

GAMMA-RAY SPECTROMETER PROFILES

EAST-WEST SCALE 1:100,000

KILOMETRES 0 2 4 6 8 10 12 KILOMETRES

MILES 0 2 4 6 8 MILES

GEOPHYSICAL LEGEND

Anomaly due to Uranium

Anomaly due to Thorium

Flight-line and control point

EXPLANATORY NOTES

The survey was flown at a nominal altitude of 80m above ground level along east-west lines spaced 300m apart.

The profiles have not been corrected for changes in count rate caused by variations from the nominal altitude.

To accompany Record No 1972/110

F54/B1-61


A
B
C
1
2
3
4
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6
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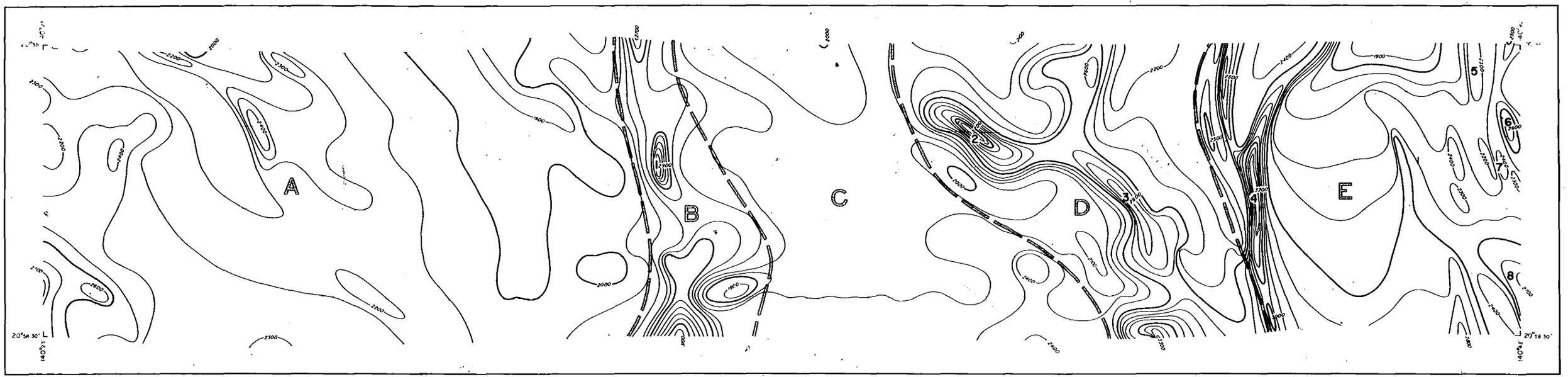
11
12
13
14
15


A
B
C
D
E
1
2
3
4
5
6
7
8
20°58 30'
140°2'