DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 75/74

CLONCURRY REGIONAL AND PROSPECTOR DETAILED AIRBORNE MAGNETIC AND RADIOMETRIC SURVEYS, QLD 1973

by

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SUMMARY

From May to August 1973 the Bureau of Mineral Resources (BMR) carried out an aeromagnetic and radiometric survey of the CLONCURRY 1:250 000 Sheet area on east-west lines 1500 m apart and at an altitude of 150 m above ground level. A detailed survey of the Prospector 1:100 000 Sheet area was also made on east-west lines 500 m apart and at an altitude of 80 m above ground level. The surveys were carried out as an aid to geological mapping and mineral exploration in the area.

The magnetic data in CLONCURRY showed that the outcropping Precambrian rocks commonly have strong magnetic response, typical of Precambrian metamorphic belts. Anomalies of amplitude 500-2000 gammas (=nanoteslas) attributed to linear sources dominate the magnetic pattern. These anomalies are typical of those produced by steeply dipping tabular bodies and appear to be caused by metavolcanics and other magnetic units parallel to the sedimentary layering, cross-cutting basic dykes, and possibly magnetic material in faults. It is believed that the main magnetic mineral is magnetite.

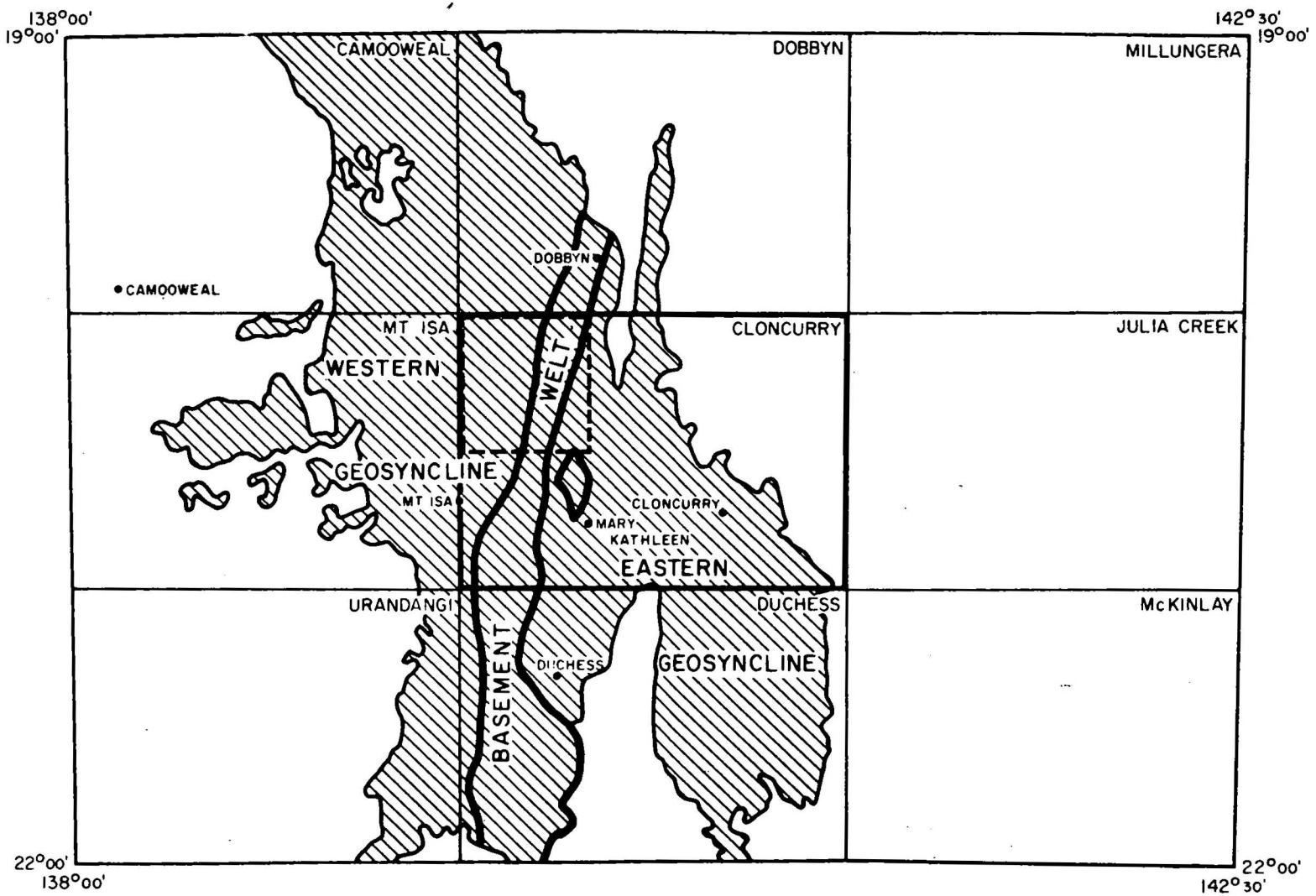
There appears to be an association between the amplitude of magnetic anomalies and the metamorphic grade of the Precambrian rocks. The amplitudes of linear anomalies over the Corella Formation are generally high close to the contact with younger granites; these anomalies are approximately parallel to the contacts.

The pattern of magnetic anomalies over the Cainozoic sediments in the east of CLONCURRY is similar to that over the adjacent Precambrian outcrop. It is likely that much of this area is underlain by steeply dipping Precambrian rocks, possibly Corella Formation, at a depth of 100-500 metres.

The radiometric data recorded over Precambrian rocks revealed strong anomalies associated with granites and the Corella Formation, Marimo Slate, Argylla Formation, and Leichhardt Metamorphics. Anomalies were recorded over various known uranium mines and prospects. The radiometric anomalies have been classified to indicate principal source elements (potassium, uranium, and thorium). Most sources fall in the 'high-potassium' classification, particularly those in the Corella Formation, Argylla Formation, and Leichhardt Metamorphics. Broadly speaking, sources in the Corella Formation fall into the high-potassium classification, but indications of potassium decrease and indications of thorium increase progressively northwards. High uranium/thorium ratios are associated with anomalies over the Marimo Slate in addition to a high-potassium classification.

Uranium anomalies were recorded over the Toolebuc Limestone, a known radiometric marker bed in the Great Artesian Basin.

It is considered that the results of the detailed survey of Prospector were not sufficiently detailed to be of much help in the 1:100 000 scale geological mapping in progress in the area. Accordingly the interpretation given in this report concentrates on the CLONCURRY regional survey.



LOCALITY MAP

Limit of Precambian outcrop

km 50 0 50 100 150 km

Regional Survey area boundary

Detailed Survey area boundary

FIGURE 1

1. INTRODUCTION

The Bureau of Mineral Resources (BMR) in co-operation with the Geological Survey of Queensland is continuing an integrated program of detailed geological mapping, geophysics, age determination, and geochemistry in the Precambrian belt of northwestern Queensland. Since the initial discovery of uranium at Skal near Mount Isa and subsequently at Mary Kathleen, almost all of CLONCURRY* has been flown in detail with either scintillometers or gamma-ray spectrometers, partly by BMR but mainly by exploration companies. Only small parts of the Sheet area have previously been flown with magnetometers. The presence of the Mount Isa orebodies and the very numerous smaller orebodies and mineral occurrences in the surrounding region provides a continuing stimulus for exploration.

From May to August 1973, BMR made an airborne magnetic and radiometric survey over the whole of CLONCURRY (Fig. 1). In addition a more detailed aeromagnetic and radiometric survey was flown over the Prospector 1:100 000 Sheet area. These surveys were undertaken to assist with the geological mapping and to provide new regional geophysical data for mineral exploration in the area. A proton-precession magnetometer was used to record variations in the Earth's magnetic field, and radiometric coverage was obtained with a four-channel gamma-ray spectrometer. All data were recorded on analogue charts. Survey details are given in Appendix 1.

The CLONCURRY area contains two main physiographic units: an upland area of which about 90 percent is outcropping Precambrian metamorphic rocks, and a lowland area covered by flat-lying Mesozoic and Cainozoic sediments.

This Record summarizes the geology of CLONCURRY, shows the results of the airborne survey, and discusses the interpretations of the magnetic and radimetric data.

*Throughout this Record the names of 1:250 000 Sheet areas are written in capital letters to distinguish them from ordinary place names.

2. GEOLOGY

The Precambrian geology of the area which includes CLONCURRY has been discussed by Carter, Brooks & Walker (1961) and more recently by Plumb & Derrick (1973). These are the main references for the regional geology and details of mineral occurrences. As 1:100 000 scale mapping of CLONCURRY proceeds, more detailed information is becoming available (Glikson & Derrick, 1970; Derrick, Wilson, Hill & Mitchell, 1971; Glikson, 1972; Derrick, Wilson, Hill, Glikson & Mitchell, in prep.).

Stratigraphy

The CLONCURRY sheet area lies in the Precambrian mineral province of northwestern Queensland and embraces three fundamental stratigraphic divisions: a central crystalline basement 'welt' (the Kalkadoon-Leichhardt Block), and eastern and western sedimentary-volcanic successions. The northeastern part of the area is covered by Mesozoic and Cainozoic sediments.

Precambrian Sediments. Even a simplified map (Pl.11) shows that the geology is extremely complex; the sediments are strongly folded and faulted, and intruded by granites and swarms of dolerite dykes. Rocks in the eastern and western geosynclines have similarities, but as there is not a continuous section across the basement welt, correlations have not yet been established. A stratigraphic correlation chart (Fig. 2) summarizes the names and positions of formations, and Table 1 summarizes the rock types. For further details of the stratigraphy refer to Carter, Brooks & Walker (1961) and Plumb & Derrick (1973).

Mesozoic and Cainozoic sediments. Grimes (1972) has discussed the Mesozoic and Cainozoic geology of CLONCURRY. Rocks of these ages underlie the eastern one-third of the sheet. Water bores and BMR stratigraphic wells indicate that the section is thin; the basement generally lies 100-300 m below the surface, although in the extreme northeast it is probably deeper.

Two units of interest in the radiometric interpretation presented

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STRATIGRAPHIC CORRELATION CHART AND MINERALISATION OF CLONCURRY AREA

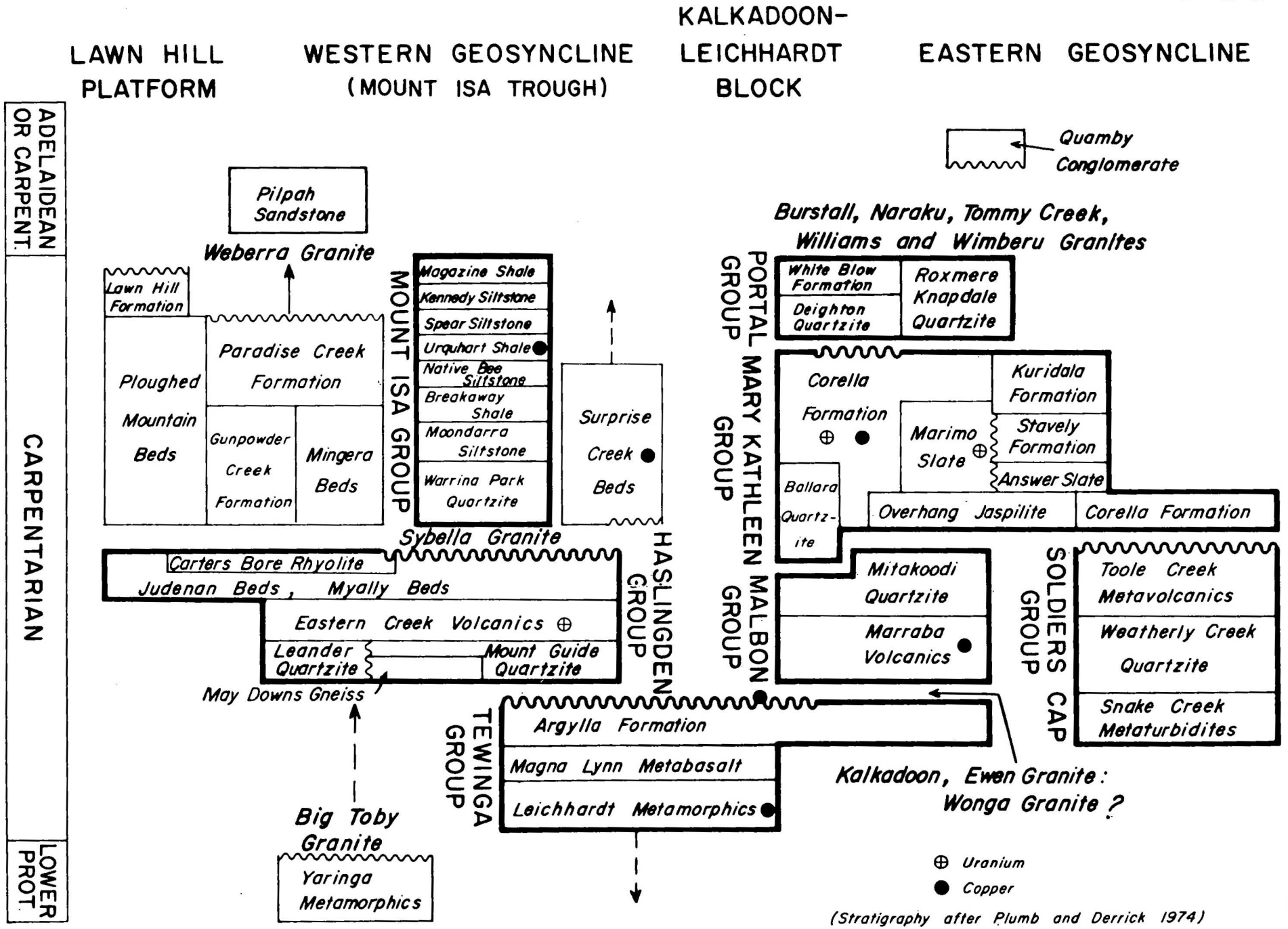


FIGURE 2

F54/BI-93A

TABLE 1

TABLE 1: SUMMARY OF LOWER PROTEROZOIC(?) TO ADELAIDEAN (?) STRATIGRAPHY, NORTHWEST QUEENSLAND PROVINCE

Unit	Thickness (m)	Main Rock Types	Remarks
MOUNT ISA OROGENIC DOMAIN			
WESTERN 'GEOSYNCLINE'			
Basic intrusives		Dolerite, metadolerite.	Rare dykes in Mt Isa Gp. Dyke swarms in lower Haslingden Gp in north-trending fractures.
MT ISA GROUP (Magazine Shale	210	Calcareous shale, some pyrite.	Some pyrite and carbonaceous material
(Kennedy Siltstone	306	Siltstone, dolomitic quartzite.	Some slump (?) breccia.
(Spear Siltstone	107	Dolomitic siltstone, shale.	Contains albite-rich marker bed.
(Urquhart Shale	900	Ferruginous pyritic shale, tuff.	Cu-Pb-Zn (Mount Isa, Hilton, Mount Novit). Soda & potash-rich marker beds common.
(Native Bee Siltstone	780	Dolomitic siltstone, minor tuff.	Tuff forms thin marker beds.
(Breakaway Shale	1000	Grey shale, minor siltstone	
(Moondarra Siltstone	1200+	Dolomitic siltstone, shale	Some pyritic iron-rich bands
(Warrina Park Quartzite	100+	Quartzite, ferruginous siltstone	Formerly part of Myally Beds; good marker bed, locally unconformable on Myally Beds.
Mingera Beds	up to 1400	Conglomerate, quartzite, shale, siltstone.	Unconformable over Sybella Gr; possible equivalent of Mt Isa Gp.
Surprise Creek Beds	up to 6000	Sandstone, dolomite, siltstone, shale, conglomerate.	Anomalous Pb-Zn zones in rocks similar to Mt Isa GP at Crystal Cr. Cu in quartzites in lower part of sequence. Stromatolites also present. Possibly equivalent to lower Mary Kathleen Gp.
Sybella Granite		Biotite granite, gneissose granite, micro-granite, quartz diorite, pegmatite.	Four separate phases in complex, intrudes Haslingden Gp west of Mt Isa Fault; overlain unconformably by Mingera Beds. Inferred to be older than Mt Isa Gp. Pegmatites contain beryl, rare earths, & muscovite. Diorites related to contamination of granite by basic rock.

HASLINGDEN BEDS (Carters Bore Rhyolite	150	Rhyolite, granite porphyry.	Also present at top of Hyally Beds; possibly cogmatic with Sybella Gr.
(Judenan Beds	1500+	Quartzite, schist, amphibolite.	
(Hyally Beds	400 to 10 000	Quartzite, siltstone, shale, conglomerate	Essentially unmineralized; unconformable under Mt Isa Gp; very feldspathic.
(Eastern Creek Volcanics	3600 to 7200	Metabasalt, quartzite.	Cu & U mineralization related to basic dykes.
(Leander Quartzite	1500	Quartzite, metabasalt.	Essentially unmineralized.
(Mount Guide Quartzite	6000+	Quartzite, greywacke, conglomerate	Unconformable on Kalkadoon Gr & Argylla Fm; May Downs Gneiss Mbr is metamorphosed equivalent adjacent to Sybella Gr. Extensively intruded by dolerite.
EASTERN 'GEOSYNCLINE'			
Quarby Conglomerate	300	Conglomerate, arkose, quartzite, sandstone locally ferruginous.	Overlies Corella Fm unconformably; probably post-metamorphic, but fault-bounded in graben structure. Some vein and related alluvial Au.
Basic dykes		Dolerite	Post-metamorphism and granite intrusion. Possibly final tectonic event, at 1380 m.y.
Burstall Granite		Granite, aplite, pegmatite, porphyry dykes.	Minor fluorite, possible source of U (Mary Kathleen)
Naraku Granite		Granite, aplite.	Intrudes Corella Fm; some skarn in contact zone; possibly two ages of intrusion present.
Teasy Creek Microgranite		Microgranite, porphyritic rhyolite.	Sills in Corella Fm; some U-bearing pegmatites.
Wimberu Granite		Granite, aplite.	Intrudes Tewinga & Malbon Gps & Answer Slate. Some amethyst.
Williams Granite		Granite, microgranite, soda aplite.	Intrudes Soldiers Gap & Mary Kathleen Gps.
Basic intrusives		Dolerite and metadolerite.	Dykes and sills of pre- to post-metamorphic age.
Lunch Creek Gabbro	1500+	Gabbro, diorite.	Forms layered sill in Corella Fm, but intruded by Burstall Gr.

PORTAL* GROUP	White Blow Formation	915-1000	Siltstone, phyllite, shale, limestone.	Conformable and unconformable over Mary Kathleen Gp. Essentially unmineralized, but possibly equivalent to upper Mt Isa Gp.
	Deighton Quartzite	190-?700	Quartzite, siltstone.	
	Roxmere Quartzite	1000-2000+	Quartzite, calcareous siltstone.	
	Mount Philip Agglomerate	200+	Tuff, agglomerate, calcareous granofels.	Possibly highly altered & fractured Corella Fm.
	Corella Formation	1500+	Calcareous granofels, limestone, schist, quartzite, metabasalt.	Cu in limestone, pelite, & phyllite; some sulphide-bearing shale. Numerous radiometric anomalies or U deposits (e.g. Mary Kathleen). Pb-Zn (Dugald River). Scapolite-rich.
MARY KATHLEEN GROUP	Marimo Slate	2600+	Slate, siltstone, marl, sandstone.	Facies equivalent of Corella Fm. Stratabound Cu.
	Kuridala Formation	2400+	Quartzite, schist, slate.	Some Pb-Zn anomalies and prospects. Siltstone member contains some shallow water structures.
	Staveley Formation	600-2400+	Calcareous granofels, siltstone, shale.	
	Answer Slate	600?	Slate, siltstone, chert, schist.	
	Overhang Jaspilite	500+	Jaspilite, limestone, shale marl, siliceous breccia.	Contains barite & Mn; transitional into Mitakoodi Qzt.
	Ballara Quartzite	500-2000	Quartzite, conglomerate, limestone.	Unconformable on basement complex; partly equivalent to Mitakoodi Qzt.
MALBON GROUP	Mitakoodi Quartzite	2500+	Quartzite, siltstone, minor basalt	Minor Cu; conformable under Mary Kathleen Gp.
	Marraba Volcanics	1000-3000	Metabasalt, siltstone, limestone.	Cu associated with dolerite.
SOLDIERS CAP GROUP	Toole Creek Metavolcanics	5500+	Metabasalt, phyllite, chert, sandstone.	Widespread Cu, some scheelite. Some deposits stratabound others related to dolerite and granite. Overlain unconformably by Mary Kathleen Gp.
	Weatherly Creek Quartzite		Quartzite, siltstone, micaceous sandstone, metabasalt.	
	Snake Creek Metaturbidites		Schist, metagreywacke, metabasalt.	
	Wanga Granite (?)		Gneissic granite.	Surrounded by regional metamorphic aureoles in Corella Fm, but only seen to intrude Argylla Fm. May form basement ridge north of Mary Kathleen, but may possibly be younger.

BASEMENT INLIERS

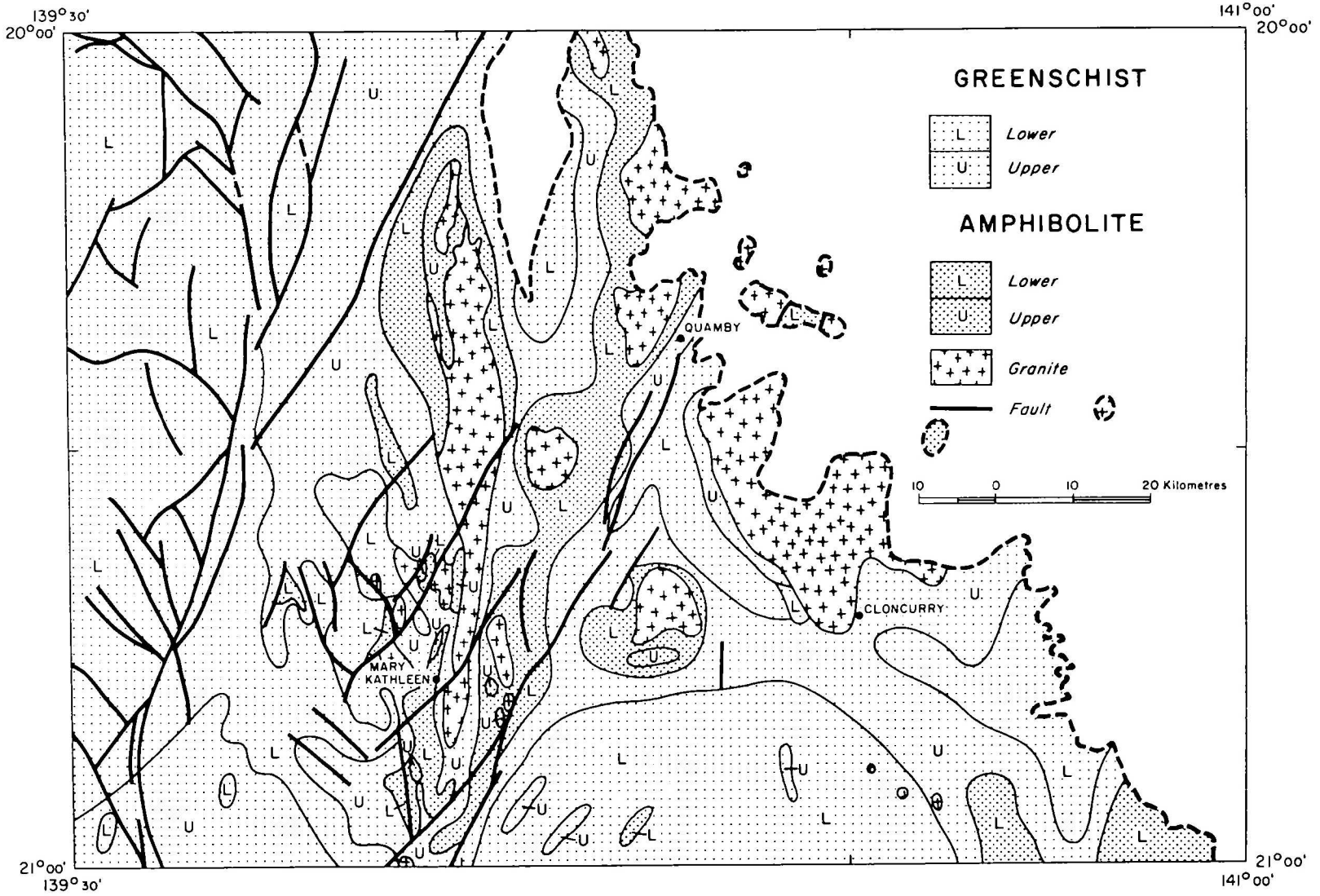
KALKADOON-LEICHHARDT BLOCK

Basic intrusives	Dolerite, metadolerite.	Some dykes possibly antedate Eastern and Western 'Geosynclines'.
Kalkadoon Granite	Granite, granodiorite.	Intrudes base of Tewinga Gp. & overlain by Haslingden Gp and Surprise Cr Beds.
Ewen Granite	Granite.	

TENNINGA GROUP	Argylla Formation	1000+	Rhyolite, dacite, quartzite, tuff.	Unconformity with Ballara Qzt. Favoured zone for Cu mineralization. Partly equivalent to base of Soldiers Gap Gp.
	Magna Lynn Metabasalt	up to 700	Metabasalt, quartzite.	Cu traces in flow tops.
	Leichhardt Metamorphics	4000+	Rhyolite, rhyodacite, schist, gneiss.	Cu related to basic dykes and flows.
BIG TOBY-YARINGA BLOCK				
	Big Toby Granite		Granite, biotite granite, granodiorite.	Formerly part of Sybella Gr, but isotopic age older. Intrudes Yaringa Metamorphics.
	Yaringa Metamorphics	1500+	Schist, gneiss, migmatite, prophyritic rhyolite.	Possibly equivalent to Murphy Metamorphics, or to parts of younger May Downs Gneiss.

After Plumb & Derrick (1973)

* nb this name is informal



CLONCURRY–METAMORPHIC FACIES

(Compiled by R. Hill)

FIGURE 3

later are designated Czr (bed and brown sand, silt, and clay) and Klo (Toolebuc Limestone - limestone and black shale) on Grimes's map. The Lower Cretaceous Toolebuc Limestone is present throughout most of the Eromanga Basin and the southern part of the Carpentaria Basin and is of interest for its hydrocarbon potential (Smart, 1972; Senior & Smart, 1973). Gamma-ray logs show an anomaly associated with Toolebuc Limestone (Smart, 1972).

Granites. The most widespread granites are the Kalkadoon, Wonga, and Naraku Granites. Brief descriptions are given in Table 1. The Kalkadoon Granite forms part of the basement 'welt' and the Wonga and Naraku Granites were emplaced after deposition of the enclosing sediments. There is some evidence (B. Duff, pers comm.) that parts of the Wonga and Naraku Granites are of anatectic origin.

Basic Intrusives. The Precambrian rocks are intruded by swarms of dolerite dykes, ranging from a few metres to 100 m or more in thickness. Inspection of aerial photographs indicates that in some areas the dolerites amount to about 15 percent of the rock volume. Basic plugs are also common. The presence of the basic rocks is of special importance because in many cases, base metal mineralization is associated with them.

Metamorphism

All of the Proterozoic sediments have been metamorphosed. Figure 3, compiled by R. Hill, shows the distribution of various facies in the area. About half the exposed rocks are metamorphosed to Lower Greenschist Facies, one-quarter to Upper Greenschist, and the rest to higher grades. There is little evidence of contact metamorphism associated with the younger granites. Contact metamorphic aureoles are either not evident or only 1-2 m across (B. Duff, pers comm.). Metamorphism plays an important part in the development of magnetic minerals in sediments, and hence can be expected to have relevance to the interpretation of the magnetic survey data (cf. McKirdy, Sumartojo, Tucker, & Gostin, 1974).

Structure

The present structure of the area is that of a north-trending basement ridge ('welt') with onlapping metasediments from pre-existing eastern and western geosynclines. The metasediments in the geosynclines have been folded about essentially north-south axes, and dips are usually near vertical. The rocks have also been extensively faulted and jointed. Major fault trends are northeast and northwest. In the extreme west of the area, the major faults trend east-west and have been referred to as 'spoon faults'. Faults have played an important part in localizing mineralization.

Economic geology

The area is of great importance as a mineral field. Major mines are the Mount Isa and Hilton mines (copper-lead-zinc) and the Mary Kathleen (uranium). Hundreds of small deposits of base metals, gold, or other minerals are known. Figure 6 shows copper and uranium occurrences in the area. Economic mineralization is discussed fully by Carter, Brooks & Walker (1961) and summarized in the light of recent knowledge by Plumb & Derrick (1973). It is mainly from these sources that the following information was derived.

Copper. Copper mineralization is widespread but usually occurs in very small, uneconomic deposits. Two main associations are recognized - basic igneous rocks and sedimentary associations. Disseminated copper sulphide is common in most of the tholeiitic basalts. However, economic deposits are known only in structurally suitable situations; for example black shales in contact with faulted lavas, faults and shears within basic igneous rocks, and breccia pipes. Copper can be associated with specific sedimentary beds, but again economic concentrations depend on proximity to favourable structures. Carbonate associations are common. Beds which often have associated base metals are indicated in Table 1.

Lead-Zinc. Control of lead-zinc mineralization appears to be mainly stratigraphic. Two examples are the Mount Isa and Hilton orebodies, which are located in the Urquhart Shale of the Mount Isa Group. Ores are finely laminated sulphides in carbonaceous and/or dolomitic shales.

Gold. Most of the gold deposits are small and were mined in the late 19th and early 20th centuries. Much of the gold was won from alluvial deposits, the primary sources of which are generally quartz reefs in structurally favourable situations. Most occurrences also show a stratigraphic control. Sulphides are commonly associated with the gold.

Uranium. The distribution of uranium occurrences in CLONCURRY is shown in Figure 6. The best known occurrence is at Mary Kathleen (Hughes & Munro, 1968). Brooks (1960), referring to the whole northwestern Queensland mineral province, stated, 'With few exceptions the uranium occurrences are confined to seven formations in the lower and middle divisions of the Lower Proterozoic. Over seventy percent of the deposits occur in two formations, the Eastern Creek Volcanics (51 percent) and the Corella Formation (22 percent)'. The restriction of most of the uranium deposits to two formations indicates the importance of stratigraphic control. Minor amounts of copper mineralization are commonly associated with the uranium, but it is unusual to find even minor amounts of uranium in the copper or other base metal deposits of the region (Brooks, 1960).

3. PREVIOUS GEOPHYSICAL SURVEYS

Radiometric surveys

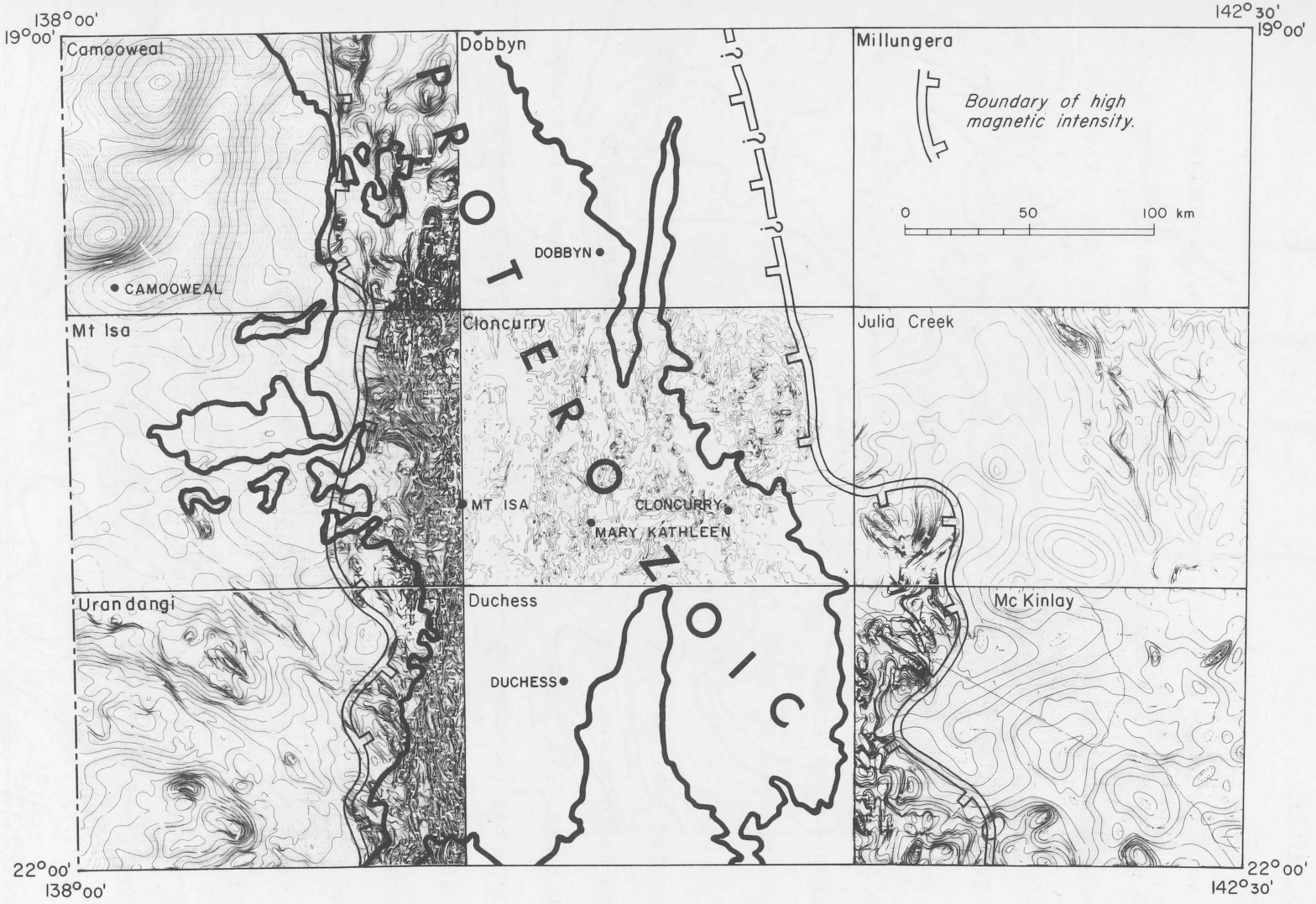
In 1954, following the discovery of the first uranium deposit, the 'Skal' in the Eastern Creek Volcanics near Mount Isa, extensive radiometric exploration for uranium in the Mount Isa/Cloncurry/Westmoreland area was undertaken by various prospectors, companies, and BMR. The work in the period 1954–60 led to the discovery of the important Mary Kathleen deposit in 1956, and other smaller deposits. In the period 1960–66 there was little activity,but in 1967 interest in uranium exploration revived and is still maintained. The history and results of uranium exploration up to 1971 are discussed by Brooks (1960, 1972).

The main target rocks for airborne and ground radiometric surveys have been the Eastern Creek Volcanics and the Corella Formation. Brooks (1972) indicates that nearly all the Lower Proterozoic rocks in a belt from Cloncurry to Westmoreland have been covered with airborne surveys by exploration companies. Most of the work in CLONCURRY has been with total-count instruments (Brooks, pers. comm.). Early surveys were based on the assumption that uranium was deposited in certain horizons in the Eastern Creek Volcanics during sedimentation. Although the surveys led to the discovery of various deposits it is now considered that the concept of syngenetic deposition is not substantiated (Brooks, 1960; R.M. Hill pers. comm.).

Previous airborne radiometric surveys by BMR in parts of CLONCURRY are described by Parkinson (1956), Mulder (1961a, b) and Lambourn & Shelley (1972). Company survey data are not available.

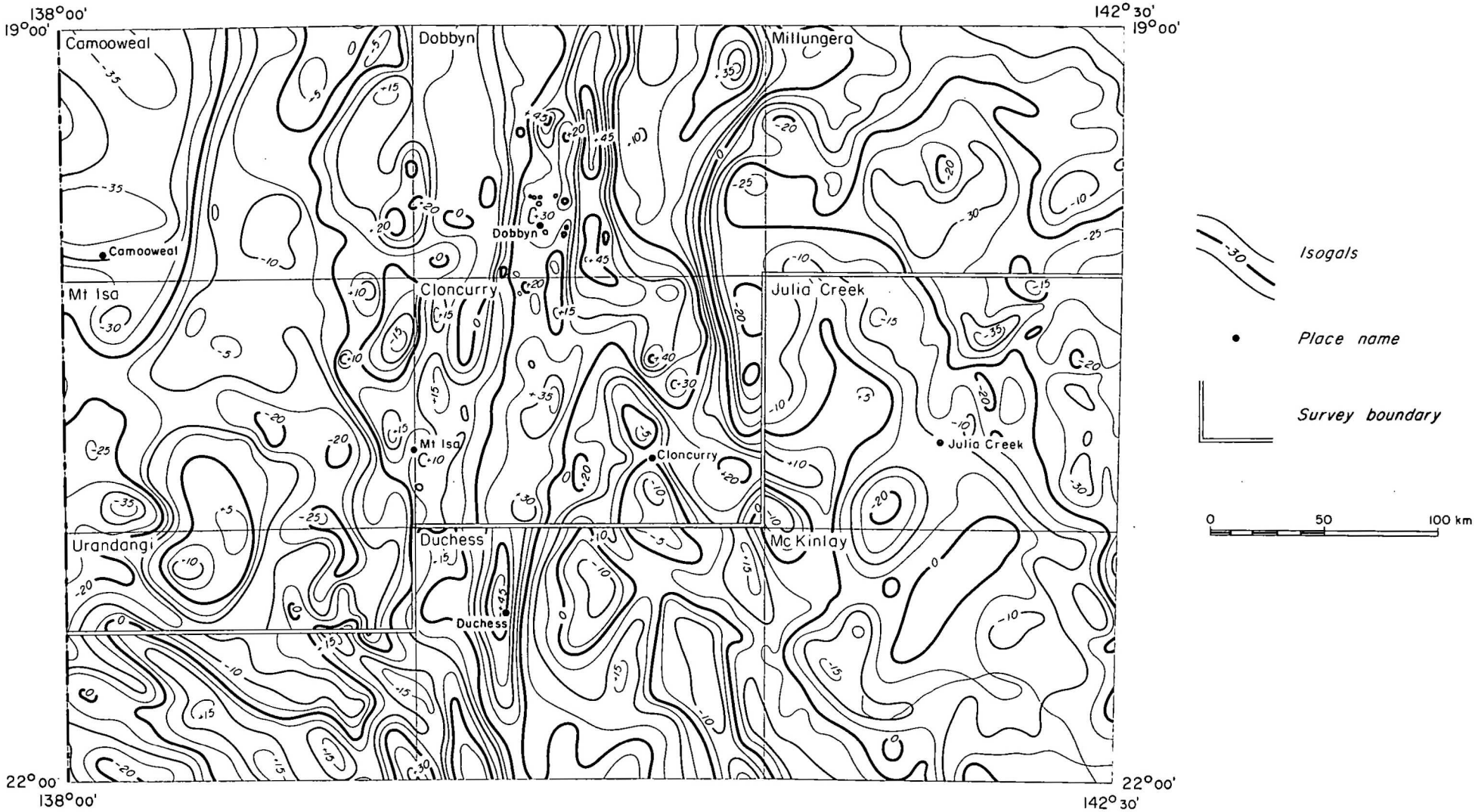
Aeromagnetic surveys

Regional airborne magnetic coverage by BMR is shown in Figure 4 as reductions of published 1:250 000 contour maps of total magnetic intensity. The contour interval for these maps is 50 gammas (=nanoteslas). For completeness a much simplified preliminary contour map of the latest



TOTAL MAGNETIC INTENSITY OF CLONCURRY AND FRINGE AREAS

FIGURE 4



BOUGUER ANOMALIES OF CLONCURRY AND FRINGE AREAS

FIGURE 5

CLONCURRY survey is shown with contour intervals of about 400 gammas. Strong shallow-source magnetic anomalies are found over most of the exposed Proterozoic rocks. These anomalies extend for considerable distances away from the outcrops, indicating the presence of magnetic rocks close to the surface under thin surficial deposits.

Previous detailed airborne magnetic surveys by BMR in or near CLONCURRY are described by Dockery & Tipper (1964, 1965) and Lambourn & Shelley (1972). Parts of the area have been flown by exploration companies, but their data are not available.

Ground metalliferous surveys

Mineral exploration companies have for many years been active in the CLONCURRY area. Most of this information is probably not available. Various sources are listed by Carter, Brooks & Walker (1961). BMR has conducted ground surveys in the adjacent to CLONCURRY and these have been listed by Gardener (1968) and Sampath (in prep.).

Regional gravity surveys

Figure 5 is a contour map of Bouguer anomalies over CLONCURRY and surrounding areas, acquired by helicopter gravity surveys on an 11-km grid (Darby & Vale, 1969). It shows a broad Bouguer anomaly high over the Proterozoic outcrop with highest culminations greater than (20 mGal) in a north-trending belt to the east of the basement 'welt'. Within this belt, the zones of highest amplitude appear to be predominantly due to a regional density increase of thick younger units, brought about by intense metamorphism, rather than to older rocks of the kind exposed in the basement welt, which have been subjected to a lower degree of metamorphism. For support of this hypothesis compare the geological map (Pl. 11), the metamorphic facies map (Fig.3), and the Bouguer anomaly map (Fig.6). Table 2 shows an estimation of density of the extensive Corella Formation based on the approximate percentages of minerals in the formations. It indicates that the Corella Formation has a substantially higher density than the suggested world average for metasediments (Smithson, 1971); this density is probably also higher than the average for rocks of the basement welt. In addition to the contribution to

the Bouguer anomaly highs attributed to regionally high density of such formations as the Corella Formation, it is also likely that a significant contribution is made by the basic intrusives, which constitute a few percent of the total rock volume, and by the considerable base metals minerals in the area. It appears that a mantle upwarp suggested by Glikson (1974) may not be necessary to explain the broad gravity high.

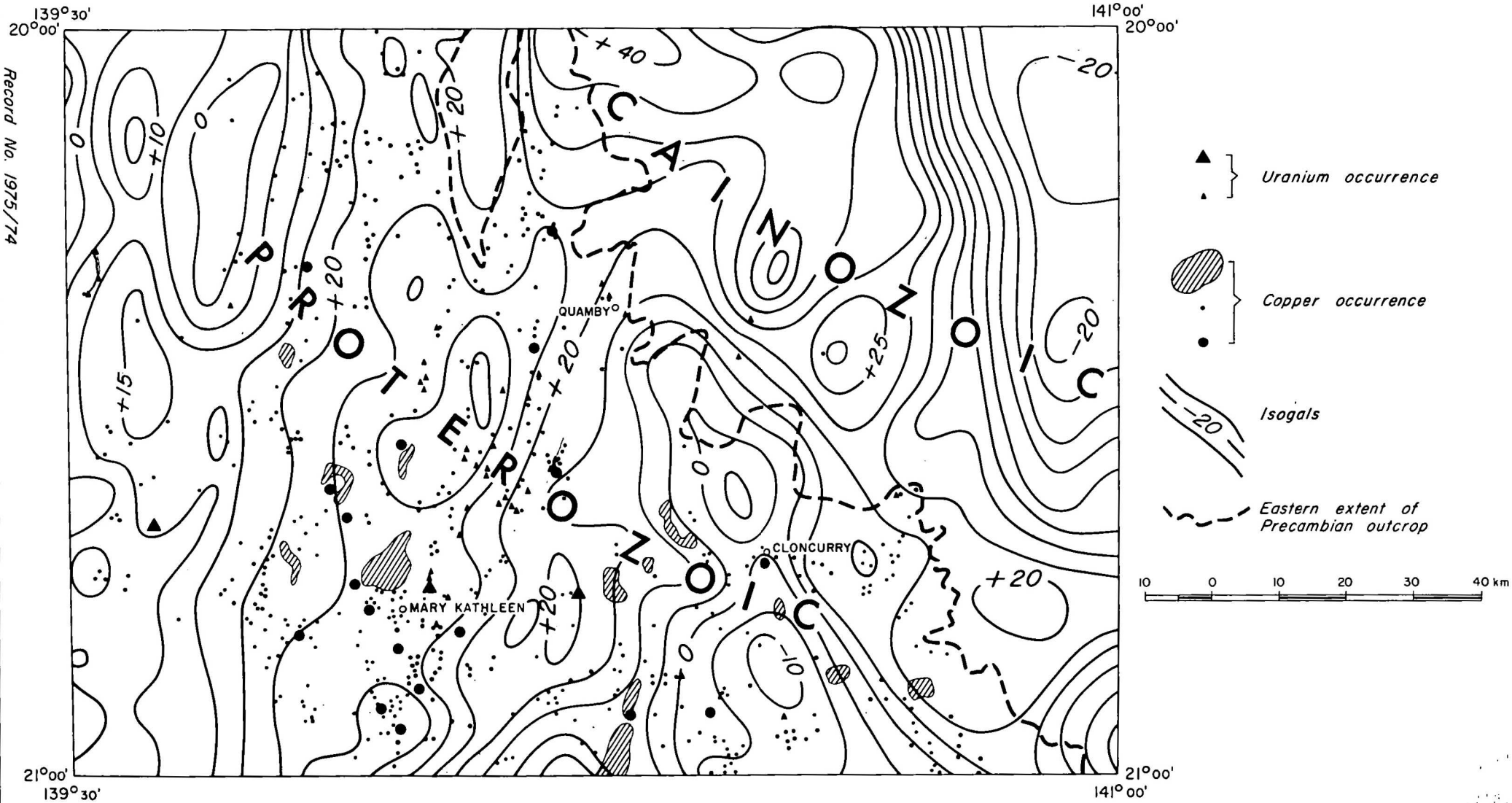
TABLE 2

Bulk density estimate of Corella Formation

Mineral	Percentage	Mineral specific gravity
Quartz	13	2.65
Feldspar	17	2.66
Calcite	15	2.71
Scapolite	10	2.70
Hornblende	20	3.20
Iron ores	3	5.5
Sphene	1	3.5
Epidote	1	3.6
Biotite	10	3.2
Garnet	1	4.0
Carbon	3	2.2
Porosity	2	0
Total	96	

Bulk Density Estimate (adjusted to 100%) = 2.89 g/cm^3
* percentages from I.Wilson (pers. comm.)

The Bouguer anomaly high zone associated with the Proterozoic rocks extends for a considerable distance into the area of Cainozoic cover, indicating the presence of dense rocks near the surface. This indicates the possible presence of rocks similar to those exposed in the area of the north-south high. The importance of this hypothesis in terms of exploration is made clear by reference to Figure 6, which shows numerous mines and prospects associated with the gravity high in the area of outcrop. Presumably a similar distribution of mineralization can be expected to be associated with the rocks that cause the gravity high in the area of Cainozoic cover.



BOUGUER ANOMALIES AND MINERAL OCCURRENCES IN THE CLONCURRY AREA

FIGURE 6

Record No. 1975/74

F54/BI-97A

Record No. 1975/74

■ *Place name*

Contour interval approximately 400 gammas.

10 0 10 20 30 km

PRELIMINARY TOTAL MAGNETIC INTENSITY CONTOURS — CLONCURRY

F54/B1-98A

FIGURE 7

4. MAGNETIC RESULTS AND INTERPRETATION

Presentation of data

The magnetic data has been presented in three forms: stacked profiles (Pl. 1), a preliminary contour map (Fig. 7), and an interpretation map (Fig. 8, Pl. 3).

Stacked profiles. These were produced at a horizontal scale of 1:250 000 by manual reduction of hand-smoothed original records onto idealized flight-lines. Because the horizontal reduction factor varied from line to line, depending on aircraft ground speed, the vertical scale on the profiles produced varies from line to line. On average the vertical scale is 1400 gammas/cm. These profiles, together with the flight path map (Plate 2) were released through the Australian Government Printer early in 1974.

Preliminary contour map. This was prepared from the stacked profiles by obtaining contour levels at about 400-gamma intervals above and below a profile base of 51 000 gammas. The map is necessarily approximate because of the method of preparation. It embodies amplitude and position inaccuracies inherent in the profile stack. Nevertheless it is a useful aid to interpretation and is presented at scales 1:2 500 000 (Fig. 4) and 1:750 000 (Fig. 7) for convenience of comparison with other figures.

Interpretation of data. For the area of Precambrian outcrop in CLONCURRY, where detailed geological maps are available, it must be appreciated that aeromagnetic surveying could not be expected to allow as detailed a geological subdivision of rock units as is already known. However, detailed geological maps allow reliable correlation of magnetic anomalies to be made with specific formations and thus provide good control for the interpretation of the geology beneath areas of Cainozoic cover. The approach adopted for interpretation of the magnetic data was to:

1. Identify and enumerate the main formations that cause the most prominent magnetic anomalies in the area of Precambrian outcrop.

2. Rock correlations of magnetic anomalies and Bouguer anomalies.

3. Attempt to identify the kind of magnetic basement beneath the areas of Cainzoic cover.

Depth estimates of magnetic bodies were made from magnetic anomalies amenable to reliable analysis. In the main, symmetrical anomalies over sources of considerable strike length were chosen. Two main depth interpretation methods were used: the half-maximum slope method of Peters (1949) and the curve-fitting method of Gay (1963). Gay's method is suitable for interpreting anomalies which are due to long tabular bodies.

Results

General features. Many of the Precambrian rocks have associated magnetic anomalies indicative of exposed or near-surface magnetic material. The magnetic pattern is dominated by linear anomalies of amplitude 500-2000 gammas with north or northeast trends. Many anomalies can be traced along strike of geological outcrop, or faults, for several tens of kilometres, and are indicative of long dipping tabular magnetic bodies. Anomalies are usually only partly resolved, which suggests multiple layering and sources close together.

The amplitude and slope of anomalies associated with various formations encountered on the east-west traverse which passes through Urquhart are illustrated in Figure 9.

The anomalies are of the kind expected over bodies that are inductively magnetized. The main sources of magnetic anomalies fall into three groups:

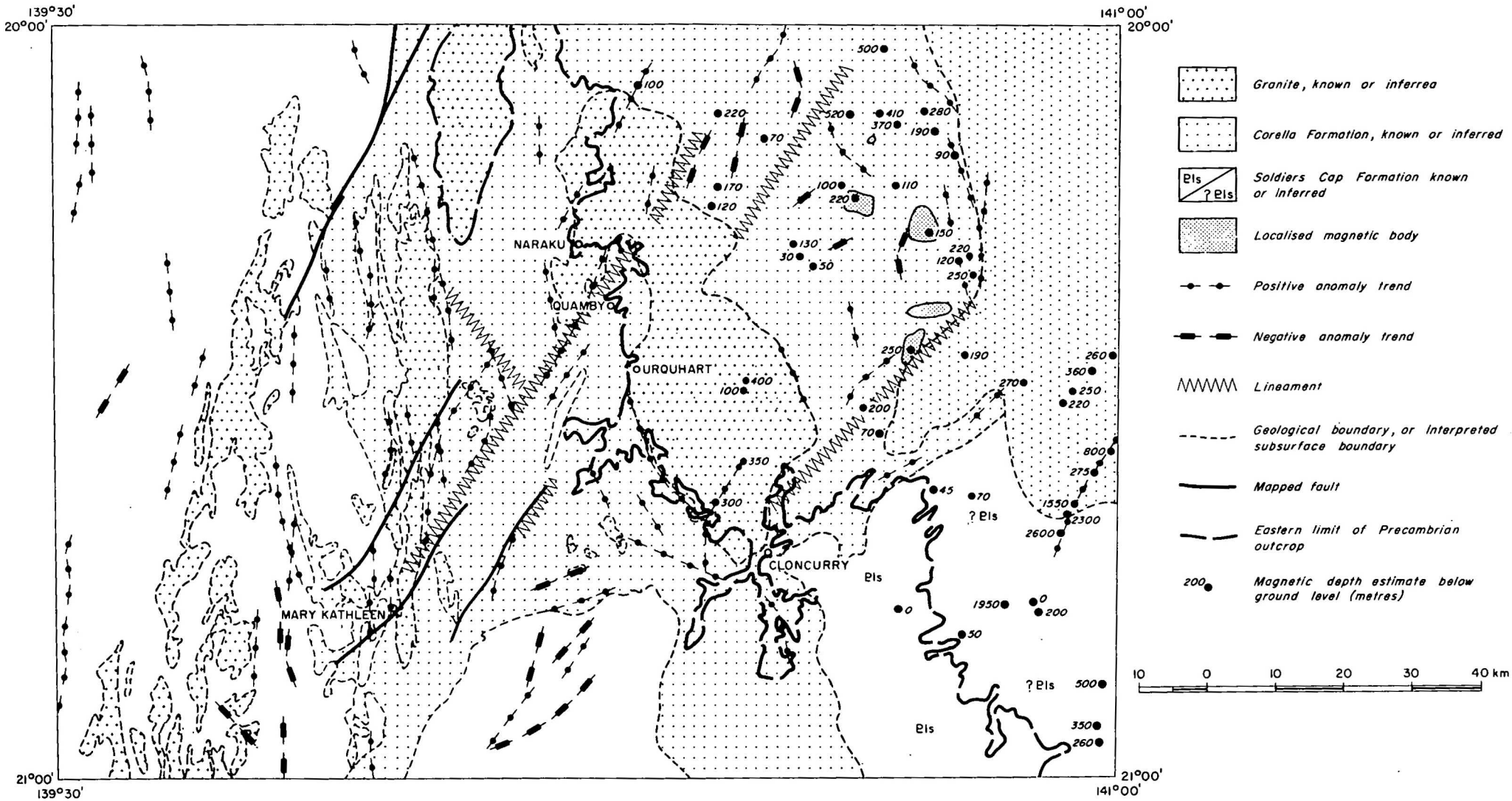
1. Metasediments and metavolcanics.

2. Basic intrusives

3. Rocks associated with faults.

Most of the granites have no magnetic response. Linear anomalies over granites may be caused by basic intrusives or in some cases remnants of enclosed magnetic country rocks.

Record No. 1975/74

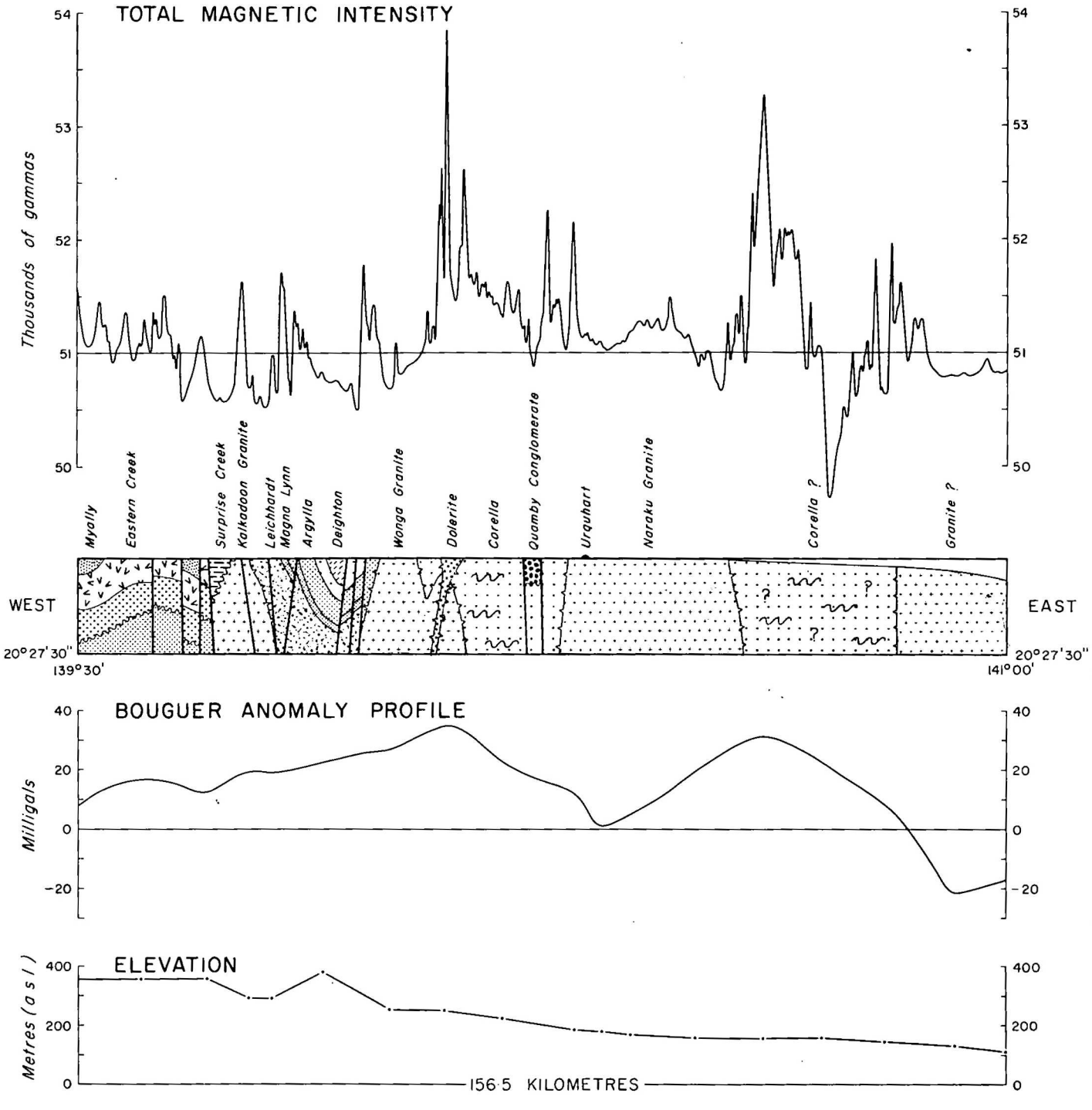


MAGNETIC INTERPRETATION — CLONCURRY

F54/BI-101A

FIGURE 8

FIGURE 9



GEOLOGICAL CROSS SECTION WITH GEOPHYSICAL RESPONSES

The magnetic pattern and amplitude of anomalies over most of the Cainozoic sediments in the east of CLONCURRY are similar to those over the Precambrian outcrop.

Metasediments and metavolcanics. Many of the metasediments and metavolcanics are magnetic and produce linear anomalies which can be traced for 20 km or more parallel to strike. The most prominent anomaly trends are shown in Plate 3. Interpretation indicates that the sources of these anomalies are magnetic beds 100–500 m thick, interlayered with wider zones of weakly magnetic material. The magnetic beds themselves may be multi-layered and consist of alternate layers of strongly magnetic and weakly magnetic rock.

Magnetic depth estimates lie in the range 0–100 m below surface in regions of Precambrian rock outcrop, and indicate the depth to which the magnetic minerals are destroyed by weathering. Thus it need not be expected that the bodies causing the magnetic anomalies will necessarily be magnetic at the surface. This is important in the areas of Cainozoic cover, where magnetic depth estimates given indicate the maximum depth to basement.

It can be expected that the magnetic beds contain from 1 to 5 percent magnetite, or perhaps more rarely pyrrhotite, which causes the anomalies. The main formations which contain magnetic beds, and the amplitude of anomalies recorded over them, are listed in Table 3.

TABLE 3

Magnetic Metasedimentary and Metavolcanic Formation

Formation	Anomaly amplitude range (gammas)
Corella Formation	500 - 3000
Marimo Slate	500 - 1000
Overhang Jaspilite	200 - 500
Eastern Creek Volcanics (basic)	200 - 500
Marraba Volcanics (basic)	200 - 500
Argylla Formation	500 - 2000
Magna Lynn Basalt	500 - 1500
Leichhardt Metamorphics	500 - 1000

There appears to be an association between the amplitude of anomalies due to sediments and the grade of metamorphism (compare Figs. 3 and 7). Broadly speaking, high-amplitude anomalies were recorded over zones of highest metamorphic grade. For example, only weak anomalies were recorded over the Lower Greenschist Facies rocks, whereas high-amplitude anomalies were recorded over rocks of Upper Greenschist or higher facies. This is strong evidence of metamorphic production (or concentration) or magnetic minerals in metamorphic rocks, even allowing for an anomaly association enhanced to some degree by rock types. A similar association has been observed in South Australia (McKirdy et al., 1974).

The amplitude of anomalies over the metasediments is generally highest close to the boundary with the younger granites, e.g. Wonga Granite and Naraku Granite. In places there are regions about 500 m to 1000 m wide in which anomalies indicative of dolerite and magnetic beds appear to be well developed. Such regions generally lie well inside zones of high-grade metamorphism. The close proximity of strong magnetic anomalies to the granites may indicate the existence of a zone of contact metamorphism. The presence of extensive contact metamorphism around the granites has not been observed to date (B.Duff, pers. comm.). It is possible, however, that the development of magnetic minerals may be a more sensitive metamorphic indicator than are other mineral assemblages. Field work near the northern end of the Wonga Granite is planned to investigate this problem (D. Ellis, pers. comm.).

Negative magnetic anomalies were recorded over the Marraba Volcanics in the eastern limb of a synclinal fold structure 20 km northwest of Marraba. On the adjacent limb, where rocks dip southeast, the anomalies are positive. It appears that the Marraba Volcanics may have a component of remanent magnetization which was acquired before folding.

Basic intrusives. Swarms of dolerite dykes and plugs occur throughout most of CLONCURRY. Some of the dykes are as thin as a few metres, others are up to 200 m across. Many of the magnetic anomalies recorded by

the survey are due to these. Anomalies attributed to the dykes, or suites of closely spaced dykes, generally have amplitudes in the range 100–1000 gammas. It is likely that most dolerites are magnetic, but the amplitudes of anomalies recorded over them vary from place to place along strike, indicating changes in magnetic mineral content or in thickness of the bodies. Many mapped dykes did not produce a resolvable anomaly, possibly because they are too thin or alternatively because anomalies due to adjacent magnetic material mask their effect. A good example of the masking effect is provided by the Lake View Dolerite Dyke, which is up to 50 m thick and strikes northeast for 30 km to the east of Mary Kathleen. A susceptibility measurement of 4900 x 10^{-6} cgs units was made on a single surface rock sample. With this susceptibility and the observed thickness, the dykes could be expected to produce an aeromagnetic anomaly amplitude of about 100 gammas. Examination of the flight charts revealed that although anomalies of approximately this amplitude lie over the dyke, they are in many places partly masked by adjacent anomalies of several hundred gammas. However, ground magnetic work at one locality showed that the dyke produced a distinct anomaly (Sampath, in prep.).

Anomalies of up to 5000 gammas in amplitude were recorded around a small area of granites 10 km southeast of Mount Maggie near the centre of CLONCURRY. These anomalies may be due to magnetic beds in the Corella Formation, which encloses the granites, or they may be partly due to the large dolerite bodies which crop out in the locality. For confirmation compare Plate 1 with Plate 11. Dolerite plugs near Cloncurry also have high-amplitude magnetic anomalies associated with them.

Rocks associated with faults. Prominent linear magnetic anomalies 500–2000 gammas in amplitude were recorded over or very near many of the faults on CLONCURRY. The most easily traced features are those which trend northeast or northwest and cut across strike. Good examples are the Mount Remarkable Fault, Cameron Fault, and Corella Fault, all of which trend north-east. Detailed analysis of selected anomalies indicated that a

faultstep model was usually inappropriate but that a dipping tabular body model was acceptable. It therefore appears likely that strongly magnetic material lies in or close to the fault planes. This is not an unexpected result, because basic rocks intrude many of the faults in the area. However, geological field work has not shown that the major faults contain long basic intrusions (R.M. Hill, pers. comm.). Nevertheless, from the magnetic data it is likely that many faults contain unrecognized magnetic material, possibly basic rocks, or other concentrations of magnetic minerals.

Lineaments. The lineaments shown on Plate 3 and Figure 8 represent an alignment of features evident in the overall pattern of magnetic anomalies. These features include linear magnetic anomalies, linear zones of low magnetic relief, and terminations and displacements of cross-cutting magnetic anomalies, and are of the kind commonly associated with faults or elongate zones of jointing. One lineament closely parallels the Cameron Fault (Pl. 11). This lineament extends for 70 km in a northeast direction across outcrops of various Precambrian lithologies, and can be traced into the region of Cainozoic cover. This and the other lineaments shown on the map are interpreted as cross-cutting faults, which do not necessarily have large displacements.

Basement under cainozoic cover. The shapes, amplitudes (500-2000 gammas), and trend directions (mainly north-south) of anomalies in most of the area of Cainozic cover in the east of CLONCURRY are similar to the anomalies recorded over the Precambrian outcrop. Selected anomalies were interpreted for maximum depth to magnetic sources. In much of the area these depths are in the range 100-200 m. It therefore appears that much of the area is underlain by Precambrian rocks at shallow depth beneath the Cainozoic cover (Pl. 3). This region is divided into areas 1 to 6 for discussion in terms of geology.

Areas 1 and 2. These areas are probably underlain by Naraku Granite. The extent of the granite established by geological mapping is only a part of its probable near-surface extent.

The eastern boundary of Areas 1 and 2 and hence the granite, was

established by the consideration of the Bouguer gravity low in addition to the magnetic pattern. The lines of magnetic anomalies in the east are probably due to magnetic beds in metasediments; the first of these was used to define the limit of the granite. In Area 2 the magnetic pattern over the granite is virtually flat, except for a few north-northeast trending anomalies of low amplitude (100-200 gammas). These trends probably delineate dolerite dykes. In Area 1, linear magnetic anomalies over outcropping granite trend north-northeast. These trends are attributed to dolerite dykes or possibly remnants of metasedimentary beds in the granite. The eastern boundary of this area is delineated by lines of stronger magnetic anomalies which are probably due to magnetic beds in fringing metasediments.

On the basis of the Bouguer anomaly contours, the northern part of the proposed granite is different from the south in that the north lies in an area of Bouguer anomaly high whereas the south is in a prominent low. The significance of this difference is not fully understood. It may indicate greater depth extent in the south than in the north, perhaps a higher content of basic intrusives in the north, or different densities of granites in the two areas.

Areas 3 and 4. The Bouguer anomaly low, quiet magnetic response, and drill-hole data provide evidence that the basement in the northeast of CLONCURRY and in JULIA CREEK (Vine, 1964) consists of granite. The western boundary of Area 3 is largely delineated by the lines of magnetic anomalies attributed to metasedimentary sources. In the south the limit was taken from Bouguer anomaly contours.

A linear anomaly in the far south of the granite is probably due to a body deep below the basement surface. The body deepens from 800 m near the edge of the Sheet to 2600 m in a southwesterly direction. Drillholes indicate the Precambrian basement surface is between 100 and 300 m below the ground level in this locality. The extension of the interpreted large mass of granite southwest of Mount Margaret (Area 4) was made on the basis of the gravity low in the area, and its enclosure

of the granite at Mount Margaret. However, because Mount Margaret itself lies in an area of magnetic disturbance, possibly due to metasediments, it must not be overlooked that the granite outcrop might be an isolated small intrusion, and that the Bouguer anomaly low is caused by a larger body of granite at depth.

Area 5. The magnetic anomalies in this area have similar characteristics to those observed over the exposed Corella Formation to the west. In addition the area has an associated Bouguer anomaly high, which extends from the area of Precambrian outcrop (Fig. 6). It is considered that in Area 5 the basement consists predominantly of metasediments, probably Corella Formation and dolerite dykes.

The basement probably contains large intrusive basic bodies, or ironstone; five prominent bodies are indicated as localized magnetic bodies in Figure 8 and Plate 3. These have anomalies of up to 8000 gammas amplitude, considerably higher than the amplitude of anomalies due to metasedimentary beds within the Precambrian outcrop area in CLONCURRY. Ironstones in the Stavely Formation in DUCHESS are known to be strongly magnetic (G.A. Young, pers. comm.); possibly the strong anomalies indicate the local presence of this formation.

Magnetic depth estimates made from selected magnetic anomalies are generally in the range 50–300 m below ground level. These depth estimates are slightly larger than water-bore basement depths. Because a full depth analysis has not been made, no attempt has been made to draw depth-to-basement contours.

Area 6. The area in the southeastern corner of CLONCURRY is only moderately disturbed. The anomaly pattern recorded is similar to that over the exposed Soldiers Cap Formation immediately to the west. Depth-to-basement estimates range between 0–500m; basement depths indicated by drilling are mostly in the range 50–200 m.

Area 7. This area is blanketed by Cainozoic sediments and surrounded by Corella Formation. The area is magnetically quiet, although on the

flight charts low-amplitude anomalies (10-20 gammas) from the near-surface sources, possibly laterites in the Cainozoic sediments, were recorded. A Bouguer anomaly low of 5 milligals which lies over the area is considered unlikely to be due to the Cainozoic sediments. Rather it is likely that Area 7 is underlain by granite at shallow depth, probably less than 200 m.

Detailed survey of Prospector 1:100 000 Sheet area

Stacked profiles of total magnetic intensity are shown in Plate 7 at an approximate vertical scale of 1400 gammas/cm. The flight-lines are shown in Plate 10.

The data have not been fully analysed, but it is considered that the detailed survey did not produce information of significantly greater use than that obtained by the CLONCURRY regional survey. Nevertheless, because of the more detailed coverage of the survey, it may be possible to correlate more precisely anomalies with mapped formations when the Prospector geological sheet becomes available. A preliminary analysis of the data has not resulted in the identification of any localized magnetic bodies which were not located by the mapping.

5. RADIOMETRIC RESULTS AND INTERPRETATION

Data acquisition

Details of the spectrometer system are included in Appendix 1. The aircraft's altitude above ground level was not recorded because the radio altimeter was out of order. This deficiency necessarily limits the scope of the interpretation of the spectrometer data, but as will be seen later, useful information was produced by the survey.

Measurements of non-geological background radioactivity were made by recording the level of radioactivity at 600 m above ground level for approximately 4 minutes. In the following text this value will be referred to as 'background'.

Presentation

The radiometric data have been presented in three forms: total-count stacked profiles (Pl. 4), a contour map of total count (Pl. 5), and an interpretation map (Pl. 6).

Total-count radiometric profiles. These profiles were produced at a horizontal scale of 1:250 000, by manual reduction of hand-smoothed original records. During this process background was removed. The horizontal reduction factor varied from line to line in proportion to the aircraft's ground speed. Accordingly the vertical scale on the profiles varies from line to line. On average it is 330 counts/s/cm.

Contour map. This was prepared from the profile stack by obtaining contour levels at approximately 65-counts/s intervals. The map includes amplitude and position errors inherent in the profiles.

Interpretation map. This shows the positions of selected anomalies and indicates their interpreted source of the radioactivity. Each anomaly has a reference number derived from the fiducial number and flight-line number; e.g. 862/1670 refers to fiducial 862 on line 1670. Details of each anomaly shown on the map are listed in Appendix 2.

Interpretation

A study of the four-channel radiometric profiles, together with BMR geological maps and topographic maps, enabled anomalies to be selected for detailed analysis. The selection was made on the basis of local increases in total-count rate and/or anomalous distribution of count rates between channels 2, 3, and 4. In practice, a lower limit of about 100 counts/s (in total-count) above background was used in anomaly selection.

The lack of a radio-altimeter calls for considerable discretion in interpretation procedures to avoid placing undue emphasis on anomalies caused by altitude variations over hills and valleys. In CLONCURRY, many of the most prominent radiometric highs are associated with ridges. Such anomalies could not be corrected for topographic effects in the absence of a record of ground clearance. Nevertheless, such anomalies were analysed and included in the interpretation map, because they give information on the composition of the underlying rocks. Support for this approach is given in Appendix 3, which summarizes the results of ground follow-up studies made during the survey.

The method of interpretation adopted was designed to give information on:

1. Total-count anomalies greater than 200 counts/s above background - the main anomalies evident in the stacked profiles.
2. Radiometric response of particular rock units, including those with total-count anomalies as low as 100 counts/s above background.
3. Anomalies of special interest because of their indications of the presence of uranium or thorium.

The count rate above background in each channel was determined for all anomalies selected for investigation. These were then analysed by means of percentage sum diagrams (Figs. 10 to 15). Each point on these diagrams was calculated by summing the counts in channels 2, 3, and 4 and then expressing the counts in each of these channels as a percentage of the sum.

The source of each anomaly was then determined as one of the following:

(1) Predominantly due to potassium

(2) Predominantly due to uranium

(3) Predominantly due to thorium

(4) Mixed potassium and uranium

(5) Mixed, with no component particularly dominant.

The divisions within the triangular diagram (Fig. 10) are based on airborne measurements over known sources and on theoretical considerations. A full analysis of the radiometric data requires knowledge of the terrain clearance and the Compton scattering coefficients. This procedure will be discussed by Horsfall & Wilkes (in prep.).

On the interpretation map, channel 3/channel 4 ratios are shown alongside plotted anomalies where this ratio exceeds 3. Such ratios are regarded as indicating that a source has a uranium contribution which warrants further investigation. It is not to be implied, however, that a lower ratio indicates that an anomaly is not of interest.

RESULTS

Figure 11 presents the source distribution of all anomalies analysed in the CLONCURRY area. It shows that most anomalies fall in the 'potassium' classification. Only two anomalies fall in the 'thorium' classification.

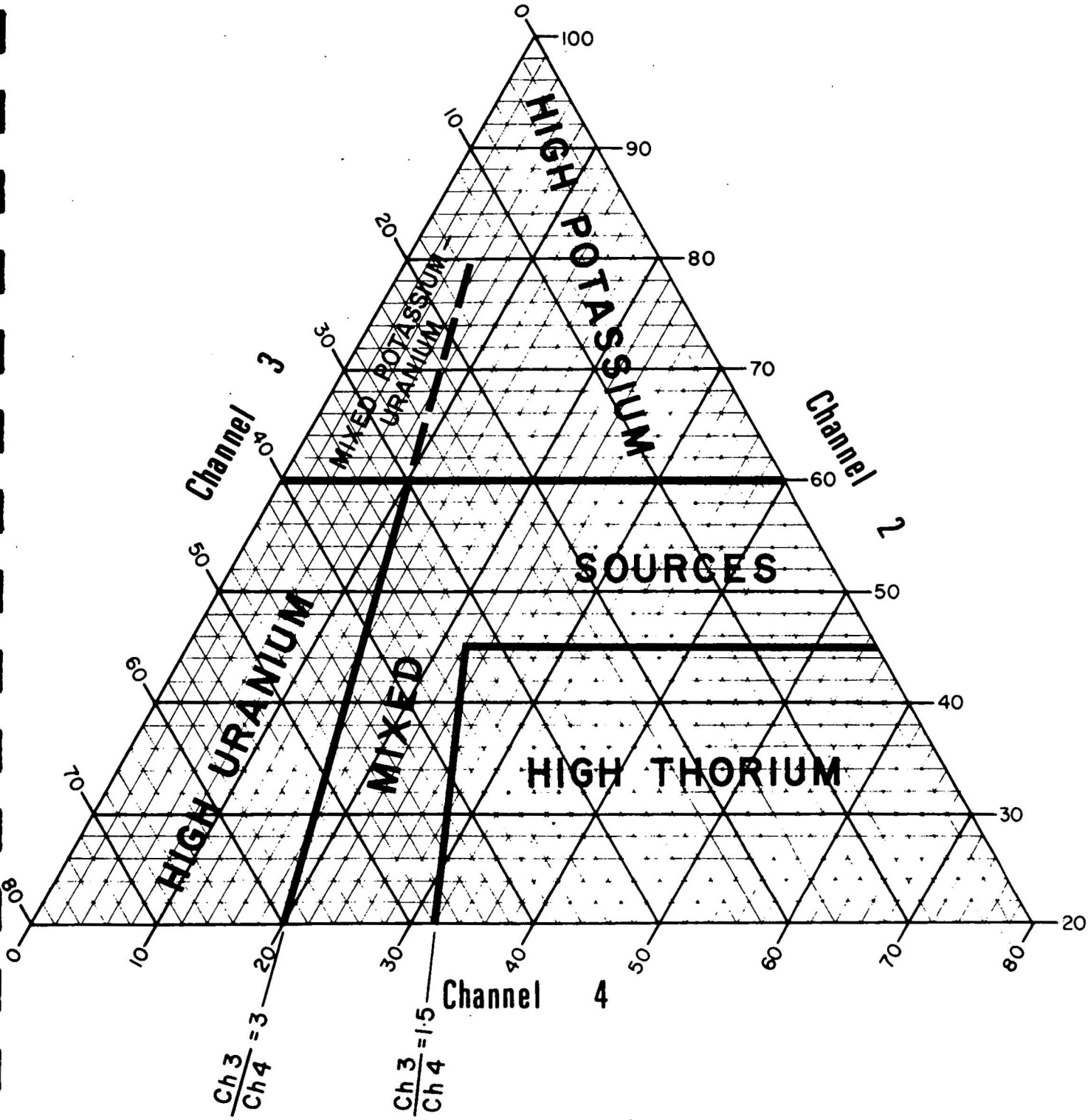
Known uranium occurrences.

Thirty-three uranium occurrences are known in CLONCURRY. During routine survey flying, anomalies were recorded from 13 of them; details of source responses are shown in Table 4 and Figure 12. The distance of the nearest flight-line to each detailed uranium occurrence is included in Table 4.

If we assume that the anomalies presented in Figure 12 are associated with the known mineralization, their characteristics should be a useful guide in the recognition of other important anomalies. In this

FIGURE 10

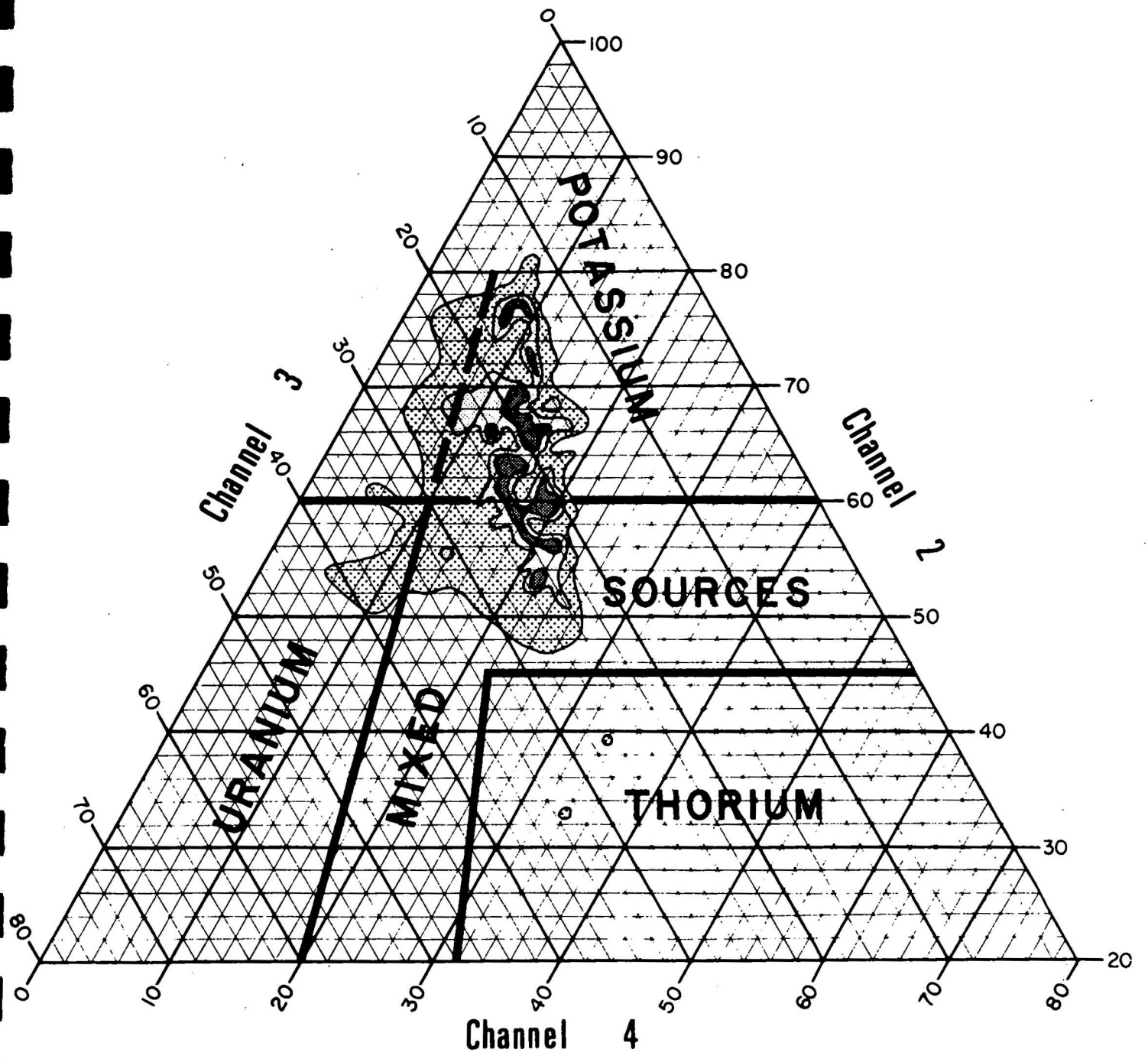
PERCENTAGE SUM DIAGRAM



$$\% \text{ Ch } 2 = \frac{\text{Ch } 2 \times 100}{\text{Ch } 2 + \text{Ch } 3 + \text{Ch } 4}$$

FIGURE 11

PERCENTAGE SUM DIAGRAM

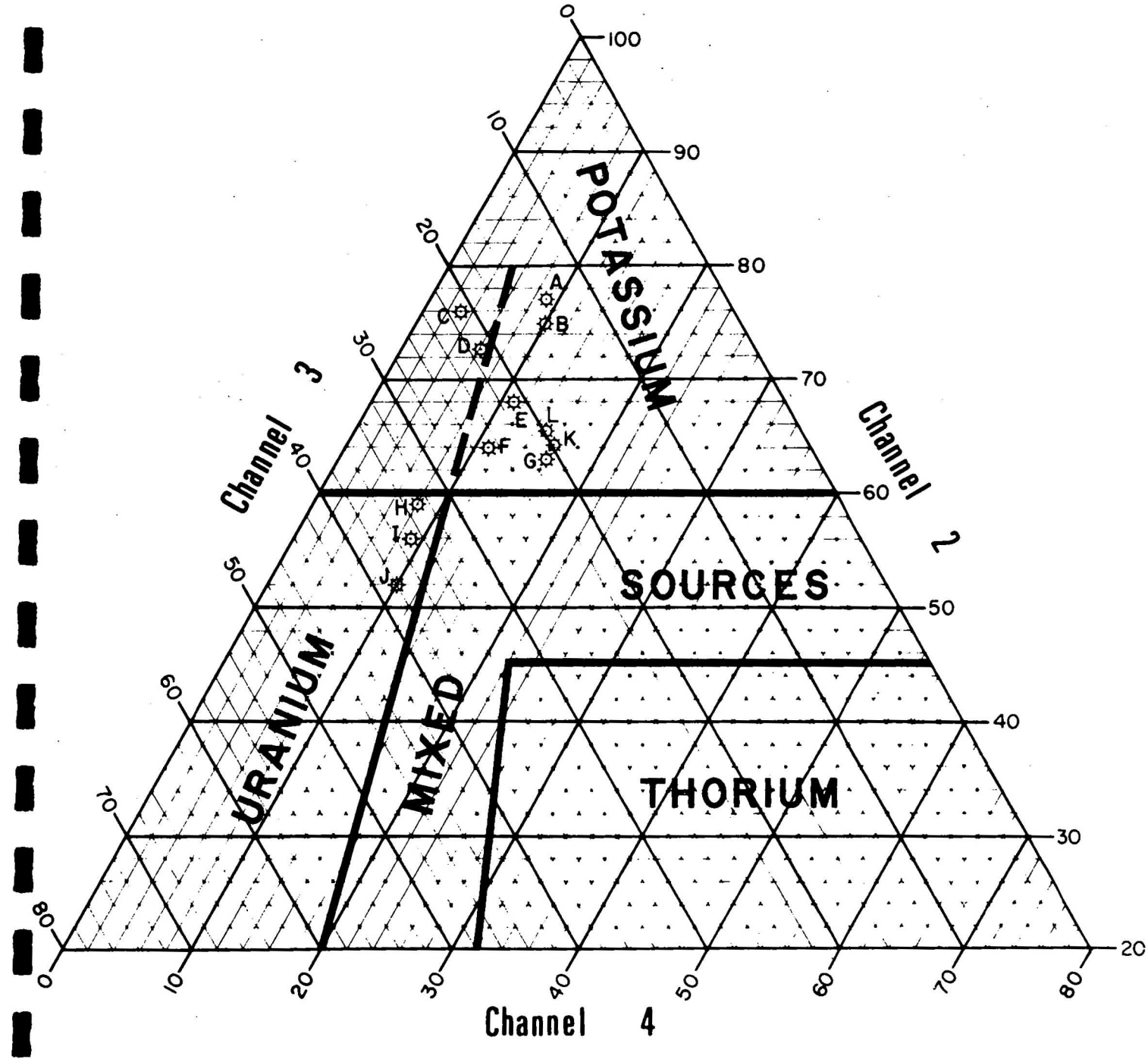


RADIOMETRIC ANOMALY SOURCE DISTRIBUTION

High density Medium density Low density

FIGURE 12

PERCENTAGE SUM DIAGRAM



ANOMALIES NEAR KNOWN URANIUM PROSPECTS

A – *Helafels*
B – *Unnumbered*
C – *Embla Ridge*
D – *456*
E – *Milo*
F – *Unnumbered*
G – *320*
H – *Mary Kathleen-open cut*
I – *Mary Kathleen works*
J – *Copper Canyon*
K – *463*
M – *467*

Numbers and names are those shown on preliminary 1:100 000 geological maps Mary Kathleen, Marraba and Cloncurry.

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TABLE 4 RADIOMETRIC ANOMALIES NEAR KNOWN URANIUM OCCURRENCES

NAME	Registered Number	Nearest Line	Fiducial (Corrected)	Distance From Line (metres)	Anomaly Detected	ANOMALY Ch2+ Ch3+ Ch4	ANOMALY % Ch2	ANOMALY % Ch3	ANOMALY % Ch4	ANOMALY Ch3/ Ch4	GEOLOGICAL BACKGROUND Ch2+ Ch3+ Ch4	GEOLOGICAL BACKGROUND % Ch2	GEOLOGICAL BACKGROUND % Ch3	GEOLOGICAL BACKGROUND % Ch4	GEOLOGICAL BACKGROUND Ch3/ Ch4	Comments
Six Kangaroos	420	1440	1396	600 S	--	79	70	15	15	1	42	71	12	17	1	100% increase in all channels. T.
Comfort	422	1450	1945	250 S	--				----------		37	68	16	16	1	G.B.
Deep Bend	411	1450	1955	600 N	--				----------		(42	71	17	12	1	G.B.
Rosie B	412	1450	1955	250 N	--						(					G.B.
Huxy	414	1460	2342	200 N	--				----------		44	68	18	14	1	G.B.
Clear Waters	444	1460	2346	750 S	--				----------		44	68	18	14	1	G.B.
Dodgeleane (Group of prospects)	432	(1460	2380	100 S	--						(					G.B.
		(1460	2380	500 S	--				----------		(56	62	27	11	2	G.B.
		(1460	2379	1000 S	--						(					G.B.
	442	1470	407	400 N	--				----------		43	70	16	14	1	(G.B.
Mount Harold	443	1470	407	400 S	--											(
	463	1490	1367	750 N	K	70	64	20	16	1	41	61	24	15	2	50-100% increase all channels. T.
	unnumbered	1490	1358	250 S	K	60	75	15	10	2	40	62	23	15	2	100% increase Ch2.
Manakoff	102	1490	1529	750 N	--				----------		35	72	17	11	2	G.B.
	unnumbered	1500	1884	on line	K	71	64	25	11	2	54	74	15	11	1	80% increase Ch3. Maybe G.B.
	456	1500	1896	700 SW	K,U	68	73	21	6	4	39	77	15	8	2	100% increase Ch3. High Ch3/Ch4
	461	1500	1884	750 S	--				----------		54	74	15	11	1	G.B.
	467	1510	2308	800 N	K	92	65	20	15	1	50	60	20	20	1	40-100% increase all channels. T.
	unnumbered	1520	1336	250 S	--				----------		23	65	22	13	1	G.B.
	473	1530	1040	500 S	--				----------		45	67	18	15	1	G.B.
Mary Kathleen Tailings Dam	-	1560	2335	on line	U?	529+	70-	16+	14-	1+	52	58	23	19	1	(Charts offscale. Test flights
" "	-	1570	410	on line	U?	431+	68-	20+	12+	2+	48	62	21	17	1	(indicate high Ch3/Ch4 ratios - Uranium (anomalies
	489	1570	414	250 S	--				----------		48	62	21	17	1	G.B.
Mary Kathleen Works	-	1580	1017	on line	U	207	56	35	9	4	49	61	25	14	2	Easily detected Uranium anomaly
	491	1580	1015	300 N	--	74	61	27	12	2	49	61	25	14	2	Masked by 1017/1580
Mary Kathleen Open Cut		Flight 078	123	on line	U	439	59	33	8	4	45	67	22	11	2	Easily detected Uranium anomaly
	493	1590	1382	400 N	--				----------		47	64	21	15	1	G.B.
Milo	310	1590	1443	500 S	K	155	68	21	11	2	53	66	23	11	2	(200% increase all channels. (High potassium % C.f G.B., T.
	320	1602	1760	500 N	K	120	63	21	16	1	47	64	21	15	1	(200% increase all channels (High potassium % C.f G.B., T.
	332	1630	960	500 N	--						47	64	21	15	1	G.B.
Embla Ridge	160	1680	1394	300 N	K,U	159	76	21	3	7	87	80	14	6	2	(100% increase Ch2, 200% increase Ch3 (Uranium Potassium mixed source
Copper Canyon	45	1710	545	600 S	U	96	52	38	10	4	84	71	17	12	1	Easily detected Uranium anomaly
Helafels	216	1740	872	on line	K	111	77	14	9	2	72	70	16	14	1	30% increase ch2

G. B. means that geological background conditions prevail.
T. means that the anomaly recorded may be due to topography.
Distances from line to occurrences ± 200 m

respect most weight should be given to data for sources directly overflown and less to those where the flight-line was offset from the known mineralization. On this basis, the five anomalies A, B, F, G, and I are the most significant. Two of these are for Mary Kathleen and, as expected, indicate a uranium source. The other three indicate potassium sources. The reason for this is not known, but it may be due to a concentration of potassium-rich rocks and/or disequilibrium of uranium with its daughter products.

Granites

The main granites in the area are the Wonga Granite, the Naraku Granite, and the Kalkadoon Granite. Anomalies recorded over these are plotted on a percentage sum diagram shown in Figure 13. Few large anomalies were recorded over the Kalkadoon Granite; therefore, to determine its radioactive source characteristics, geological background count rates as well as data from the obvious anomalies were plotted in Figure 13.

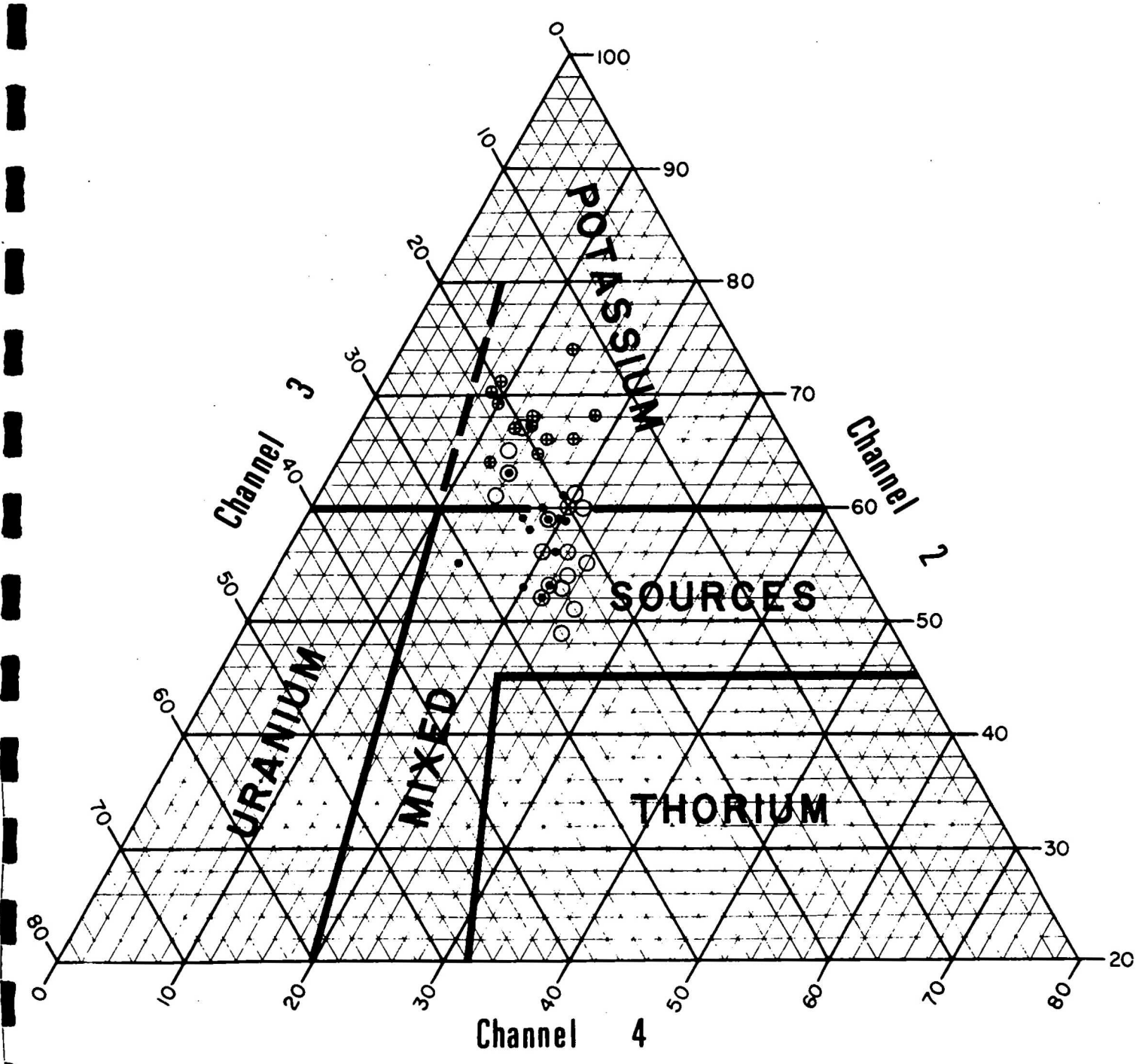
Broadly speaking, the Wonga and Naraku Granites are similar in terms of the gamma radiation recorded; anomalies fall mainly in the 'mixed source' region but a few points from each granite fall in the high-potassium region. The tighter grouping of points for the Wonga Granite possibly indicates that this granite is slightly more homogeneous than the Naraku in terms of radioactive mineral content. The generally low count rates and the high-potassim characteristic of the Kalkadoon Granite differentiates it from the Wonga and Naraku Granites.

In the area of Cainozoic sediments and scattered granite outcrops in eastern CLONCURRY, two thorium anomalies were recognized. If these anomalies, 1788/1450 and 2515/1460, are caused by the granite then the granite differs from the Wonga and Naraku Granites.

Metasediments

The source characteristics of the anomalies over six main geological units are shown in Figure 14 and are discussed below. Nearly all of the anomalies indicate that sources lie in the 'potassium' classification. This is in contrast to the response of granites, which, with the

PERCENTAGE SUM DIAGRAM

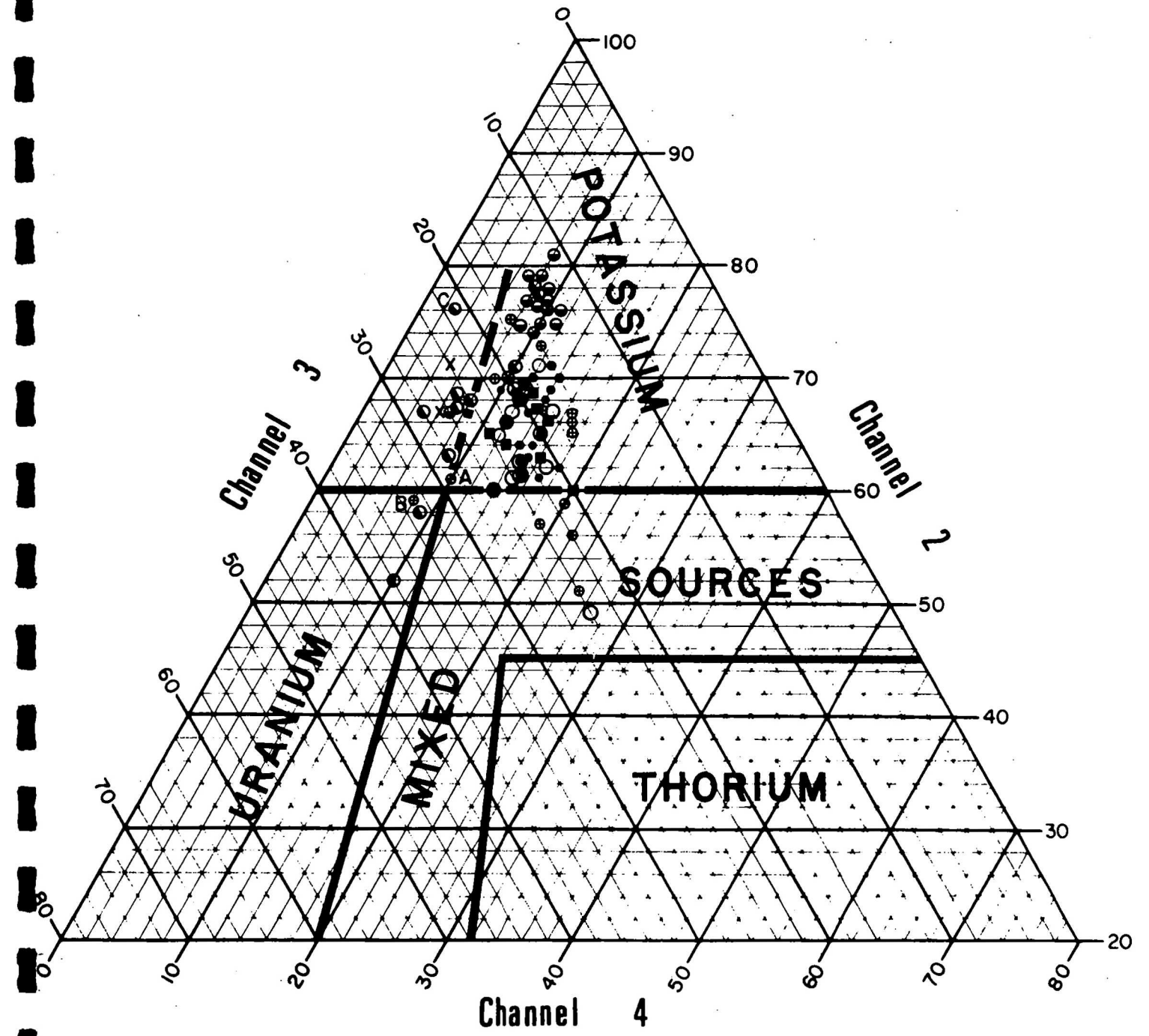


GRANITES

- Wonga
- Naraku
- Kalkadoon (values shown mainly represent geological background)

FIGURE 14

PERCENTAGE SUM DIAGRAM



METASEDIMENTS

- ⊕ *Corella Formation – North*
- ◒ *Corella Formation – South*
- ◐ *Marimo Slate*
- • *Argylla Formation*
- ○ *Soldiers Cap Formation*
- ■ *Leichhardt Metamorphics*
- X *Mitakoodi Quartzite*

A – *3 km northwest of Milo* B – *Mary Kathleen open cut* C – *Embla Ridge*

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exception of the Kalkadoon Granite, fall in the 'potassium' and 'mixed source' classification. This difference between the granites and metasediments can be described in terms of thorium/potassium content of the rocks, the sediments having a lower ratio of thorium/potassium than the granites.

Corella Formation. The anomalies over the Corella Formation show different characteristics in different areas. South of about 20°45', points plotted on the percentage sum diagram lie high in the 'potassium' classification. North of this latitude the points have considerable scatter from 'potassium' to 'mixed sources'. On the basis of this information there is a clear difference between the rocks in the north of CLONCURRY and those in the south. Most of the uranium occurrences within the Corella Formation lie north of latitude 20°45'. While the survey did not record obvious anomalies near most of these occurrences it may be of importance that the anomalies recorded in the northern area show a wide scatter on the percentage sum diagram.

Anomaly 958/1580, about 3 km northwest of the Milo uranium deposit, has characteristics similar to that over Mary Kathleen, and may therefore be of special interest. Because of the proved prospective nature of the Corella Formation, it is considered that all anomalies recorded may be of interest.

Marimo Slate. This formation is mapped as a lateral equivalent of the Corella Formation, but its gamma radiation shows a marked difference from that over the Corella Formation (Fig. 14). The anomalies have a higher channel 3/channel 4 ratio, thus reflecting a lower thorium content than that of the Corella Formation. Most of the anomalies lie in the 'mixed potassium-uranium' classification. Eight of the 11 points plotted on the percentage sum diagram have channel 3/channel 4 ratios of three or more.

The anomaly recorded adjacent to the Embla Ridge uranium deposit (1394/1680) lies in the 'mixed potassium-uranium' classification and has a high channel 3/channel 4 ratio. Other anomalies with similar characteristics are 1765/1690, 1738/1690, 1117/1734, 854/1740 and 1500/1750. Two anomalies

recorded over the Marimo Slate lie in the 'uranium' classification (1404/1680 and 545/1710) and should be investigated further.

Mitakoodi Quartzite. Two anomalies over this formation were analysed. Both lie in the 'mixed potassium-uranium' classification (862/1670 and 1386/1680).

Argylla Formation. This formation also produced prominent radiometric anomalies, all of which fall in the 'potassium' classification.

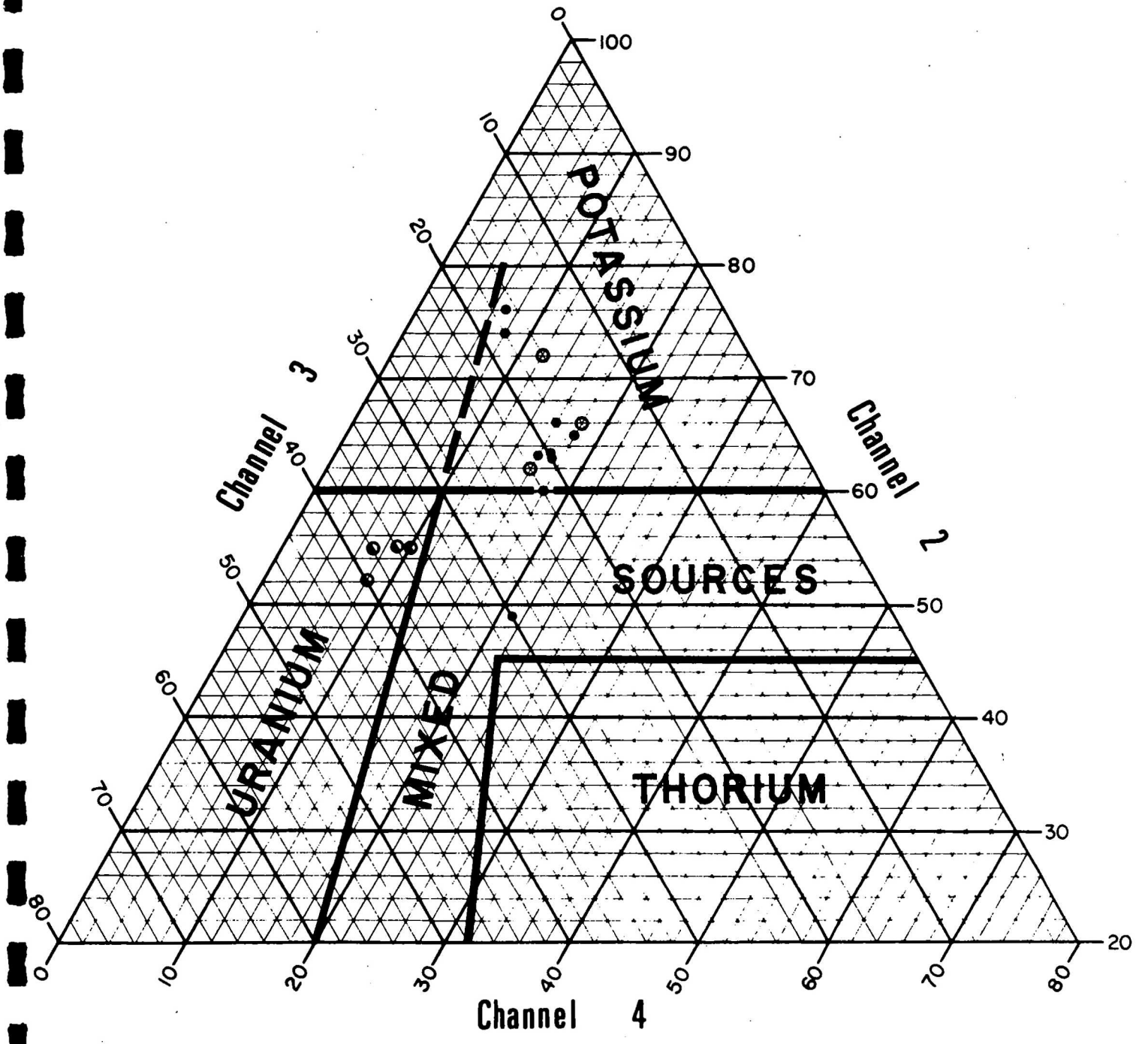
Soldiers Cap Formation. With the exception of anomaly 1730/1760, which falls in the 'mixed' classification, all of the selected anomalies over this formation fall in the 'potassium' classification. In the main, the anomalies were located close to dolerites in the southwest of the area of Soldiers Cap Formation. Anomaly 1730/1760 was recorded near a north-south fault.

Leichhardt Metamorphics. The anomalies recorded over these rocks fall in the 'potassium' classification on the percentage sum diagram.

Cainozoic and Mesozoic sediments

Radiometric anomalies of low amplitude were recorded over these sediments. Broadly speaking, relative highs in total-count are generally located over streams. Good examples are those over the Cloncurry River and the Williams River. Total-count rates over the streams are sometimes two or three times as great as the geological background over adjacent material. While the increased counts are recorded in all channels, channel 3 usually has a proportionally greater increase. Thus the channel 3/channel 4 ratio is usually higher than that of the adjacent geological background (Table 5). It appears that radioactive minerals, particularly uranium, are concentrated in or near the streams.

PERCENTAGE SUM DIAGRAM



CAINOZOIC AND MESOZOIC SEDIMENTS

- ○ Qra – Modern alluvium *(sand and silt)*
- ● Czr – *(red and brown sand, silt and clay)*
- ◔ Klo – Toolebuc Limestone *(limestone and calcareous shale)*

TABLE 5

Radiometric anomalies over streams

Fiducial	Line	Counts					%			
		ch1	ch2	ch3	ch4	ch2+ ch3+ ch4	ch2	ch3	ch4	ch3/ ch4
1633	1190	140	40	13	10	63	63	21	16	1.3
	*	70	20	4	4	28	72	14	14	1.0 *
702	1170	150	40	15	12	67	60	22	18	1.3
	*	70	20	6	5	31	65	19	16	1.2 *
869	1180	160	50	14	12	76	66	18	16	1.2
	*	50	25	3	4	32	78	9	13	0.8 *

* adjacent background

East of the Cloncurry River, count rates are lower. This radiometrically quiet area largely corresponds with the surface extent of recent sediments and an older unit designated Czs by Grimes (1972). West of the Cloncurry River, and in the southeast corner of the sheet, the higher background levels are associated mainly with a Cainozoic unit designated Czr and described as 'red and brown sand, silt and clay' by Grimes (op. cit.).

Data derived from anomalies over the unit Czr are shown on a percentage sum diagram (Fig. 15). These have a wide scatter, and sources range in classification from 'potassium' to 'mixed sources'.

Toolebuc Limestone. Four 'uranium' anomalies were recorded over the Toolebuc Limestone in the southeast of CLONCURRY (1687/1540, 1674/1650, 649/1660, 685/1670). These are shown also in Figure 15.

The formation has been studied in other areas, and its geology is discussed by Grimes (1972), and Senior & Smart (1973). These authors noted the high gamma-log response and pointed out the consequent importance of this thin bed (10-30 m) as a marker bed in various sedimentary basins. Senior & Hughes (1972) reported that Springvale No. 6 drill-hole penetrated

the Toolebuc Limestone with the usual high gamma-log response. They commented that the radioactivity probably originates in organic phosphatic material. Casey et al. (1960) observed a uranium mineral on fish scales in the Toolebuc Limestone in BOULIA.

Four radioactive samples of black shale from the Toolebuc Limestone were selected from the Croydon No. 1 drill core and were analysed for uranium and thorium content by X-ray fluorescence. The results (Table 6) show that uranium and minor thorium were detected.

TABLE 6

Croydon No. 1 - Toolebuc Limestone XRF Results*

Lab. No.	Depth (feet)	Uranium ppm	Th ppm	Comments
74/42	166	2	8	background sample
74/43	331	55	nd	Toolebuc (Black shale)
74/44	344	38	nd	" " "
74/45	348	188	5	" " "
74/46	374	18	6	" " "

* XRF analysis by BMR; nd represents less than 3 ppm
Croydon No. 1 (Lat 18°18'S Long. 141°30'E) is approx. 350 km NNE of the Toolebuc Limestone outcrop on CLONCURRY.

Detailed survey of Prospector 1:100 000 Sheet area

Stacked profiles of total-count data are shown in Plate 8. While the data have not been subjected to as exhaustive an analysis as were the data for CLONCURRY, they were analysed by a similar method; but more attention was given to detecting uranium anomalies rather than to providing data for all anomalies of high total-count rate. The results are shown in Plate 9. Plate 10 is the flight-line map for the detailed survey.

It is considered that the survey did not produce significantly more useful information than the CLONCURRY survey. Because the Prospector survey was flown at a lower altitude, the influence of topography on the profiles is stronger.

6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The magnetic data in CLONCURRY showed that the outcropping Precambrian rocks commonly have strong magnetic response, typical of Precambrian metamorphic belts. Anomalies of amplitude 500–2000 gammas, attributed to linear sources, dominate the magnetic pattern. These anomalies are similar to those produced by steeply dipping tabular bodies, and appear to be caused by metavolcanics and other magnetic units parallel to the sedimentary layering, cross-cutting basic dykes, and possibly magnetic material in faults. It is believed that the main magnetic mineral is magnetite.

There appears to be an association between the amplitude of magnetic anomalies and the metamorphic grade of the Precambrian rocks. The amplitudes of linear anomalies over the Corella Formation are generally high near the contact with younger granites; these anomalies are approximately parallel to the contacts.

The pattern of magnetic anomalies over the Cainozoic sediments in the east of CLONCURRY is similar to that over the adjacent Precambrian outcrop. It is likely that much of this area is underlain by steeply dipping Precambrian rocks, possibly Corella Formation, at a depth of 100–500 metres.

The radiometric data recorded over Precambrian rocks revealed strong anomalies associated with granites and the Corella Formation, Marimo Slate, Argylla Formation, and Leichhardt Metamorphics. Anomalies were recorded over various known uranium mines and prospects. The radiometric anomalies have been classified to indicate principal source elements – potassium, uranium, and thorium. Most sources fall in the 'high potassium' classification, particularly those in the Corella Formation, Argylla Formation, and Leichhardt Metamorphics. Broadly speaking sources in the

Corella Formation fall into the 'high potassium' classification; however, indications of potassium decrease and indications of thorium increase progressively northwards. High channel 3/channel 4 ratios characterize anomalies over the Marimo Slate in addition to a 'high potassium' classification.

Uranium anomalies were recorded over the Toolebuc Limestone, a known radiometric marker bed in the Great Artesian Basin.

Recommendations

1. Further investigations should be made of the association between the metamorphic grade of rocks and the magnetic mineral content as indicated by the magnetic data. It is suggested that samples of fresh rock for magnetite analysis should be collected along traverses which cross the linear magnetic anomalies bordering the granites.

2. The mineral potential of the basement underlying the Cainozoic sediments in the east of CLONCURRY should be investigated further.

3. The CLONCURRY sheet area has already received close attention by exploration companies and prospectors in the search for uranium. This work has involved airborne surveys on closer line spacings than the present survey, and ground scintillometer surveys and drilling. In making recommendations for follow-up work, it is appreciated that many of the anomalies selected and listed in earlier sections for further investigation may have already been detected and followed up by earlier workers. However, the precise localities of earlier follow-up work are not known. Interested parties may be able to acquire details of earlier surveys from the exploration companies involved.

The anomalies considered to be of special interest for follow-up work are listed in Table 7. Most of these were selected because of their high channel 3/channel 4 ratio. Two of them, 1780/1450 and 2515/1460, are of interest, however, because they have very low channel 3/channel 4 ratios, and are classified as 'thorium' anomalies.

4. The Toolebuc Limestone in CLONCURRY should be drilled, so that samples can be tested for their uranium content. The association of uranium with this hydrocarbon-rich bed could be of commercial interest.

TABLE 7

Radiometric anomalies recommended for further investigation

Fiducial	Line	Formation	Element of interest
1788	1450	? Cainozoic	Th
2515	1460	? Cainozoic	Th
1687	1540	Toolebuc Limestone	U
958	1580	Corella Formation	U
1674	1650	Toolebuc Limestone	U
649	1660	Toolebuc Limestone	U
685	1670	Toolebuc Limestone	U
862	1670	Mitakoodi Quartzite	U
1404	1680	Marimo Slate	U
1386	1680	Mitakoodi Quartzite	U
1765	1690	Marimo Slate	U
1738	1690	" "	U
545	1710	" "	U
1117	1734	" "	U
854	1740	" "	U
1500	1750	" "	U

While the anomalies listed above are considered the most important, some of the others shown in the interpretation map may also be of interest. For this reason, full data for all anomalies studied are given in Appendices 2 and 4.

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APPENDIX 1

Operational Details

Staff

Party Leader:	B.Wyatt	(part time)
	D. Tucker	(part time)
Geophysicist:	R. Taylor	
Draftsmen:	T. Kimber	
	I. O'Donnell	
Technical Staff:	M. Johnson	
	S. Wilcox	
Pilot :	First Officer L.Manning (TAA)	

Aircraft

Aero Commander 500U (VH-BMR)

Airborne Magnetometer

Type:	Proton-precession MNS-2 of BMR design with towed-bird detector
Cycling time:	1 s
Recorder:	Moseley 7100 B
Sensitivities:	40 and 400 gammas/cm
Chart speed:	5 cm/min CLONCURRY
	15 cm/min Prospector

Base-station magnetometer

Type:	Proton-precession MNS-1 of BMR design
Cycling time:	30 s
Recorder:	Esterline Angus
Sensitivity:	10 gammas/cm
Chart speed:	15 cm/h

Timer

Type: Solid state of BMR design

Gamma-ray spectrometer

Detectors	:	Two Harshaw 15 cm x 10 cm NaI (Tl) crystals
Electronics	:	Hamner modules
Stabilization	:	Caesium-137
Energy windows	:	Channel 1: 0.84 - 2.80 MeV (Total count)
		Channel 2: 1.30 - 1.60 MeV (Potassium)
		Channel 3: 1.60 - 1.90 MeV (Uranium)
		Channel 4: 2.40 - 2.80 MeV (Thorium)
Time constant	:	3 s (all channels)
Recorders	:	Two Speedomax Mk II, 3-channel
Sensitivities	:	Channel 1: 100 counts/sec/cm
		Channel 2: 50 " " "
		Channel 3: 10 " " "
		Channel 4: 10 " " "
Chart speed	:	5 cm/min

Altimeter

Type	:	Barometric

Tracking Camera

Type	:	Vinten 35-mm single-frame with fish-eye lens.

Surveying details

Line direction	:	East-west
Spacing	:	1500 m (CLONCURRY)
		500 m (Prospector)
		150 m above ground level (CLONCURRY)
Altitude	:	80 m above ground level (Prospector)
Speed	:	200 km/h

APPENDIX 2

DETAILS OF RADIOMETRIC ANOMALIES IN CLONCURRY

Fiducial	Line	counts/sec					Percentages **				*	
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4	ch3/ ch4	Anomaly width (Fiducials)	Classification
2136	1040	200	40	18	8	66	61	27	12	2	1	K
458	1050	290	90	27	16	133	68	20	12	2	1	K
1136	1060	160	60	14	11	85	70	17	13	1	1	K
1124	1060	200	80	16	8	104	77	15	8	2	1	K
2065	1080	170	60	13	12	85	71	15	4	1	2	K
496	1090	270	70	20	16	106	66	19	15	1	2	K
529	1090	270	80	24	17	121	66	20	14	1	1	K
1152	1100	330	90	26	17	133	68	20	12	2	1	K
1148	1100	290	80	28	20	128	63	22	15	2	0.5	K
1147	1100	280	80	21	12	113	71	19	10	2	0.5	K
879	1100	150	80	17	12	109	73	16	11	1	5	K
1465	1110	410	125	32	22	179	70	18	12	2	2	K
1753	1110	180	50	12	14	76	66	16	18	1	5	K
2137	1120	270	70	22	18	110	64	20	16	1	1	K
2106	1120	210	60	20	13	93	64	22	14	2	1	K
530	1130	320	95	22	23	140	68	16	16	1	1.5	K
557	1130	260	75	18	18	111	68	16	16	1	1	K
638	1130	290	75	27	26	128	59	21	20	1	1	M
857	1130	180	50	18	13	81	62	22	16	1	1	K
1228	1140	270	75	23	16	114	66	20	14	1	1.5	K
1137	1140	230	50	20	20	90	56	22	22	1	1	M
1070	1140	110	25	15	6	46	54	33	13	2	2	M
1463	1150	250	75	18	16	109	69	16	15	1	2	K
1504	1150	320	105	26	22	153	69	17	14	1	1	K
456	1170	300	90	18	17	125	72	14	14	1	1	K
487	1170	240	65	16	16	97	68	16	16	1	1	K
572	1170	240	75	22	18	115	65	19	16	1	2	K
992	1180	240	65	21	21	107	60	20	20	1	2	K
980	1180	320	75	31	34	140	54	22	24	1	1.5	M
908	1180	175	55	14	15	84	65	17	18	1	5	K
869	1180	160	50	14	12	76	66	18	16	1	6	K
1517	1190	430	110	47	40	197	56	24	20	1	2	M
1569	1190	140	40	13	11	64	63	20	17	1	30	K
1633	1190	140	40	13	10	63	63	21	16	1	10	K
1540	1190	160	40	12	11	63	64	19	17	1	3	K
1356	1190	220	60	22	12	94	64	23	13	2	2	K
1936	1200	280	70	28	29	128	54	23	23	1	1	M
391	1210	260	90	24	16	130	69	19	12	2	1.5	K
487	1210	240	90	14	10	114	79	12	9	1	1.5	K
1155	1220	240	65	15	8	88	74	17	9	2	1.5	K
1135	1220	240	80	24	10	114	70	21	9	2	1.5	K
1117	1220	300	85	24	18	127	67	19	14	1	2	K
1082	1220	280	65	28	23	116	56	24	20	1	1	M
1034	1220	240	75	22	10	107	70	21	9	2	2	K
990	1220	180	55	20	8	83	66	24	10	2	1	K
1440	1230	320	80	35	22	137	58	26	16	2	1	M
1451	1230	240	70	26	16	112	63	23	14	2	2	K
1458	1230	240	60	24	18	102	59	24	17	1	1	M
2100	1240	350	90	37	26	153	59	24	17	1	1	M
1999	1240	260	65	27	22	114	57	24	19	1	2	M
436	1250	250	85	22	20	127	67	17	16	1	2	K
478	1250	350	95	37	22	154	62	24	14	2	1	K
491	1250	250	65	22	23	110	59	20	21	1	1	M

APPENDIX 2

Fiducial	Line	counts/sec					Percentages**			ch3/ch4	Anomaly* width (Fiducials)	Classification
		ch1	ch2	ch3	ch4	ch2+ch3+ch4	ch2	ch3	ch4			
583	1250	290	75	32	22	129	58	25	17	2	1	M
1234	1260	300	80	30	19	129	62	23	15	2	1	K
1231	1260	250	60	26	19	105	57	25	18	1	1	M
1219	1260	270	70	33	29	132	53	25	22	1	1	M
1143	1260	300	70	33	30	133	53	25	22	1	3	M
1117	1260	240	55	26	20	101	54	26	20	1	1	M
1518	1270	280	80	20	20	120	66	17	17	1	1	K
1560	1270	340	85	35	28	148	57	24	19	1	2	M
1563	1270	290	70	29	24	123	57	24	19	1	1	M
1634	1270	260	75	25	22	122	62	20	18	1	1	K
1653	1270	310	70	27	27	124	56	22	22	1	1	M
1659	1270	310	80	33	26	139	57	24	19	1	1	M
1697	1270	360	85	33	36	154	55	21	24	1	2	M
2198	1280	300	65	29	20	114	57	25	18	2	1	M
2116	1280	300	65	32	28	125	52	26	22	1	1	M
2111	1280	310	85	30	22	137	62	22	16	1	1	K
2077	1280	300	75	24	27	126	60	19	21	1	2	K
1089	1300	170	40	18	10	68	59	26	15	2	2	M
985	1300	240	45	24	23	92	49	26	25	1	4	M
1442	1310	250	65	23	22	110	59	21	20	1	1	M
1508	1310	310	70	32	23	125	56	26	18	1	1	M
1715	1310	85	20	12	6	38	53	32	15	2	2	M
2089	1320	230	55	21	17	93	59	23	18	1	1	M
1959	1320	250	60	25	18	103	58	24	18	1	2	M
442	1330	300	80	34	27	141	57	24	19	1	1.5	M
1075	1340	240	70	27	17	114	61	24	15	2	2	K
946	1340	280	70	33	28	131	53	25	22	1	2	M
2048	1360	220	65	24	14	103	63	23	14	2	3	K
2005	1360	270	75	26	20	121	62	21	17	1	1	K
1990	1360	260	85	17	9	111	77	15	8	2	1	K
1979	1360	250	65	26	16	107	61	24	15	2	1	K
1967	1360	320	75	31	26	132	57	23	20	1	1	M
1950	1360	300	65	33	27	125	52	26	22	1	1	M
1848	1360	230	60	24	21	105	57	23	20	1	3	M
596	1370	400	100	35	34	169	59	21	20	1	3	M
561	1370	200	50	30	17	97	51	31	18	2	1	M
872	1380	260	90	24	18	132	68	18	14	1	2	K
880	1380	240	70	24	16	110	64	22	14	2	2	K
1524	1390	280	70	26	20	116	60	22	18	1	10	K
1881	1400	235	60	22	18	100	60	22	18	1	2	K
1900	1400	290	80	26	20	126	63	21	16	1	1	K
1906	1400	290	80	25	17	122	66	20	14	2	2	K
2517	1410	235	60	27	17	104	58	26	16	2	1	M
2506	1410	240	60	30	23	113	53	27	20	1	1	M
2502	1410	240	65	25	23	113	58	22	20	1	1	M
2474	1410	420	110	40	35	185	59	22	19	1	2	M
2413	1410	240	60	22	14	96	63	23	14	2	1	K
432	1420	240	70	22	16	108	65	20	15	1	2	K
440	1420	340	85	36	30	151	56	24	20	1	3	M
552	1420	350	85	40	36	161	53	25	22	1	3	M
1050	1430	290	90	22	16	128	70	17	13	1	5	K
906	1430	210	55	23	16	94	59	24	17	1	2	M
876	1430	270	70	24	26	120	58	20	22	1	2	M
871	1430	350	80	43	36	159	50	27	23	1	2	M

APPENDIX 2

Fiducial	Line	counts/sec					Percentages**			ch3/ ch4	Anomaly* width (Fiducials)	Classification
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4			
1364	1440	310	80	31	26	137	58	23	19	1	2	M
1509	1440	370	85	40	40	165	52	24	24	1	7	M
1975	1450	320	90	37	28	155	58	24	18	1	-	M
1829	1450	300	70	40	19	129	54	31	15	2	4	M
1788	1450	140	20	20	20	60	33	33	34	1	1	Th
2283	1460	300	80	26	17	123	65	21	14	2	2	K
2323	1460	420	95	53	24	172	55	31	14	2	1	M
2463	1460	380	95	44	42	181	53	24	23	1	4	M
2469	1460	320	75	41	26	142	53	29	18	2	1	M
2515	1460	220	40	28	35	103	39	27	34	1	1	Th
295	1470	200	60	22	13	95	63	23	14	2	1	K
378	1470	190	55	23	14	92	60	25	15	2	1	K
527	1470	250	65	24	26	115	57	21	22	1	1	M
547	1470	250	70	27	27	124	56	22	22	1	2	M
556	1470	260	65	28	28	121	54	23	23	1	3	M
848	1480	270	75	32	22	129	58	25	17	2	1	M
1311	1490	240	75	18	15	108	69	17	14	1	2	K
1358	1490	125	45	9	6	60	75	15	10	2	.5	K
1367	1490	160	45	14	11	70	64	20	16	1	2	K
1481	1490	320	75	34	34	143	52	24	24	1	2	M
1968	1500	240	60	18	10	88	68	20	12	2	1	K
1916	1500	240	75	25	23	123	61	20	19	1	1	K
1896	1500	150	50	14	4	68	73	21	6	4	1.5	K U
1884	1500	170	45	18	8	71	64	25	11	2	-	K
2295	1510	260	80	20	20	120	68	16	16	1	3	K
2308	1510	210	60	18	14	92	65	20	15	1	3	K
2388	1510	260	65	27	25	117	56	23	21	1	1	M
2449	1510	260	70	30	24	124	57	24	19	1	2	M
442	1520	280	75	31	25	131	57	24	19	1	4	M
521	1520	240	85	24	19	128	66	19	15	1	3	K
1063	1530	300	75	36	27	138	54	26	20	1	3	M
1056	1530	230	60	24	24	108	56	22	22	1	2	M
1008	1530	240	85	19	10	114	75	17	8	2	3	K
1180	1530	110	25	20	5	50	50	40	10	4	1	U
1411	1540	300	70	29	27	126	56	23	21	1	1	M
1482	1540	300	90	24	22	136	66	18	16	1	2	K
1687	1540	140	35	22	6	63	55	35	10	4	3	U
2080	1550	320	105	27	16	148	71	18	11	2	2	K
2067	1550	260	80	27	14	121	66	22	12	2	3	K
2040	1550	320	100	22	18	140	71	16	13	1	1	K
2027	1550	380	90	40	32	162	56	25	19	1	1	M
2013	1550	470	115	44	38	197	59	22	19	1	3	M
1964	1550	260	90	24	23	137	66	17	17	1	7	K
1891	1550	240	70	24	17	111	63	22	15	1	1	K
1886	1550	250	65	26	15	106	61	25	14	2	1	K
2280	1560	300	95	26	17	138	69	19	12	2	1	K
2289	1560	220	65	28	15	108	60	26	14	2	1	K
2292	1560	260	85	24	14	123	69	19	12	2	3	K
2334	1560	500+	335	82+	76							U ?
2343	1560	420	120	35	26	181	67	19	14	1	4	K
359	1570	300	75	25	17	117	64	21	15	2	1	K
410	1570	530+	300	84+	52	436+					2	U ?
422	1570	450	115	47	32	194	59	24	17	2	3	M
491	1570	270	70	27	14	111	63	24	13	2	2	K

APPENDIX 2

Fiducial	Line	counts/sec					Percentages**			ch3/ ch4	Anomaly* width (Fiducials)	Classification
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4			
574	1570	245	75	22	12	109	69	20	11	2	2	K
1087	1580	240	70	26	12	108	65	24	11	2	1	K
1079	1580	285	80	28	17	135	66	21	13	2	1	K
1065	1580	315	90	34	22	146	62	23	15	2	4	K
1060	1580	280	75	27	15	117	64	23	13	2	2	K
1034	1580	280	70	27	21	118	59	23	18	1	3	M
1028	1580	240	65	24	16	105	62	23	15	2	2	K
1023	1580	330	75	33	25	133	56	25	19	1	2	M
1017	1580	490	120	73	20	213	57	34	9	4	2	U
1005	1580	300	60	28	24	112	54	25	21	1	6	M
958	1580	240	60	28	10	98	61	29	10	3	4	K
1395	1590	330	90	28	24	142	63	20	17	1	1	K
1373	1590	350	95	40	29	164	58	24	18	1	2	M
123 FLT	078	990	265	141	31	437	61	32	7	5	1.5	U
1391	1590	470	135	45	34	214	63	21	16	1	4	K
1396	1590	340	80	29	24	133	60	22	18	1	1	K
1442	1590	350	105	35	17	157	67	22	11	2	3	K
1474	1590	310	110	21	13	144	76	15	9	2	3	K
1575	1590	340	120	18	12	150	80	12	8	2	1	K
2066	1600	260	75	22	15	112	67	20	13	2	2	K
2021	1600	270	60	30	26	116	52	26	22	1	2	M
2004	1600	330	70	34	31	135	52	25	23	1	3	M
1995	1600	330	90	34	23	147	61	23	16	1.5	1	K
1989	1600	340	90	34	29	153	59	22	19	1	2	M
1983	1600	270	60	27	22	109	55	25	20	1	2	M
2314	1610	270	80	21	17	118	68	18	14	1	1	K
2362	1610	300	70	32	28	130	54	25	21	1	1	M
2366	1610	360	90	34	36	160	56	21	23	1	2	M
2388	1610	460	130	39	33	202	65	19	16	1	4	K
2496	1610	280	85	14	9	108	79	13	8	2	1	K
2499	1610	290	105	20	12	137	77	15	8	2	2	K
2507	1610	320	110	20	13	143	77	14	9	2	4	K
2513	1610	300	100	19	14	133	75	14	11	1	1	K
274	1620	260	75	21	13	109	69	19	12	2	1	K
314	1620	240	65	23	16	104	63	22	15	1	1	K
319	1620	250	90	20	13	123	73	16	11	2	1	K
322	1620	230	70	21	10	101	69	21	10	2	1	K
367	1620	280	85	27	25	137	62	20	18	1	4	K
382	1620	300	105	23	16	144	73	16	11	1	1	K
388	1620	490	145	46	35	226	64	20	16	1	1	K
410	1620	130	45	18	5	68	67	26	7	4	1	K
499	1620	305	115	16	11	142	81	11	8	2	3	K
538	1620	260	90	19	12	121	74	16	10	2	1	K
1010	1630	280	75	28	19	122	62	23	15	2	6	K
970	1630	310	75	27	26	128	59	21	20	1	1	M
957	1630	310	70	33	34	137	51	24	25	1	1	M
950	1630	345	95	27	28	150	63	18	19	1	1	K
892	1630	280	85	15	12	112	76	13	11	1	2	K
1222	1640	330	90	30	30	150	60	20	20	1	1	K
1225	1640	280	70	20	15	105	67	19	14	1	1	K
1268	1640	240	60	16	18	94	64	17	19	1	1	K
1273	1640	310	90	21	18	129	70	16	14	1	2	K
1277	1640	320	95	26	16	137	69	19	12	2	2	K

APPENDIX 2

Fiducial	Line	counts/sec					Percentages**			ch3/ch4	Anomaly* width (Fiducials)	Classification	
		ch1	ch2	ch3	ch4	ch2+ch3+ch4	ch2	ch3	ch4				
1293	1640	240	75	17	8	100	75	17	8	2	1	K	
1318	1640	400	105	39	34	178	59	22	19	1	2	M	
1326	1640	290	65	28	22	115	57	24	19	1	1	M	
1452	1640	310	100	18	13	131	76	14	10	1	3	K	
1978	1650	280	75	21	18	114	66	18	16	1	1	K	
1937	1650	300	70	28	28	126	56	22	22	1	2	M	
1871	1650	180	55	14	7	76	72	18	10	2	1	K	
1704	1650	210	85	19	8	112	76	17	7	2	1	K	
1700	1650	180	75	18	8	101	74	18	8	2	4	K	
1674	1650	140	30	20	5	55	55	36	9	4	1	U	
362	1660	510	125	52	46	223	56	23	21	1	2	M	
503	1660	320	105	26	12	143	73	18	9	2	1	K	
618	1660	180	35	21	15	71	49	30	21	2	2	M	
649	1660	200	45	34	7	86	52	40	8	5	2	U	
1029	1670	240	75	22	12	109	69	20	11	2	-	K	
1005	1670	320	85	28	25	138	62	20	18	1	2	K	
966	1670	240	75	20	13	108	67	19	14	2	2	K	
920	1670	240	55	21	17	93	59	23	18	1	1	M	
862	1670	200	65	22	5	92	71	24	5	4	.5	K	U
893	1670	250	65	29	10	104	63	28	9	3	1	K	
846	1670	300	75	32	16	123	61	26	13	2	2	K	
685	1670	170	40	27	5	72	55	38	7	5	1	U	
1251	1680	350	90	27	22	139	65	19	16	1	2	K	
1260	1680	240	70	21	14	105	67	20	13	2	3	K	
1267	1680	370	120	27	22	169	71	16	13	1	2	K	
1386	1680	190	55	21	6	82	67	26	7	4	1	K	U
1394	1680	260	60	34	5	99	61	32	5	7	1	K	U
1404	1680	245	40	29	8	77	52	38	10	4	1	U	
1426	1680	210	50	22	8	80	63	27	10	3	1	K	
1448	1680	260	80	15	11	106	76	14	10	1	1.5	K	
1464	1680	250	70	19	15	104	67	18	14	1	5	K	
1486	1680	250	70	19	12	101	69	19	12	2	2	K	
1975	1690	230	70	20	15	105	67	19	14	1	1.5	K	
1937	1690	260	70	24	14	108	65	22	13	2	1	K	
1837	1690	210	55	10	8	73	75	14	11	1	1	K	
1765	1690	220	60	25	5	90	67	28	5	5	2	K	U
1724	1690	300	100	20	10	130	77	15	8	2	1	K	
1716	1690	250	75	21	11	107	70	20	10	2	2	K	
1697	1690	250	70	25	13	108	65	23	12	2	1	K	
1693	1690	240	60	26	14	100	60	26	14	2	1	K	
1680	1690	240	65	21	12	98	66	22	12	2	1	K	
2100	1710	190	50	16	9	75	67	21	12	2	1	K	
2108	1700	230	65	22	14	101	64	22	14	2	1	K	
2134	1700	330	90	25	23	138	65	18	17	1	1	K	
2136	1700	290	80	26	15	121	66	22	12	2	1	K	
2138	1700	190	75	18	16	109	69	16	15	1	1	K	
2178	1700	290	75	24	17	116	65	20	15	1	1	K	
2360	1700	250	95	14	8	117	81	12	7	2	1.5	K	
2369	1700	330	80	26	26	132	60	20	20	1	1.5	K	
2376	1700	300	95	17	9	121	79	14	7	2	1.5	K	
2397	1700	230	70	17	12	99	71	17	12	1	3	K	
290	1710	260	60	23	17	100	60	23	17	1	2	K	
319	1710	270	75	27	15	117	64	23	13	2	1	K	
355	1710	260	70	25	19	114	61	22	17	1	2	K	
388	1710	240	75	17	13	105	71	16	13	1	3	K	

APPENDIX 2

Fiducial	Line	counts/sec					Percentages**				Anomaly* width (Fiducials)	Classification
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4	ch3/ ch4		
545	1710	260	60	34	10	104	58	33	9	3	1	U
548	1710	220	60	26	10	96	62	27	11	3	1	K
554	1710	280	95	21	10	126	75	17	8	2	4	K
563	1710	260	85	16	10	111	77	14	9	2	1	K
1080	1720	260	70	27	20	117	60	23	17	1	2	K
1031	1720	260	80	26	20	126	63	21	16	1	2	K
828	1720	270	90	16	10	116	78	13	9	2	2	K
306	1730	260	65	22	16	103	63	21	16	1	2	K
343	1730	260	70	20	16	106	66	19	15	1	1	K
510	1730	240	70	16	10	96	73	17	10	2	3	K
515	1730	240	70	22	10	102	69	21	10	2	1	K
540	1730	180	60	22	9	91	66	24	10	2	1	K
584	1730	240	65	20	12	97	67	21	12	2	2	K
1109	1734	220	55	25	9	89	62	28	10	3	1	K
1117	1734	340	95	34	11	140	68	24	8	3	1	K U
1109	1740	200	65	20	12	97	67	21	12	2	1	K
1037	1740	300	85	26	19	130	65	20	15	1	3	K
880	1740	250	80	21	12	113	71	19	10	2	2	K
872	1740	250	90	17	10	117	77	14	9	2	1.5	K
854	1740	180	60	22	6	88	68	25	7	4	1	K U
830	1740	250	90	14	8	112	80	13	7	2	2	K
826	1740	250	90	18	12	120	75	15	10	2	1	K
1214	1750	330	90	28	16	134	67	21	12	2	2	K
1293	1750	290	90	25	18	133	68	19	13	1	2	K
1310	1750	250	75	19	16	110	68	17	15	1	2	K
1372	1750	220	60	16	10	86	70	18	12	2	1	K
1500	1750	200	60	28	8	96	63	29	8	4	1	K U
1507	1750	190	50	19	7	76	66	25	9	3	1	K
1561	1750	260	65	26	16	107	61	24	15	2	2	K
2088	1760	310	75	29	10	114	66	25	9	3	1	K
1904	1760	240	70	14	13	97	72	15	13	1	1	K
1825	1760	230	60	28	11	99	61	28	11	3	1	K
1809	1760	290	95	17	12	124	76	14	10	1	5	K
1770	1760	240	70	22	16	108	65	20	15	1	1	K
1730	1760	310	60	30	33	123	49	24	27	1	1.5	M
2206	1770	300	85	15	14	114	75	13	12	1	2	K
2287	1770	240	60	23	15	98	61	24	15	2	2	K
2465	1770	260	90	16	9	115	78	14	8	2	1.5	K
2513	1770	260	85	21	9	115	74	18	8	2	2	K
2546	1770	240	70	24	19	113	62	21	17	1	1	K
815	1790	400	90	51	15	156	58	32	10	3	2	U

* Width is measured at half maximum amplitude of Channel 1.
One fiducial is approximately 350 m.

** Percentage each channel contributes to the sum of counts ch2 + ch3 + ch4.

APPENDIX 3

GROUND RADIOMETRIC SURVEY RESULTS

During the survey, ground radiometric traverses were made over four areas where airborne radiometric anomalies had been recorded. The traverses were made with an Austral Exploration SG2b scintillometer, and 12 samples of radioactive rock were collected for U and Th analysis. Details of the traverses are presented in Table 8, and the results of the analyses are shown in Table 9.

The traverses were made as an aid in determining suitable criteria for discriminating against anomalies due to topography in the airborne data. Traverses 1, 2, 3, and 4 were made across hills which were about 50 to 100 m above the surrounding plains. It was found that the ratio of total count over the radioactive bodies to local background was approximately 20 percent higher for the airborne than the ground work.

Traverse 5 was made over flat plain country, where granite outcrops from 1 to 50 m across are exposed through the surficial cover. It was found that a 10-cm layer of soil was sufficient to drop count rates by about 25 percent. In the general area underlain by the granite, counts were about 3 times the local background. Traverse 6 was largely over exposed granite.

The main peaks of ground and airborne anomalies coincided, verifying the accuracy of plotting of the airborne data. Because ratios of peak to adjacent background count rates for airborne work were found to be only about 20 percent higher than for ground work it is considered that topography had a significant but not excessive influence on the airborne survey data.

TABLE 8

Details of ground radiometric traverses

Locality	Traverses	Length (m)	Station spacing (m)	Rocks	Count level	Source as interpreted from airborne data	Samples collected for analysis
21°01'S, 139°54'E	C11T1	2750	40	Wonga Granite	10 x background*	Mixed	C11A1, C11A2, C11A3, C11A4, C11A5
20°03'S, 139°56'E	P3T2	800	40	Argylla Formation (Feldspar porphyry	2½ x background		P3A1
" "	P3T3	800	40	" "	2 x background	K	P3A2
" "	P3T4	700	40	" "	3 x background		-
20°13'S, 140°20'E	C10T5	1200	40	Naraku Granite	4 x background	Mixed	C10A1
21°02'S, 140°48'E	C14T6	4000	40	Williams Granite	7 x background	U	C14A1, C14A2, C14A3, C14A5

*Background was taken as a mean of low readings obtained away from the radioactive rocks

TABLE 9

Radioactive element analyses

Sample number		Rock type	Parts/million		Percentage
Collectors	Laboratory		U^1	Th^2	K^3
C11A1	73/163	Granite	14	59	3.54
C11A2	73/164	Gossan (on east	87	21	.01
C11A3	73/165	Mudstone) side of	5824	15	.12
C11A4	73/166	Chert) granite	17	nd	.01
C11A5	73/167	Chert)	41	nd	.01
P3A1	73/173	Pink porphyry	6	33	4.27
P3A2	73/174	Black porphyry	6	24	5.38
C10A1	73/168	Gneiss	19	163	3.53
C14A1	73/169	Granite	11	60	2.27
C14A3	73/171	Granite	37	17	.29

1. Delayed Neutron Analysis by Australian Atomic Energy Commission
2. X-ray Fluorescence Analysis by BMR; nd represents less than 3 ppm
3. Atomic Absorption Analysis by BMR

DETAILS OF RADIOMETRIC ANOMALIES IN Prospector

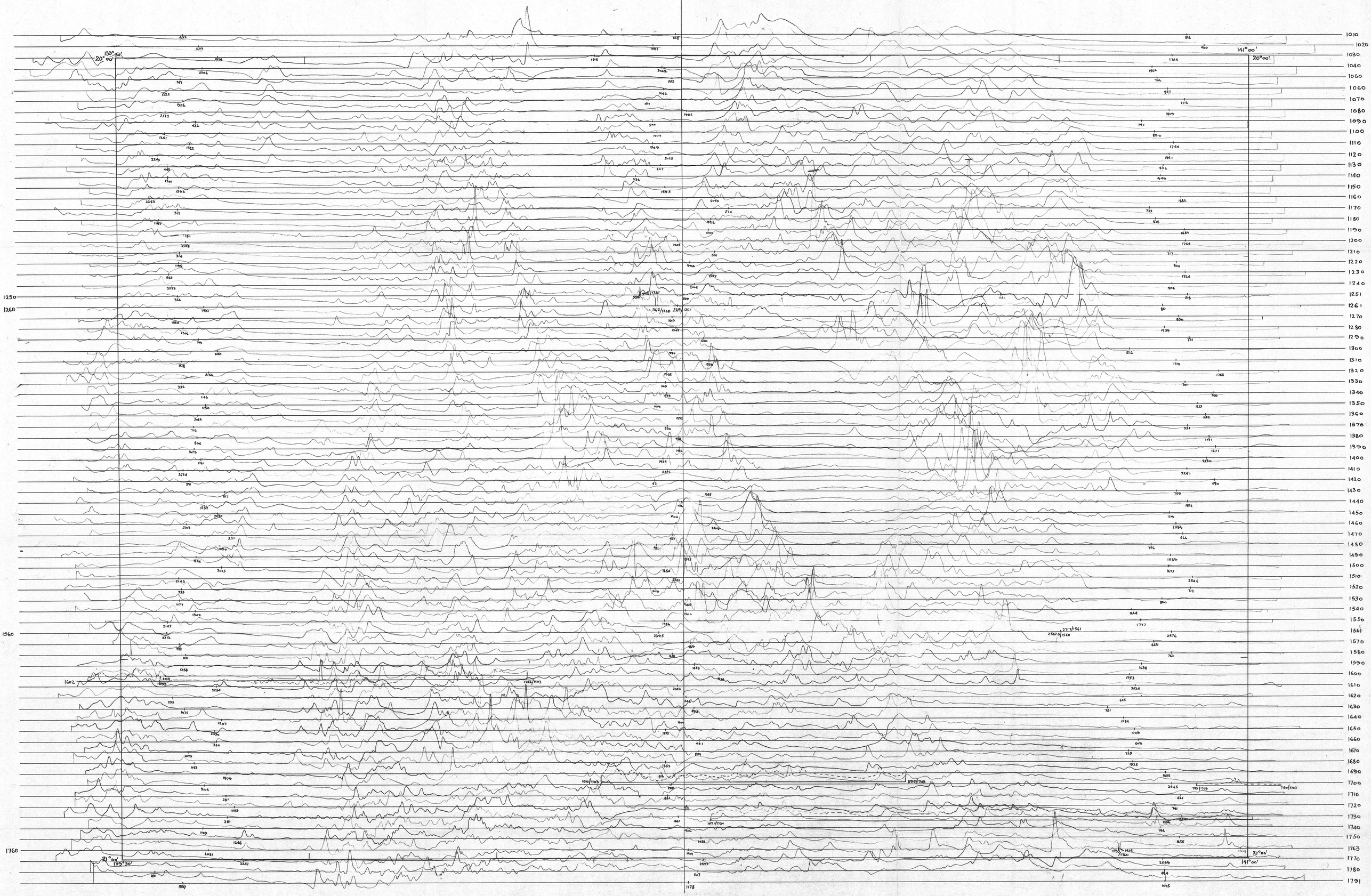
Fiducial	Line	counts/sec					Percentages **				Anomaly * width (Fiducials)	Classification
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4	ch3/ ch4		
238	2120	220	55	29	12	96	57	30	13	2	1	M
379	2151	110	20	15	5	40	50	38	12	3	1	U
356.5	2151	150	40	16	5	61	66	26	8	3	1	KU
308	2151	260	80	22	10	112	71	20	9	2	2	K
501	2160	160	45	22	5	72	63	30	7	4	1	KU
506	2160	180	45	19	7	81	68	24	8	2	1	K
906.5	2180	150	80	17	7	104	77	16	7	2	1	K
950	2180	130	30	18	6	54	56	33	11	3	0.5	U
952	2180	280	90	23	10	123	73	19	8	2	1	K
1165	2190	130	40	15	4	59	68	25	7	4	3	KU
1104	2190	220	60	20	9	89	67	23	10	2	0.5	K
1079.5	2190	230	65	23	9	97	67	24	9	2	0.5	K
1077	2190	190	60	21	9	90	67	23	10	2	0.5	K
1255.5	2200	230	60	23	10	93	64	25	11	2	1	K
254	2250	200	55	24	12	91	60	26	13	2	1	K
874.5	2270	90	25	14	2	41	61	34	5	7	1	KU
1068	2280	180	60	20	8	88	68	23	9	2	1	K
1090.5	2280	240	65	29	14	108	60	27	13	2	1	K
374.5	2371	130	35	13	5	53	66	24	10	2	1	K
640	2391	220	60	23	9	92	65	25	10	2	1	K
1223.5	2421	200	65	21	9	95	68	23	10	2	1	K
1741	2451	190	45	23	10	78	58	29	13	2	0.5	M
1926.5	2461	130	35	16	7	58	60	28	12	2	1.5	K
302	2490	140	35	22	9	66	53	33	14	2	1	M
766	2520	130	35	20	9	64	55	31	14	2	1	M
1469	2550	170	70	18	4	92	76	20	4	4	1	K,U
1388	2550	200	50	19	9	78	64	24	12	2	0.5	K
644	2590	180	45	20	9	74	61	27	12	2	1	K
1394	2630	210	60	24	10	94	64	26	10	2	1	K
1377	2630	210	60	24	10	94	64	26	10	2	1	K
1600	2640	180	45	21	7	73	62	29	9	3	0.5	K
694	2710	230	60	23	10	93	64	25	11	2	1	K
906	2720	140	25	20	8	53	47	38	15	2	1	M
1102	2730	220	60	22	8	90	67	24	9	2	1	K
1457	2750	330	90	38	19	147	61	26	13	2	1	K
1873	2770	190	55	16	6	77	71	21	8	2	1	K
2153	2780	120	40	15	6	61	66	24	10	2	1	K
457.5	2820	250	55	24	27	106	52	23	25	1	1	M
622	2830	240	70	20	8	98	72	20	8	2	1.5	K
2008.5	2900	210	65	22	10	97	67	23	10	2	1	K
1954	2900	130	50	16	3	69	73	23	4	5	1	KU
460	2930	150	45	18	8	71	63	26	11	2	1	K
580	2940	200	65	24	11	100	65	24	11	2	1	K
756.5	2950	190	60	21	7	88	68	24	8	3	0.5	KU
750.5	2950	170	65	21	8	94	69	23	8	2	0.5	K
1182	2970	150	40	19	8	67	60	28	12	2	1	K
1129	2970	80	25	12	4	41	61	29	10	3	1	KU
2101	3020	170	50	17	5	72	70	23	7	3	1	KU
2202.5	3020	130	45	18	6	69	65	26	9	3	1	KU
2498.5	3040	80	20	15	4	39	52	38	10	4	1	U
2530.5	3040	290	80	31	14	125	64	25	11	2	1	K
245	3050	230	70	25	12	107	66	23	11	2	2	K
911.5	3090	220	80	18	8	106	76	17	7	2	1	K
701.5	3160	85	30	11	4	45	67	24	9	2	1	K

* width is measured at half maximum amplitude of Channel 1. One fiducial is approximately 350 m.

** percentage each channel contributes to the sum of counts ch2 + ch3 + ch4.

CLONCURRY

PLATE I



PRELIMINARY
TOTAL MAGNETIC INTENSITY PROFILES

REFERENCE TO 1:250 000 MAP SERIES

138°00'		142° 30'
19°00' CAMOOWEAL	DOBBYN	MILLUNGERA
MOUNT ISA	CLONCURRY	JULIA CREEK
URANDANGI	DUCHESS	McKINLAY
22°00'		

SCALE 1:250000

5 0 5 10 15 20 25km

APPROX. PROFILE SCALE : 1400 gammas per cm

EXPLANATORY NOTE

This map was compiled from an airborne magnetic survey made by the Bureau of Mineral Resources in 1973.

The magnetic profiles were recorded at a nominal altitude of 150metres above ground level along east-west lines spaced approx. 1·5km apart.

This map should be used in conjunction with the flight-line map No. F54/B1-91

Record No. 1975/74

F54/B1-90

CLONCURRY

PLATE 2

PRELIMINARY
FLIGHT - LINE MAP

SCALE 1:250000

5 0 5 10 15 20 25km

REFERENCE TO 1:250 000 MAP SERIES

138°00'		142°30'
19°00'		
CAMOOWEAL	DOBBYN	MILLUNGERA
MOUNT ISA	CLONCURRY	JULIA CREEK
URANDANGI	DUCHESS	McKINLAY
22°00'		

The information contained in this map has been obtained by the Department of Minerals and Energy, as part of the policy of the Australian Government to assist in the exploration and development of mineral resources.

It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resouces, Geology and Geophysics.

Record No. 1975/74

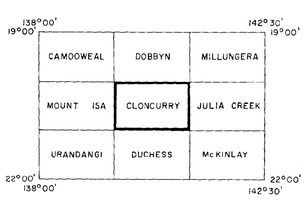
F54/BI-91

CLONCURRY

AUSTRALIA 1:250,000 — QUEENSLAND — PLATE 3

(BASED ON F54/80-2)

INDEX TO 1:250 000 MAP SERIES



TOPOGRAPHICAL LEGEND

- Highway or main road
- Secondary road
- Road or track
- Railway
- Built-up area
- Named place
- Homestead
- Mine
- Aerodrome or landing ground

AIRBORNE SURVEY, CLONCURRY QLD, 1973

MAGNETIC INTERPRETATION

KILOMETRES 5 0 5 10 15 20 KILOMETRES

GEOLOGICAL LEGEND

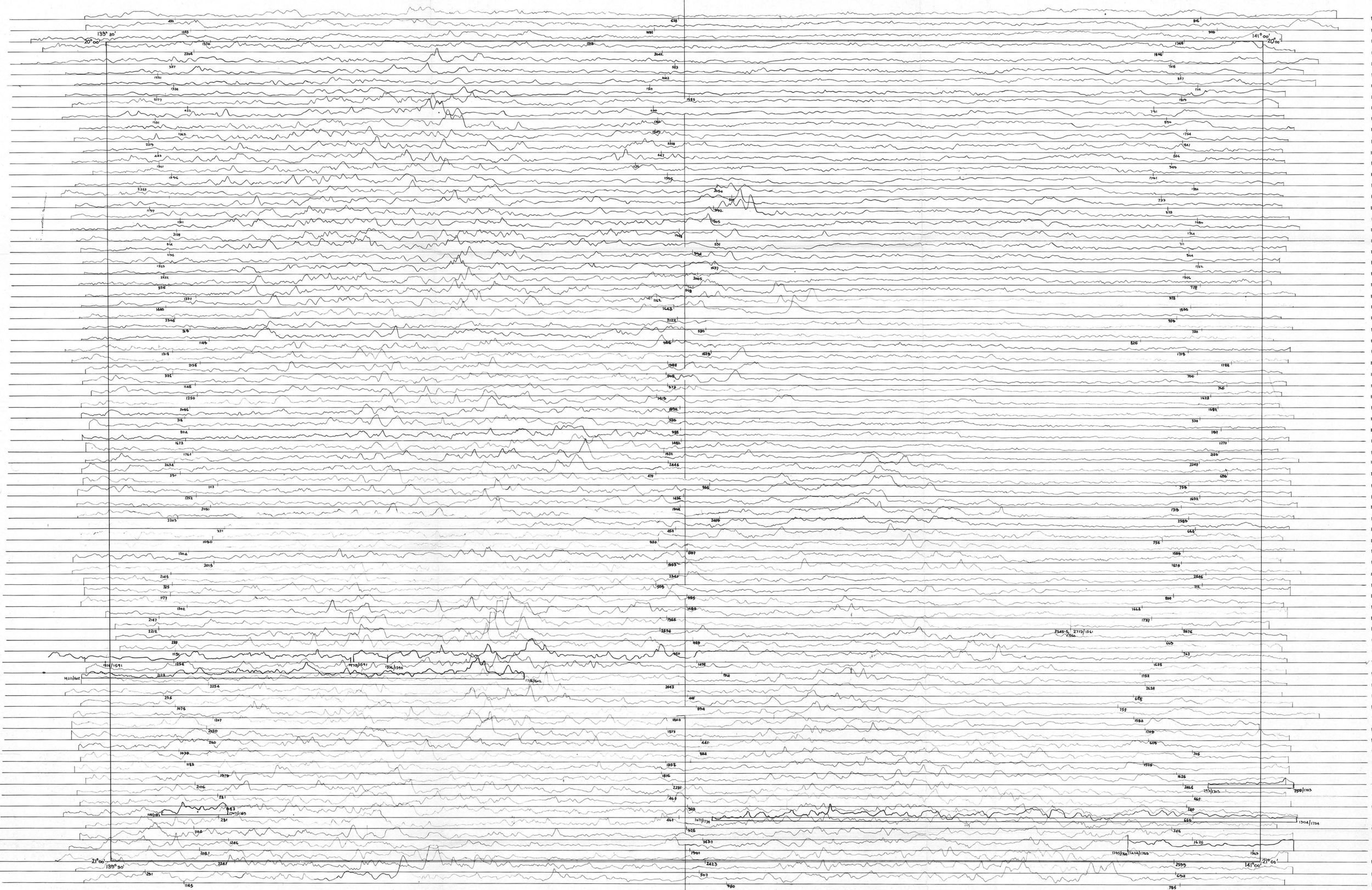
- Egu — Naraku Granite
- Egw — Wonga Granite
- pεk — Kalkadoon Granite
- Inferred subsurface granite
- Corella Formation, known or inferred subsurface
- Pls — Soldiers Cap Formation, known or inferred subsurface
- Dolerite, undifferentiated
- pε — Precambrian rocks, undifferentiated

GEOPHYSICAL LEGEND

- Positive anomaly trend
- Negative anomaly trend
- Lineament
- Geological boundary, or interpreted subsurface boundary
- Fault
- Eastern limit of Precambrian outcrop
- 23 — Magnetic depth estimate below ground level (metres)
- 92 — Depth to basement (metres); from Queensland Irrigation and Water Supply Commission
- 7 — Area discussed in text

CLONCURRY

PLATE 4



REFERENCE TO 1:250000 MAP SERIES

138°00' / 19°00'		142°30'
CAMOOWEAL	DOBBYN	MILLUNGERA
MOUNT ISA	CLONCURRY	JULIA CREEK
URANDANGI	DUCHESS	McKINLAY

22°00'

NOTE

The profiles are incorrectly positioned with respect to the flight-lines. The actual location of an anomaly is at a point 2·3 fiducials (ie. approximately 750m) less than that indicated on this map.

This map must be used in conjunction with the flight-line map No. F54/B1-91

PRELIMINARY
TOTAL COUNT RADIOMETRIC PROFILES

SCALE 1:250000

5 0 5 10 15 20 25km

APPROX. PROFILE SCALE : 330 counts/s/cm

EXPLANATORY NOTES

This map was compiled from an airborne radiometric survey made by the Bureau of Mineral Resources in 1973

The radiometric data were recorded at a nominal altitude of 150 metres above ground level along east-west lines spaced approx. 1·5km apart.

The detector volume was 3550 cm^3 and the profiles displayed are those of gamma-ray intensity in the energy range 0·84 to 3·00MeV. The time constant was 3s.

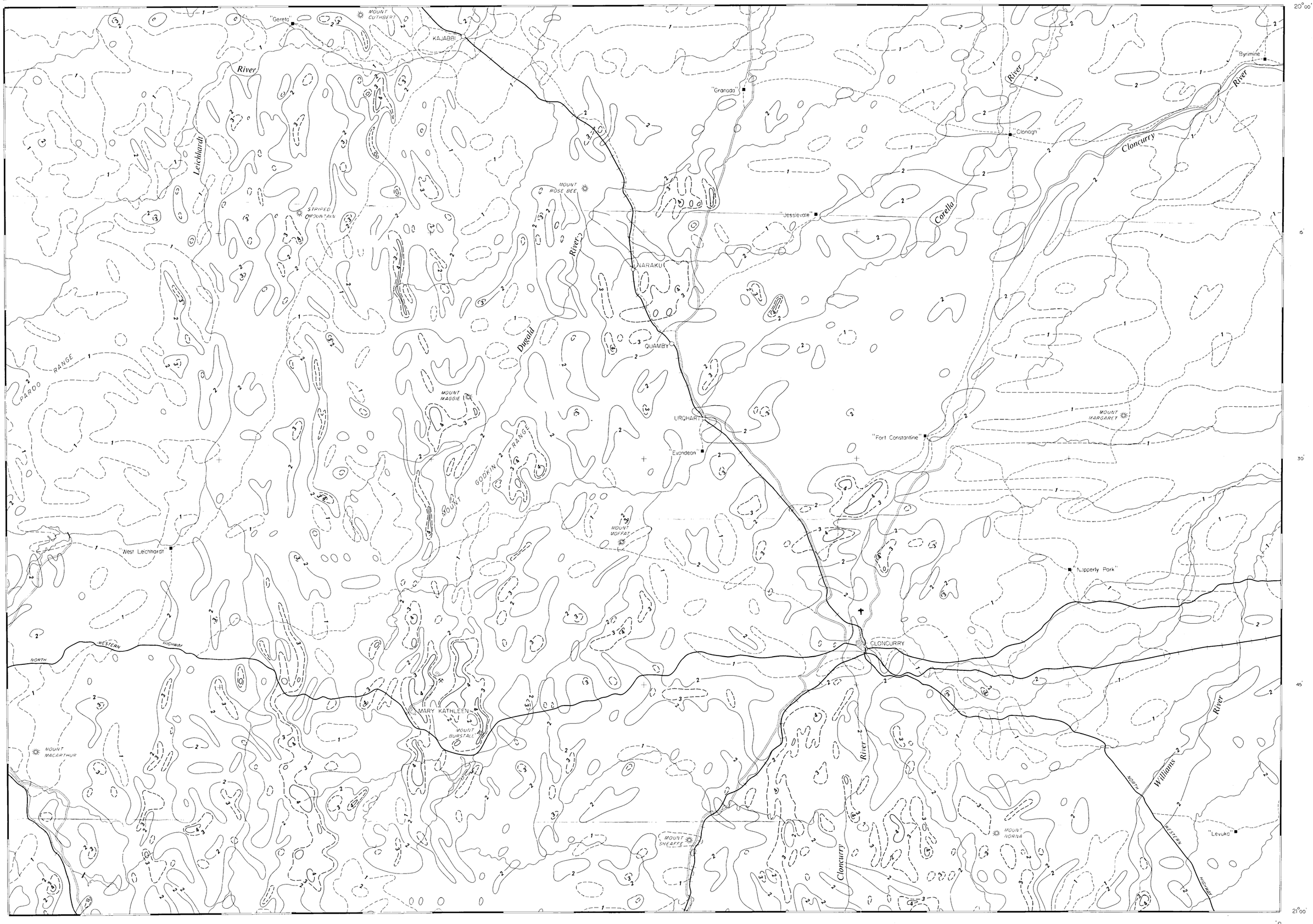
The profiles have been corrected for background radiation (i.e. the baselines represent zero terrain emission).

Record No. 1975/74

F54/B1-89

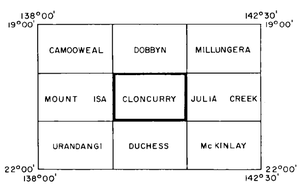
CLONCURRY

AUSTRALIA 1:250,000 — QUEENSLAND — PLATE 5



(BASED ON F54/80-2)

INDEX TO 1:250 000 MAP SERIES



TOPOGRAPHICAL LEGEND

- Highway or main road
- Secondary road
- Road or track
- Railway
- Built-up area
- Named place
- Homestead
- Mine
- Aerodrome or landing ground

AIRBORNE SURVEY, CLONCURRY, QLD 1973

PRELIMINARY TOTAL COUNT RADIOMETRIC CONTOURS

KILOMETRES 5 0 5 10 15 20 KILOMETRES

LOCATION DIAGRAM

Record No 1975/74

GEOPHYSICAL LEGEND

- 1 — 65 counts/second (approx)
- 2 — 130 counts/second (approx)
- 3 — 195 counts/second (approx)
- 4 — 260 counts/second (approx)

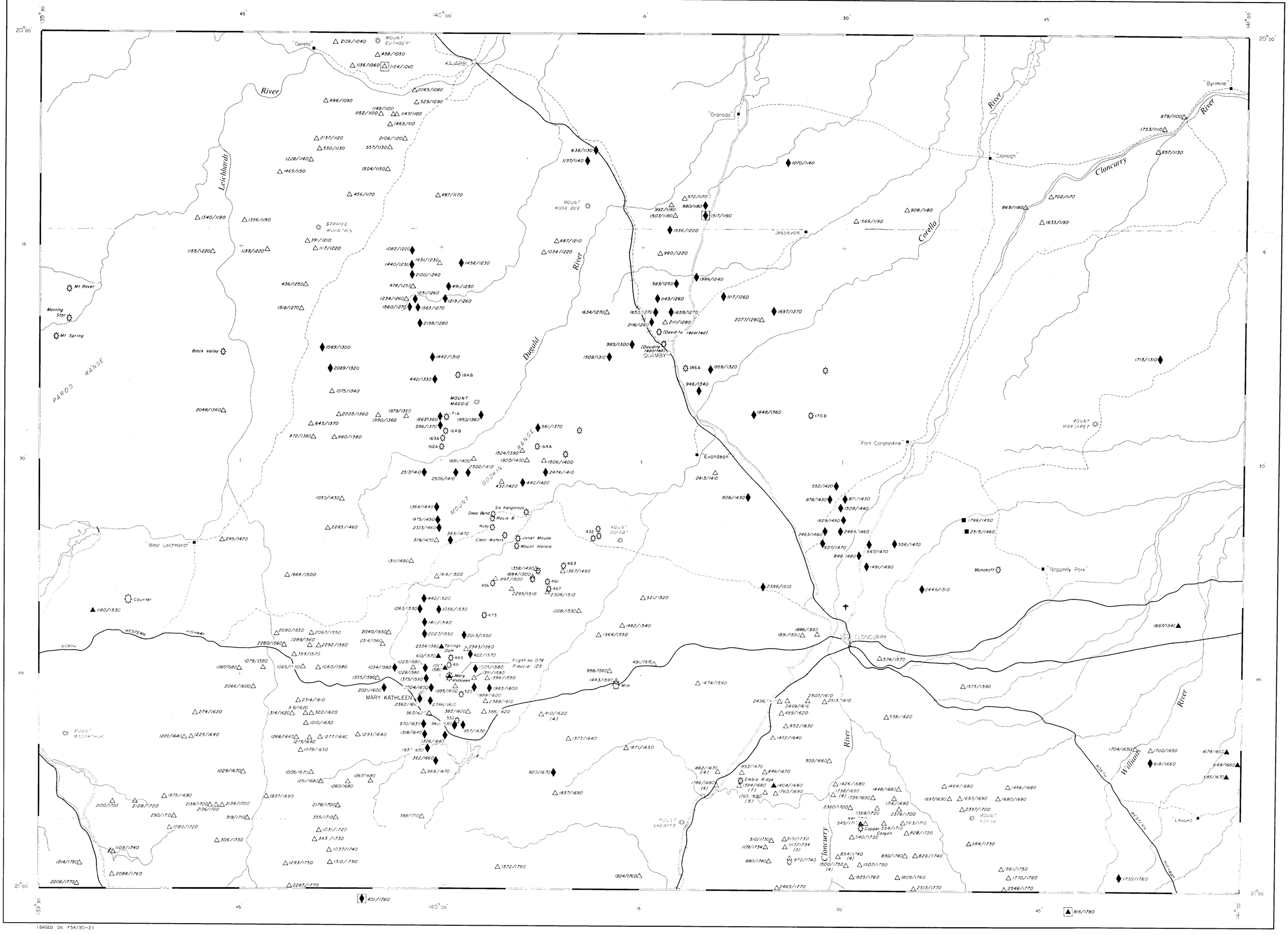
F54/BI-109

AUSTRALIA 1:250 000

CLONCURRY

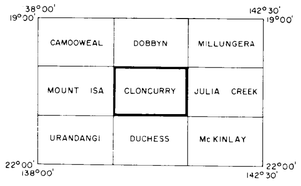
QUEENSLAND

PLATE 6



(BASED ON F54/90-21)

INDEX TO 1:250 000 MAP SERIES



TOPOGRAPHICAL LEGEND

- Highway or main road
- Secondary road
- Road or track
- Railway
- Built-up area
- Named place
- Homestead
- Mine
- Aerodrome or landing ground

AIRBORNE SURVEY, CLONCURRY, QLD 1973

RADIOMETRIC INTERPRETATION

KILOMETRES 5 0 5 10 15 20 KILOMETRES

CHANNEL RANGES

Channel 1 : 0·84 — 2·90 MeV
Channel 2 : 1·30 — 1·60 MeV
Channel 3 : 1·60 — 1·90 MeV
Channel 4 : 2·40 — 2·80 MeV

NOTE: *Details of counts in each channel are listed in text.*

GEOPHYSICAL LEGEND

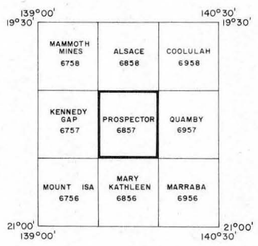
- Anomaly predominantly due to potassium
- (4) Anomaly due to a mixed potassium and uranium source. Number gives channel 3/channel 4 count ratio if 3 or more
- Anomaly predominantly due to uranium
- Anomaly predominantly due to thorium
- Mixed source
- Locality tested on ground
- Mila / Rossie B / 459 — Major and minor uranium occurrence. Names and numbers from 'Cloncurry', Marraba, Mary Kathleen and Prospector 1:100 000 geological maps
- 823/1690 Anomaly peak fiducial number and flight-line number

Record No. 1975/74

F54/BI—110

PLATE 7

INDEX TO 1:100 000 MAP SERIES



DETAILED AIRBORNE SURVEY, PROSPECTOR, QLD 1973

PRELIMINARY TOTAL MAGNETIC INTENSITY PROFILES

KILOMETRES 2 0 2 4 6 8 KILOMETRES

APPROX. PROFILE SCALE : 2000 gammas/cm

EXPLANATORY NOTES

This map was compiled from an airborne magnetic survey made by the Bureau of Mineral Resources in 1973.

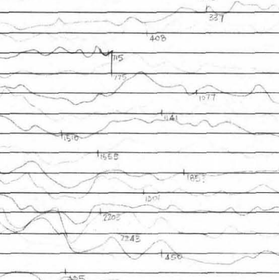
The magnetic profiles were recorded at a nominal altitude of 80 metres above ground level along east-west lines spaced approx. 0·5 km apart.

This map should be used in conjunction with the flight-line map F54/B1-114.

Record No. 1975/74

F54/B1-111

INDEX TO 1:100 000 MAP SERIES



DETAILED AIRBORNE SURVEY, PROSPECTOR, QLD 1973

PRELIMINARY TOTAL COUNT RADIOMETRIC PROFILES

KILOMETRES 2 0 2 4 6 8 KILOMETRES

APPROX. PROFILE SCALE : 140 counts/s/cm

EXPLANATORY NOTES

This map was compiled from an airborne radiometric survey made by the Bureau of Mineral Resources in 1973.

The radiometric data were recorded at a nominal altitude of 80 metres above ground level along east – west lines spaced approx. 0·5 km apart

The detector volume was 3550 cm^3 and the profiles displayed are those of gamma-ray intensity in the energy range 0·84 to 3·00 MeV. The time constant was 3

The profiles have been corrected for background radiation (ie. the baselines represent zero terrain emission)

Record No. 1975/74

F54/B1–112

PLATE 9

139°30' 40' 50' 140°00'
20°00'

"Gereta"

238/2120

379/2151

(3) 356·5/2151

308/2151

Creek

501/2160 (4)

506/2160

Surprise

906·5/2180

950/2180

952/2180

1079·5/2190

1077/2190

1104/2190

Leichhardt

1165/2190 (3)

1255·5/2200

River

254/2250

874·5/2270 (7)

1068/2280

1090·5/2280

374·5/2371

Julius Dam (under construction)

Creek

Creek

640/2331

Cromwell Creek

Wodgil Creek

1223·5/2421

White Gorge Creek

10'

1926·5/2461

1741/2451

Miranda

Prospector Creek

River

302/2490

366/2521

(4) 1469/2550

1388/2550

Parao Creek

644/2590

Mt Remarkable

1394/2630

1377/2630

1600/2640 (3)

694/2710

Leichhardt

906/2720

1102/2730

1457/2750

"Glenroy"

1873/2770

2153/2780

Conglomerate Creek

457·5/2820

622/2830

20'

1954/2900 (5)

2008·5/2900

460/2930

RANGE

Creek

756·5/2950 (3)

750·5/2950

580/2940

1129/2970 (3)

PAROO

River

1782/2970

Police Creek

1301/3020

2498·5/3040

2530·5/3040

245/3050

2202·5/3020 (3)

Spider Creek

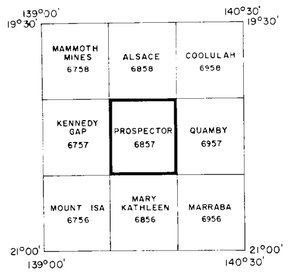
Leichhardt

911·5/3090

701·5/3160

20°30'
139°30' (BASED ON F54/B0-35) 40' 50' 140°00'

INDEX TO 1:100 000 MAP SERIES



LOCATION DIAGRAM

DETAILED AIRBORNE SURVEY, PROSPECTOR, QLD 1973

RADIOMETRIC INTERPRETATION

KILOMETRES 2 0 2 4 6 8 KILOMETRES

TOPOGRAPHICAL LEGEND

- Minor road
- Vehicular track
- Railway (abandoned)
- Homestead
- Aerodrome or landing ground

GEOPHYSICAL LEGEND

- △ Anomaly predominantly due to potassium
- (4)△ Anomaly due to a mixed potassium and uranium source. Number gives channel 3/channel 4 count ratio if 3 or more
- ▲ Anomaly predominantly due to uranium
- ♦ Mixed source

238/2110 Anomaly peak fiducial number and flight-line number

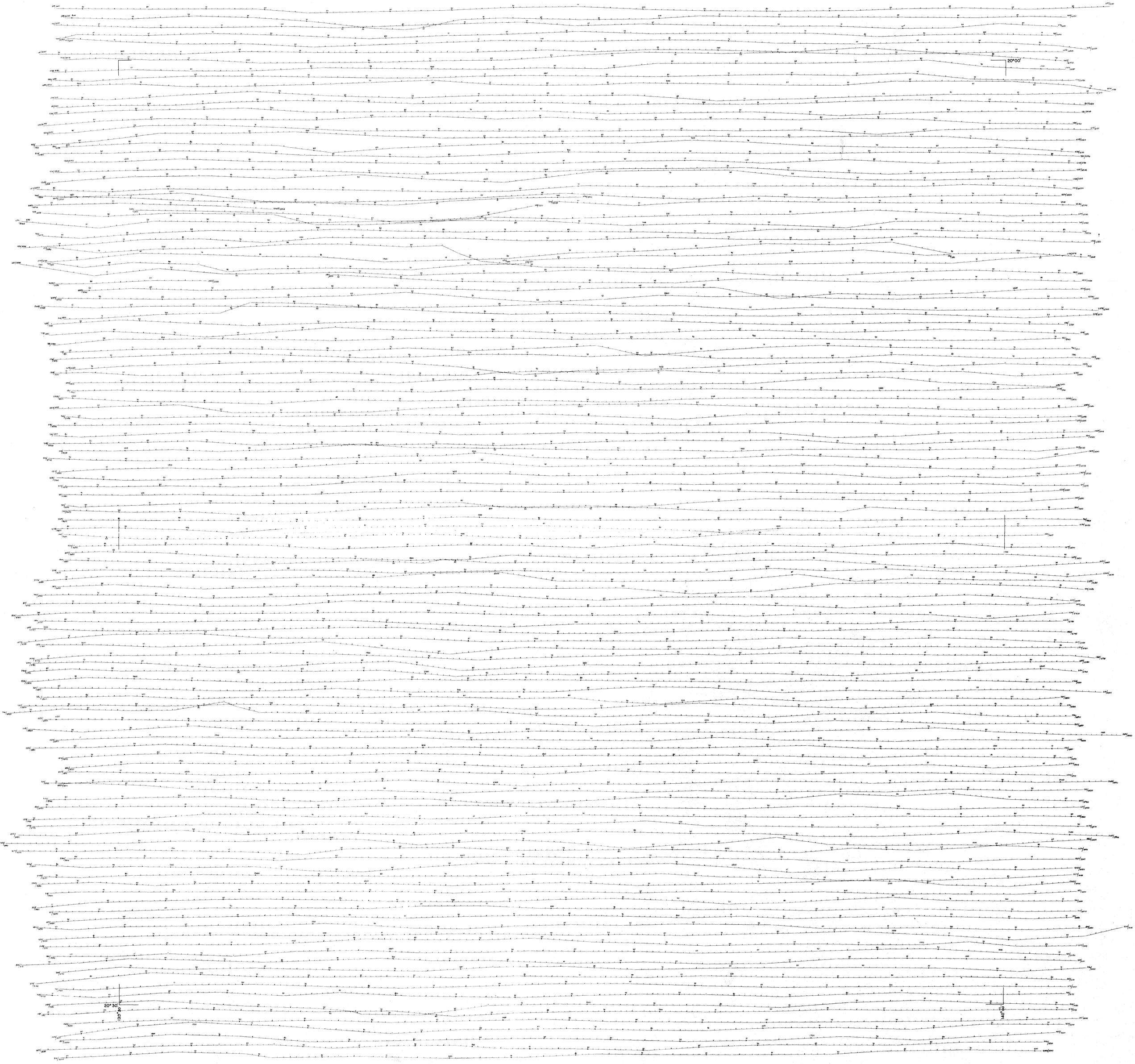
CHANNEL RANGES

Channel 1	0·84	— 2·90 MeV
Channel 2	1·30	— 1·60 MeV
Channel 3	1·60	— 1·90 MeV
Channel 4	1·90	— 2·80 MeV

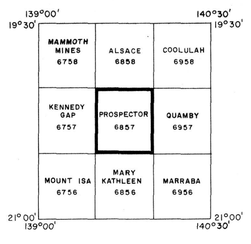
Record No. 1975/74

F54/B1-113

PLATE 10



INDEX TO 1:100 000 MAP SERIES



DETAILED AIRBORNE SURVEY, PROSPECTOR, QLD 1973

PRELIMINARY FLIGHT-LINE MAP

KILOMETRES 2 0 2 4 6 8 KILOMETRES

LOCATION DIAGRAM

Record No. 1975/74

F54/B1 - 114

139°30'
20°00'
140°00'
20°00'
21°00'
139°30'
21°00'
140°00'

MT ISA
MARY KATHLEEN
CLONCURRY
FAULT
CAMERON
CORELLA
Corella River
Clancurry River
Williams River

GEOLOGICAL LEGEND

- Klo — *Toolebuc Limestone*
- Pgu — *Naraku Granite*
- Pgw — *Wonga Granite*
- pCk — *Kalkadoon Granite*
- Pld — *Deighton Quartzite*
- Plc — *Corella Formation*
- Plm — *Marimo Slate*
- Ploj — *Overhang Jaspilite*
- Plu — *Surprise Creek Bed, Mt Isa Group*
- Ply — *Myally Beds, equivalents*
- Pla — *Marraba volcanics*
- Ple — *Eastern Creek Volcanics*
- Pls — *Soldiers Cap Formation*
- Plg — *Mt Guide Quartzite*
- Pln — *Argylla Formation*
- Plm — *Magna Lynn Basalt*
- pCl — *Leichhardt Metamorphics*
- *Fault*
- *Concealed fault*

INDEX TO ADJOINING SHEETS

CAMOOWEAL	DOBBYN	MILLUNGERA
MT ISA	CLONCURRY	JULIA CREEK
URANDANGI	DUCHESS	McKINLAY

138°00' 142°30' 19°00' 22°00'

Geology after Carter et al 1961.

AIRBORNE SURVEY, CLONCURRY QLD, 1973

GEOLOGY

KILOMETRES 5 0 5 10 15 20 KILOMETRES

SCALE: 4 miles to 1 inch

Record No. 1975/74

F54/BI—115