BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

1980/78

WESTMORELAND AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, QLD 1973

by

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ABSTRACT

An airborne magnetic and radiometric survey of the WESTMORELAND 1:250 000 Sheet area in northwest Queensland was made by the Bureau of Mineral Resources during August and September 1973.

Rocks exposed in the area are Precambrian sediments and volcanics in the west and Cainozoic and Mesozoic sediments in the east. Linear magnetic anomalies trend east across the area and are associated with a similar trend in the strike of the Precambrian rocks, which are interpreted as underlying the younger sediments to the east at shallow depth. An attempt is made in the interpretation to divide magnetic anomalies into zones according to their character and to associate such zones with rock units in tabular form. Where possible the depth of burial of source rocks is also tabled.

Areas of anomalous surface radioactivity are delineated in the Precambrian sediments but radiometric activity over the Cainozoic sediments is minimal. Radiometric anomalies are classified with respect to their probable source type, which is found to be predominantly potassium.

1. INTRODUCTION

BMR in cooperation with the Geological Survey of Queensland has for a number of years engaged in an integrated program of detailed geological mapping, geophysical surveys, age determination, and geochemistry in the Precambrian belt of northwest Queensland. Since the initial discovery of uranium near Mary Kathleen, detailed radiometric surveys have been made over most of the areas of Precambrian rocks exposed in the mineral belt.

Such Precambrian rocks are exposed in the western third of the WESTMORELAND* 1:250 000 Sheet area, which is bounded by latitudes 17° and 18°S and longitudes 138° and 139°30'E (Fig. 1). Earlier radiometric surveys in the west of WESTMORELAND led to the discovery of several uranium occurrences.

During 1973 BMR flew a regional aeromagnetic and radiometric survey over WESTMORELAND to assist geological mapping and to provide basic geophysical data for use in mineral exploration. Although the survey was designed to be flown with north-south lines 1.5 km apart, it was found that only the western one-third of the sheet area needed to be flown at this spacing. In the eastern two-thirds of the sheet area, where Phanerozoic sediments overlie Precambrian basement, a 3 km line spacing proved to be adequate.

The Precambrian rocks in the west of the sheet area are mainly unmetamorphosed interlayered sediments and volcanics which are almost flat-lying and form an upland area. The eastern two-thirds of the sheet area is covered by Cainozoic and Mesozoic sediments.

2. GEOLOGY

The Precambrian geology of the area has been described by Carter (1959), Carter, Brooks & Walker (1961), Roberts, Rhodes & Yates (1963), Plumb & Sweet (1974), Sweet & Slater (1975), Mitchell (1976), Gardner (1978); the Cainozoic and Mesozoic geology has been described by Grimes (1974). The 1:253 440 scale geological map of Carter (op. cit.) has been superseded by the 1:250 000 scale compilation based on the most recent mapping (Plate 1).

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*Names in capitals in this Record refer to the 1:250 000 Sheet areas

PHYSIOGRAPHY

The WESTMORELAND sheet can be divided into three main physiographic units.

a) Coastal dunes, swamp and tidal areas which extend as much as 30 km inland in the northeast of the sheet area.

b) Level to gently undulating plain country which occupies about two-thirds of the sheet area. The plains lie between sea level and 100 m, and drain east and northeast to the coast.

c) An elevated dissected area of extensive rock outcrop which lies in the west and southwest of the sheet, between 70 and 270 m above sea level.

STRATIGRAPHY

i) Precambrian

The Precambrian geology falls into four tectonic divisions, the central east-trending Murphy Tectonic Ridge, the South Nicholson Basin and Lawn Hill Platform to the south, and the Wearyan Shelf (McArthur Basin) to the north. These main divisions are indicated in Figure 1. The detailed stratigraphy is shown in Plate 1.

Murphy Tectonic Ridge. The exposed part of this east-trending feature consists mainly of the Nicholson Granite Complex and the Cliffdale Volcanics, both of which are extensively intruded by acid porphyry tykes. Basic dykes are rare. Schists occur beneath the Cliffdale Volcanics on CALVERT HILLS to the west.

McArthur Basin - The Wearyan Shelf. Amongst the rock units in this part of the basin the Westmoreland conglomerate is considered to be the most prospective for uranium mineralisation, and hence most appropriate for radiometric surveying.

South Nicholson Basin and Lawn Hill Platform. The Lawn Hill Platform contains rocks of similar age and lithology to those of the Wearyan Shelf, but the sequence is thinner and the proportion of volcanics to sediments is higher.

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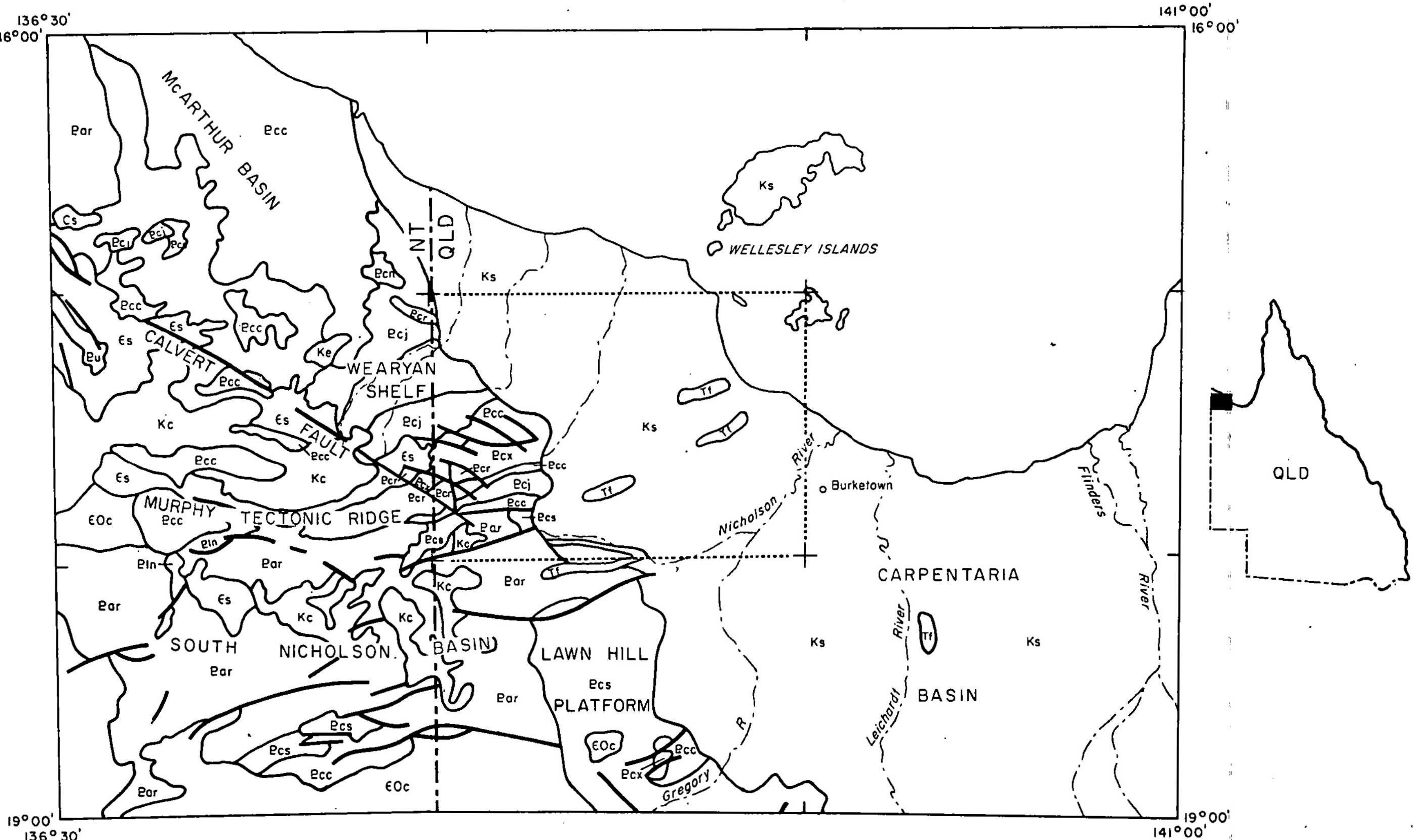


REGIONAL GEOLOGY OF WESTMORELAND AND FRINGE AREAS

GEOLOGICAL LEGEND

0 50 100 km

Fault — Geological Boundary

CAINOZOIC	Tf	*Sandstone, conglomerate.*
MESOZOIC	Kc & Ks	*Sandstone, siltstone, mudstone, limestone, conglomerate.*
PALAEOZOIC	Є0c	*Limestone, shale, siltstone, dolomite, mudstone, limestone.*
	Єs	*Sandstone, shale, limestone, siltstone, conglomerate.*
PROTEROZOIC	Ꝑar	*Sandstone, siltstone, conglomerate, shale.*
	Ꝑcs	*Siltstone, sandstone, quartzite, limestone, dolomite, conglomerate, shale.*
	Ꝑcc	*Sandstone, shale, conglomerate, dolomite, acid volcanics*
	Ꝑcj	*Mainly basic volcanics, minor acid volcanics*
	Ꝑcr	*Granitic rocks*
	Ꝑcx	*Acid volcanics*
	Ꝑln	*Low grade metamorphics*

E54/B1-87A

FIGURE 1

The Fickling Group occurs only in the Lawn Hill Platform, and consists of sandstone, silicified dolomite, and siltstone. These rocks are regarded as equivalent to part of the Mount Isa Group and accordingly have been prospected for base metal mineralisation.

The sandstones, siltstones, and shales of the South Nicholson Basin are the youngest Precambrian rocks in the region. They contain major oolitic iron deposits in the Constance Range area in LAWN HILL (Harms, 1965).

ii) Mesozoic

Many small mesas on the Precambrian rocks are capped by flat-lying, generally lateritised Mesozoic sediments. The maximum thickness of these sediments measured in outcrop in WESTMORELAND is 30 m, but a considerably greater thickness of Mesozoic strata lies beneath the soil and laterite of the plains country (Gibson & others, 1973). A bore at Burketown penetrated nearly 700 m of (?)Mesozoic sediments (Doutch & others, 1970).

iii) Cainozoic

Cainozoic sediments cover much of the sheet area and include both lateritic and sandy soils, and coastal sediments.

IGNEOUS ROCKS

Rocks of the Nicholson River Granite Complex crop out in places in the central western part of the area. With the exception of the extensive acid porphyry dykes in the Murphy Tectonic Ridge, intrusives of any kind are rare.

METAMORPHIC ROCKS

The Precambrian rocks in WESTMORELAND are essentially unmetamorphosed.

STRUCTURE

The outcropping Precambrian strata lap onto the Murphy Tectonic Ridge, which formed a divide between the Lawn Hill Platform and the McArthur Basin during part of the middle Proterozoic. Dips in sediment and volcanics are generally less than 30°, and rocks are strongly jointed.

The most prominent faults in, and north of, the Murphy Tectonic Ridge, strike west-northwest and northeast. All of these dip at high angles and some are filled by sheared porphyry dykes (I.P. Sweet, pers. comm.). East to east-northeast fault trends are reported in and south of the Murphy Tectonic Ridge. Mesozoic strata are almost flat lying and have not been faulted.

MINERALISATION

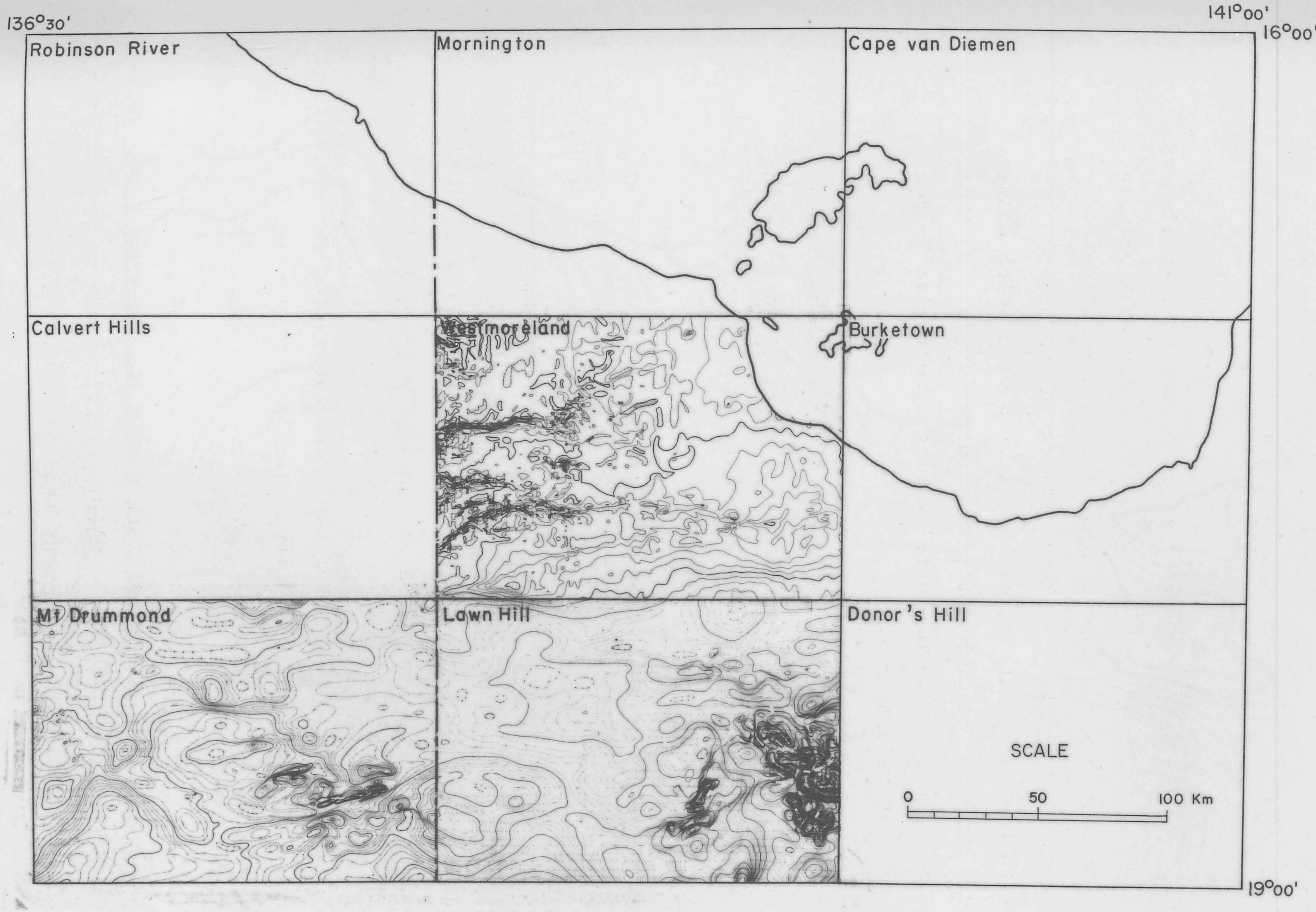
The WESTMORELAND area lies in a major uranium province. Livingstone (1957) recorded radiometric anomalies over the Westmoreland Conglomerate; as a result, follow-up work has led to the discovery of several sub-economic uranium occurrences (Plate 1). Both primary and secondary uranium mineralisation are known, the former associated with joint zones and the latter occurring in stratiform deposits (Brooks, 1972). In the adjacent sheet, CALVERT HILLS, uranium mineralisation occurs also in the Cliffdale and Peters Creek Volcanics.

Other minor mineralisation includes malachite and galena, which occur in narrow fissure veins and disseminations in rocks of the Fickling Group in the Gorge Creek area, and some tin associated with granite.

3. PREVIOUS GEOPHYSICAL SURVEYS

In 1956 BMR flew a low-level airborne radiometric survey in the Nicholson River region which included the Precambrian outcrop in WESTMORELAND (Livingstone, 1957). The survey was flown at 60 m above ground level along north-south lines spaced at 300-400 m intervals. Ninety-one anomalies were selected from the survey results, which led Livingstone to suggest that the Westmoreland Conglomerate was the most prospective formation. The location of numerous uranium occurrences during subsequent exploration (Brooks, 1972) supported this view.

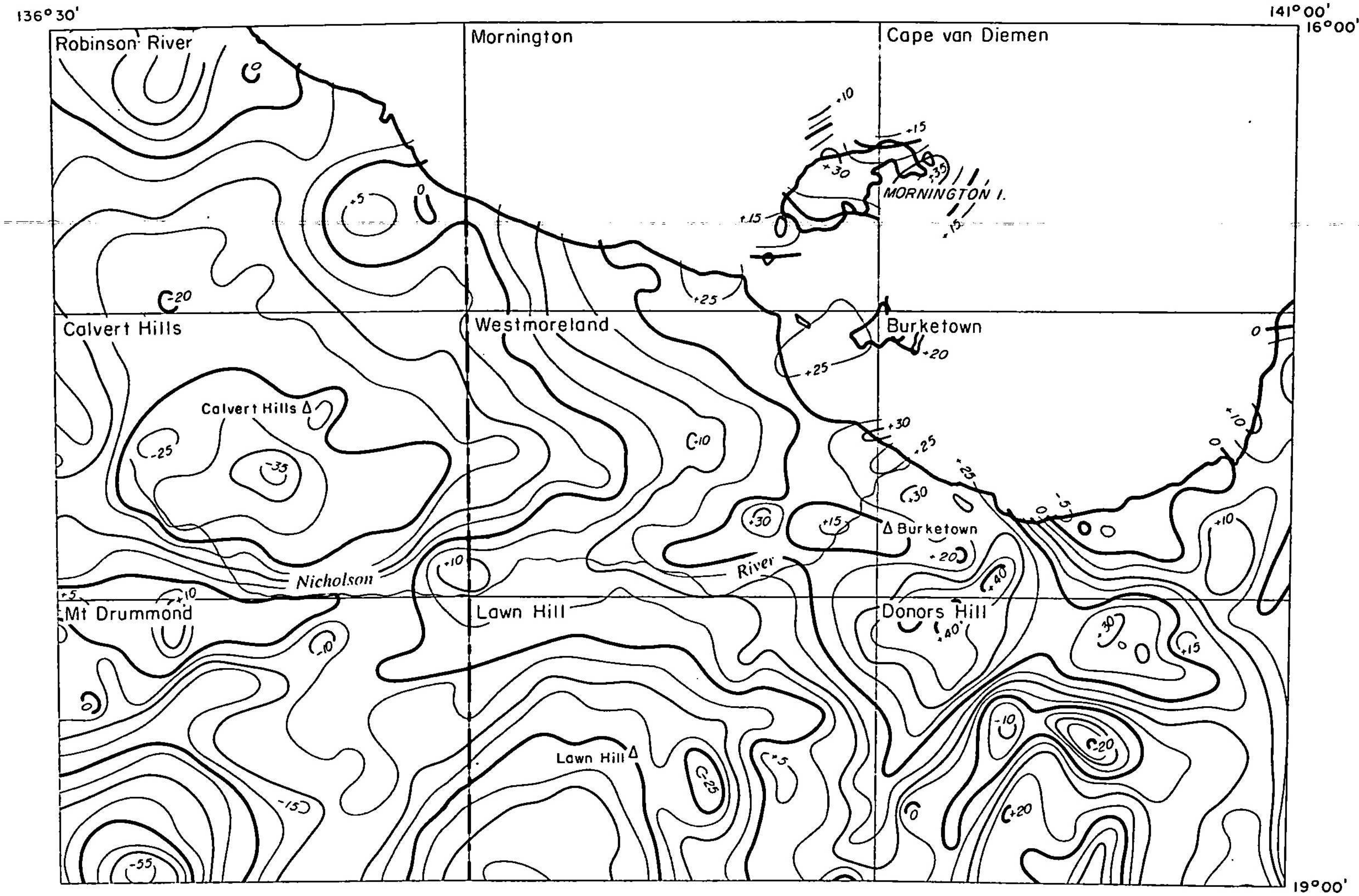
Before this 1973 survey, no aeromagnetic work had been done in WESTMORELAND. Of the adjacent sheet areas, only LAWN HILL and MOUNT DRUMMOND had been flown, in 1964 (Fig. 2). These surveys showed mainly broad low-amplitude anomalies typical of those expected over thick



TOTAL MAGNETIC INTENSITY OF
WESTMORELAND AND FRINGE AREAS

E54/B1-88A

FIGURE 2



BOUGUER ANOMALIES OF WESTMORELAND AND FRINGE AREAS

-20 *Isogals*

Δ *Isogal stations*

Bouguer density = 2·2 g/cm³

0 50 100 km

accumulations of non-magnetic sediments. On LAWN HILL, a small group of high-amplitude anomalies at about 18°40'S, 139°E was recorded over exposure of volcanics belonging to the Myally beds. The large area of high-amplitude anomalies in the east of the sheet may be caused by similar rocks beneath Cainozoic and possibly older cover rocks. In the east of MOUNT DRUMMOND the high-amplitude anomalies were recorded over the Carrara Range Formation, part of which is possibly equivalent to the Peters Creek Volcanics (I.P. Sweet, pers. comm.), which crop out in WESTMORELAND.

WESTMORELAND has been covered by BMR helicopter gravity surveys on an 11 km grid, the results of which are shown in Figure 3. Correlations of the Bouguer anomalies with geology are indefinite. Broadly speaking the McArthur Basin and the South Nicholson Basin lie in regions of Bouguer anomaly lows and are separated by a narrow belt of Bouguer anomaly highs which extends from MOUNT DRUMMOND across WESTMORELAND to BURKETOWN. The gravity lows are probably caused by the thick accumulations of unmetamorphosed Proterozoic and younger sediments.

The most prominent Bouguer anomaly apparent in the survey area is the broad gravity low which extends from CALVERT HILLS across WESTMORELAND to the Gulf of Carpentaria. This trend direction is essentially the same as that of the gravity high belt mentioned above which lies about 10 km south of the acid rocks of the Murphy Tectonic Ridge, and reflects the major structural trend of the area. The origin of the belt of highs, apparently related in some way to the Murphy Tectonic Ridge, is not clear. A 10 mGal culmination in the southwestern corner of WESTMORELAND lies over exposures of Fickling beds. These are calcareous rocks with 50-80 percent carbonate (I.P. Sweet, pers. comm.) and probably are denser than most other units within the region. A 10 mGal culmination near the northern margin of MOUNT DRUMMOND lies over basement schists. On the available evidence it appears that the Bouguer anomaly high in the region of the Murphy Tectonic Ridge is partly caused by the thick section of Fickling beds and older sediments, and partly by dense rocks of an underlying basement. The basement in the area is unlikely to be of granitic composition.

4. MAGNETIC RESULTS AND INTERPRETATION

Acquisition of data

Details of the equipment are shown in Appendix 1. It was found that with the north-south flight-line direction some instrument noise was recorded. This noise becomes a problem when it is similar both in amplitude and frequency to some of the smaller magnetic anomalies. Its presence has in some cases prevented the making of reliable depth estimates.

Presentation of data

The data are presented as stacked profiles of total magnetic intensity in Plate 2; the flight-lines are shown in Plate 3. The stacked profiles were produced at a horizontal scale of 1:250 000 by manual reduction of hand-smoothed magnetometer records. Because the horizontal reduction factor varied from line to line, depending on aircraft ground speed, the vertical scale of the profiles also varies from line to line. On average the vertical scale is 140 nT/cm. A contour map of total magnetic intensity is presented in Plate 8. The magnetic interpretation shows depth estimates to magnetic basement, and zones of anomalies which are attributed to similar magnetic rock types (Plate 4).

Interpretation methods

The results of 1:100 000 scale geological mapping of the areas of Precambrian outcrop are now available; the aeromagnetic survey could not be expected to produce a geophysical pattern as detailed as the known geological subdivision of formations, but reliable correlation of the magnetic anomalies with specific formations was possible. An attempt has been made to identify anomalies that have obvious explanations in the known geology, and also to recognise anomalies that do not have obvious geological expression. This latter class of anomalies may be associated with possible basic dykes and plugs. The good geological control in the west of the area has facilitated the identification of rock formations under Cainozoic cover to the east of the Precambrian outcrop.

Depth estimates were made where suitable magnetic anomalies were amenable to analysis. However, owing to instrument noise the results should be used with caution. Wherever possible, elongated symmetrical anomalies were analysed. Where the source was thought to be a dipping tabular body with width less than the altitude of the detector, the simple interpretation methods of Peters (1949) such as the 'half-maximum-slope' and 'half-width' methods were applied. For noisy data the 'half-width method' is the more reliable and consequently was the main method used. Assymmetrical anomalies were interpreted by the method of Gay (1963), which yields dip values as well as depth estimates. Results obtained are shown on the interpretation map (Plate 4).

Magnetic susceptibilities (k) of exposed rock units, and of various unexposed magnetic bodies, were estimated to aid the identification of the unexposed magnetic rocks. The method of Gay (1963) was used for inductively magnetised tabular bodies which strike east-west, applying the relation:

$$k = (AZ)/(2To't)$$

where A is amplitude in nT
Z is depth of source below aircraft
t is thickness of source
To' is effective field strength in nT
(49 000 nT in this area for bodies of east-west strike)

In most cases, source thickness was taken as the formation thickness measured in the field by I.P. Sweet (pers. comm.). If several sources were detected within a formation the thickness was taken as equal to half the distance between source and detector. This approach gave minimum values of estimated susceptibility of the source. It should be noted however that if remanent magnetisation is also present the values of susceptibility obtained could be subject to gross error.

Results of interpretation

A geological cross-section with a corresponding magnetometer trace is shown in Plate 5, to give an impression of the aeromagnetic pattern over various formations.

The magnetic contour pattern in WESTMORELAND is generally of low relief. The most prominent features are narrow curvilinear and linear anomalies which lie over outcropping or near-surface volcanic rocks. In this regard the magnetic effect of the Precambrian rocks in WESTMORELAND is as expected over unmetamorphosed dipping sequences of interlayered volcanics and sediments. The volcanic rock formations produce high-amplitude magnetic anomalies, and the sediments produce a few curvilinear low-amplitude anomalies. The magnetic pattern is dominated by linear belts of anomalies which trend east-west and are essentially parallel to the geological strike, or to faults. The amplitude of these anomalies is in the range 100-300 nT. They extend over the plain of Cainozoic and Mesozoic sediments in the eastern part of WESTMORELAND, and are here interpreted as being caused by magnetic rocks about 300-100 m below the surface.

Remanent magnetisation may be important in some localised cases on WESTMORELAND. Included in Plate 5 are theoretical total-field magnetic anomalies over inductively magnetised, thin, dipping tabular bodies striking east-west. Three examples are chosen - gentle dip to the north, gentle dip to the south, and vertical dip. Although these theoretical anomalies range from predominantly positive to predominantly negative, all have a very slight maximum on the northern side. Examination of the profile in Plate 5 and the stacked profiles (Plate 2) indicates that some anomalies have a distinct minimum on the northern side, or are contrary in sign to that expected for the known geological dip angles. One explanation for this is that the source rocks possess an element of remanent magnetisation in a different direction from the present earth's magnetic field.

Another explanation for the presence of linear magnetic anomalies with a negative on the northern side could be that the source is a step fault rather than a dipping tabular body. As a guide to some of the shapes of step fault anomalies, a set of theoretical profiles for three possible geological situations is included in Plate 5.

Table 1

Magnetic character of rock units on Westmoreland - Along section from North to South

Formation	Symbol	Anomaly Amplitude (nT)	Estimated Susceptibility (cgs unit $x10^{-6}$)	Zone	Character
Hobblechain Rhyolite Member	Pth	?		1)	These formations are flat lying and thin. A disturbed magnetic pattern of anomalies of 50-200 nT in amplitude occurs both over the outcrops and over Cainozoic sediments for 5-10 kilometres around the outcrops. These anomalies are probably caused by Ptg and/or Pte.
Gold Creek Volcanic Member	Ptg	?		1)	
Wollogorang Formation	Pto	?		1)	
Settlement Creek Volcanics	Pte	?		1)	
Aquarius Formation	Ptq	?		1)	
Sly Creek Sandstone	Ptl)	50		17 }	Broad anomalies with indefinite trend to north.
McDermott Formation	Ptd)			17 }	EW trend close to southern margin of Ptl may be due to Ptd.
Seigal Volcanics	Pts	50-500	500-5000	4	Prominent trend ENE parallel to strike of outcrop of inliers north of Lagoon Creek. Irregular pattern in south of Lagoon Creek is probably due to Pts under Cainozoic.
Westmoreland Conglomerate	Ptw	-	100	7	Magnetically quiet.
Cliffdale Volcanics	Pcc5		300-500	8	Mainly anomalies with indefinite trend directions.
Cliffdale Volcanics	Pcc4	30-50 200-400	2000-4000	8	Some E.W. trends run parallel to or lie over boundary faults and porphyry dykes; in addition there are many anomalies with indefinite trend direction.
Cliffdale Volcanics	Pcca	50-100	500-1000	8	Some EW trends. Some anomalies have indefinite trend direction and therefore appear to be caused by localised rather than linear sources.
Nicholson Granite	Pgn	-	100	10	Magnetically quiet.
Wire Creek Sandstone	Pti	-	100		Magnetically quiet.
Peters Creek Volcanics	Ptp1	200-400	2000-4000	11	Trends run parallel to strike of outcrop.
Peters Creek Volcanics	Ptp2	20-50	200-500		Negative anomaly runs parallel to strike of outcrop.
Peters Creek Volcanics	Ptp3	-	100		Magnetically quiet.
Peters Creek Volcanics	Ptp4	20-50	600-1500		Some trends run parallel to strike of outcrop.
Peters Creek Volcanics	Ptp5	-	100		Magnetically quiet.
Peters Creek Volcanics	Ptp6	50-100	300-600	12	Trend runs parallel to strike of outcrop.
Peters Creek Volcanics	Ptp7	50	500	12	Trends parallel to outcrop.
Fish River Formation	Ptf	20-50 50	200-500		Trend parallel to outcrop. A negative trend lies close to contact between Ptf and Pf.
Fickling Group	Pf	-	100		Magnetically quiet but see note for Ptf.
Constance Sandstone	Psa	-	100		Magnetically quiet.

Response of the various formations outlined above may differ from that shown on plate 5 for the Profile FG. All the stacked profiles were used for the compilation above.

Exposed Precambrian rock units. Table 1 summarises the magnetic field recorded over near-surface sources within known rock units. This should be examined in conjunction with Plate 4, where anomalies have been zoned for reference purposes. Anomalies arising from deep sources are referred to later in the text. The correlation of specific anomalies with particular rock units was found to be difficult, probably because the very shallow dips make some rock exposures thin and contacts irregular.

The basic extrusive rocks of the Peters Creek Volcanics and the Seigal Volcanics are the most magnetic, but the acid units of the Peters Creek Volcanics are not magnetic. Rhyolites and ignimbrites of the Cliffdale Volcanics appear to be magnetic and produce linear anomalies. A preliminary microscopic examination of selected thin sections of Cliffdale Volcanics by J. Mitchell revealed up to 0.5% magnetite in ignimbrite and traces of magnetite with abundant hematite in rhyolite. The acid porphyry dykes in the Cliffdale Volcanics also had associated magnetic anomalies but thin sections were not available for study. The acid porphyry dyke rocks examined do not appear to contain magnetite.

The sedimentary rocks are generally non-magnetic, but a low-amplitude linear anomaly was recorded over the Fish River Formation, indicating variations of magnetite content within it, possibly associated with siltier portions.

Faults. Some of the faults mapped on WESTMORELAND have linear magnetic anomalies adjacent to them which might indicate the presence of magnetic rocks in the fault planes, or alternatively marked difference in the magnetic properties of rocks on either side of the faults. It is not possible to distinguish between these two kinds of anomaly source by analysis of the magnetic anomalies, especially if remanent magnetisation is present or if the anomalies are not well resolved. This latter situation is common in WESTMORELAND.

Table 2 summarises the magnetic anomalies adjacent to various faults, and in selected cases offers interpretation. Negative anomalies were recorded over some of the faults in the area; these included step fault anomalies where the more magnetic material is on the northern side (see Plate 5), e.g. faults F1, F3, F5 in Plate 4. In other localities the negative anomalies cannot be accounted for in this way, and are more likely to be due to magnetic rocks infilling the fault planes; positive linear anomalies appear to be associated with faults F6, F7, and F8.

A prominent east-trending 100 nT anomaly in Zone 14 lies 1000-1500 m north of fault F7 in an area of Constance Sandstone. The anomaly extends for about 35 km to the east of the mapped extremity of the fault, and may indicate an eastern extension of the fault. Eastward, the anomaly increases in amplitude and appears to divide into three peaks. Interpretions using the dipping tabular body model show that the depths to the magnetic rocks range from about 900 m in the west to 1600 m in the east. The anomaly trends in Zone 14 lie on the Bouguer anomaly high discussed in Chapter 3, and generally correspond to structural trends in the area.

Several interpretations of these magnetic anomalies are possible. Firstly, they could be caused by unexposed inductively magnetised beds dipping south at about 20-30° and with a magnetic susceptibility of approximately 2000 x 10^{-6} cgs units. This susceptibility is approximately that measured for the Peters Creek Volcanics (Appendix 2). Thus the Peters Creek Volcanics may be repeated in Zone 14. If fault F7 caused this repetition then the fault plane would have to dip northwards at about 30-40°. Field evidence shows the fault is almost vertical (I.P. Sweet, pers. comm.). Despite this lack of agreement the faults F7 and F8 may be only minor expressions of a more extensive fault system beneath the Constance Sandstone. Secondly, the anomalies could be caused by some other unexposed and hence unrecognised magnetic formation, in the Precambrian section and possibly unconformably overlain by younger formations.

Thirdly, the anomalies could be caused by dolerite dykes. If this is so, they may intrude part of the Proterozoic section. If the measured thicknesses of Table 1 are used as a guide, then the dykes may have intruded the Fish River Formation.

Another fault of special interest in F1, described in Table 2, which is parallel to a 50 nT anomaly. One thousand metres to the north of fault F1 another higher-amplitude and better-defined anomaly exhibits a similarly parallel trend and extends for approximately 25 km in zones 4 and 6. This is a symmetrical anomaly positive to the north with an amplitude of 700 nT. It can be interpreted in terms of the dipping tabular body model, in which case the source body, if inductively magnetised, could be a thin near-vertical dyke at a depth of 200-500 m below the surface, with a magnetic susceptibility of about 5000 x 10^{-6} cgs units. Such a susceptibility is consistent with that measured for samples of Seigal Volcanics (Appendix 2).

The anomaly source could be a feeder dyke for the widespread Seigal and Peters Creek Volcanics, or alternatively a remanently magnetised tabular body conformable with the other sediments in the area. Again the most likely source is the Seigal Volcanics. The alternative interpretation is less favoured because there is no clear evidence of strong remanent magnetisation of the Seigal Volcanics. Furthermore the nearby parallel fault suggests the presence of basement fractures with which dykes are often associated.

Localised anomalies. Various anomalies from near-surface sources of limited strike extent were recognised in the area. These are designated A to G in Plate 4. The most likely sources for anomalies of this kind are plugs or small dyke swarms of basic igneous rocks. Table 3 lists the anomalies and interpretations.

Magnetic basement beneath Mesozoic and younger sediments. This has been interpreted mainly in terms of the exposed Proterozoic rock units in the west of the sheet area. Generalised contours of depth to magnetic basement are shown in Plate 4. Table 4 gives an interpretation of the zones of anomalies recognised in the area.

The depth estimates are maximum depths to magnetic rocks. The basement surface of Precambrian rocks could lie at considerably shallower depths. For example in Zone 14 and to the east of it, the magnetic rocks lie beneath about 900 m of sediments in the area of outcrop of Precambrian rocks.

Table 2

Linear Magnetic anomalies near Faults

Fault Reference	Trend	Anomaly Amplitude (nT)	Notes on Character
F1	ENE	-50	Poorly resolved near-surface source anomaly. Fault marks N side of Westmoreland Conglomerate, and contact with S side of (?)Peters Creek Volcanics.
F2	NW	mainly -20 in west	Poorly resolved anomaly follows western part of fault. Source may be deep (500-1000 m). Intrusive body, may dip N.
		± 30 near centre	A well defined asymmetrical anomaly from a near-surface source is located near centre of fault. May be a near vertical magnetic plug.
F3	EW	-50	Poorly resolved anomaly follows mapped length of fault. Source may be magnetic rocks in the fault plane, or be caused by a vertical displacement of the Cliffdale Volcanics across the fault.
F4	SE	-20 to -100	Poorly resolved negative anomaly from a near-surface source trends across Peters Creek Volcanics. It may be due to magnetic rocks within the fault plane. Trends following strike of Peters Creek Volcanics are difficult to trace across the fault.
F5	EW	-50	Negative anomaly with slight positive on south side near centre. Source may be Fickling Beds or Fish River Formation.
F6	EW	+200	Fault appears to be extension of F5 to west of Calvert Fault. Anomaly is of positive sign. Depth estimates 800-900 m below surface for a tabular body dipping south at about 50°. May be intrusive body.
F7	ENE	50 to 400	Well defined anomaly in zone 14 lies parallel to and 1000-1500 m north of fault. Depth to source 900 m in west, 1600 m in east. Anomaly extends 35 km east of end of fault. Follows southern gradient of Bouguer anomaly high.
F8	ENE	100	EW trending anomaly cuts across fault. Probably has similar source and depth as for anomaly associated with F8.

Table 3

Localised Magnetic Anomalies

Reference	Line	Amplitude (nT)	Country Rock	Anomaly Character
A	1291	+30, -60 (sth)	Cainozoic - (?) Westmoreland Conglomerate at depth	Asymmetrical anomaly; source depth and width approx. 200 m.
B	1260	+30, -10 (sth)	Westmoreland Conglomerate	Asymmetrical anomaly; source depth and width 100-200 m.
C	1041	-60	Nicholson Granite	Negative anomaly, remanently magnetised plug; depth 100-200 m.
D	1010	-150, +40 (sth)	Nicholson Granite	Asymmetrical anomaly; remanently magnetised plug; depth 100-200 m.
E	1190	-300 +200 (sth)	Cliffdale Volcanics	Asymmetrical anomaly; may be due to Cliffdale Volcanics or a plug; depth 100-200 m.
F	1700 1720	-150 -50	(Cainozoic, basement unknown (	Symmetrical anomaly, negative sign; may be due to remanently magnetised plug; depth and width 800 m.
G	1370	-1000	Cainozoic (?) Westmoreland Conglomerate at depth	Prominent negative anomaly probably due to remanently magnetised plug; depth 200 m maximum. May be part of a magnetic dyke swarm with general E-W trend.

Table 4

Magnetic Zone Interpretation - Basement Depth and Composition

Zone	Depth (m)	Interpreted rock units
1	50-100	Volcanics - Gold Creek Volcanic Member and Settlement Creek Volcanics
2	600	Metasediments or dipping volcanics
3	?	Sediments - Sly Creek Sandstone and Aquarius Sandstone
4	50	Seigal Volcanics - strongly magnetic component
5	50	Seigal Volcanics - less strongly magnetic component
6	150 m west) 600 m east)	Seigal Volcanics
9	up to 800	Rocks of Murphy Tectonic Ridge
13	200-900	Peters Creek Volcanics. Drilling at Chookies Yard immediately south of zone 13, penetrated black shales believed to be Fickling Group (I.P. Sweet, pers. comm.)
14	800-1600	Peters Creek Volcanics, dolerites or metasediments
15	1000	Dolerite dykes or metasediments
16	?	Granite (has associated Bouguer anomaly low).

Thus it is emphasised that in this zone and perhaps in others, the magnetic basement contours (Plate 4) do not necessarily give the depth to the top of the Precambrian rocks; hence, the thickness of flat-lying cover rocks could be considerably less than the basement depth contours would suggest.

Short-wavelength anomalies of up to 50 nT amplitude are probably caused by near-surface laterites, particularly in the northern half of the area.

5. RADIOMETRIC RESULTS AND INTERPRETATION

Acquisition of data

Equipment details are listed in Appendix 1.

Because of a malfunction in the radio-altimeter, altitude above ground level was not recorded. This severely limits the interpretation, but useful information was still obtained from the data.

Non-geological background radioactivity was measured by flying at 600 m above ground level and recording the level of radioactivity for approximately 4 minutes. This background has been removed from all data.

Presentation of data

The radiometric data have been presented in two forms: total-count stacked profiles, and an interpretation map. Total-count radiometric profiles were produced at a horizontal scale of 1:250 000 by manual reduction of hand-smoothed original records (Plate 6). During the process the background radioactivity was removed. Because the horizontal reduction factor varied from line to line, depending on the aircraft ground speed, the vertical scale on the profiles varies similarly. The average scale is about 350 counts/s/cm. The interpretation map shows the positions of selected anomalies derived from the data. Each anomaly has a reference number consisting of the fiducial number and flight-line number; e.g. 862/1670 refers to fiducial 862 on line 1670. The anomalies are classified to indicate the principal source element causing the anomalies (potassium, uranium, or thorium), as discussed below. Details of each anomaly are listed in Appendix 3.

Interpretation of data

From a study of the four-channel radiometric profiles, together with BMR geological mapping and topographic maps, anomalies were selected for analysis. The selection was made on the basis of local increases in total-count rate and/or anomalous distribution of count rates between data channels 2, 3, and 4, which are respectively the potassium, uranium, and thorium channels. A lower limit of 100 counts/s in total-count above non-geological background was used in anomaly selection.

The lack of radio-altimeter altitude control calls for discretion in interpretation procedures to avoid placing undue emphasis on anomalies caused only by variation in aircraft height over hills and valleys. On WESTMORELAND some of the prominent radiometric highs were detected over hills. Such anomalies could not be corrected for topographic effects, but were included in the interpretation because they provide information about the composition of the underlying rocks. It is considered that these anomalies should not necessarily be regarded as invalid for exploration. They may be partly due to a "window" effect, where the hill is the only clean exposure of the radioactive rocks; in adjacent valleys the same rocks may be blanketed by surficial cover.

The method of interpretation adopted was designed to give radioactive source information for:

1. Total-count anomalies of more than 200 counts/s - the main anomalies evident in the stacked profiles.

2. Anomalies over particular rock units, including those with total-count anomalies as low as 100 counts/s.

3. Anomalies of special interest because of indications of the presence of uranium and thorium.

The counts of the 4-channel data for all anomalies selected for investigation were recorded, then analysed by means of percentage sum diagrams (Figs 4 to 9). Each plotted point on these diagrams was arrived at by summing the counts in channels 2, 3, and 4, then expressing the counts in each of these

TABLE 5

Radiometric anomalies near known uranium occurrence

Name	Nearest line	Fiducial (corrected)	Distance* to line (m)	Counts/sec ch1	ch2+ ch3+ ch4	Percentages ch2	ch3	ch4	ch3/ ch4	Anomaly detected
Moongooma	1080	760	600	-						
"	1090	1082	700	-						
"	Anomaly is at	1079	1500	380	170	59	33	8	4	U
				(70	37	54	24	22	1)	
Redtree	1110)		400)							
	)		)	520	334	67	29	4	7)	KU
Namalangi	1110)	1832	300)	(80	33	61	24	15	2)	(mixed)
Huarabagoo	1121	1174	300	150	70	57	33	10	3	U
				(60	27	56	33	11	3)	
Long Pocket	1190	2160	100	150	57	52	45	7	6)	U
				(35	28	53	36	11	3)	
Tjuambi	1200	364	100	210	100	50	24	26	1	K, Th
				(50	21	54	30	16	2)	(mixed)

*Distance estimates ± 200 m

Note: The count-rates, percentages, and ratios in parentheses are for the geological background adjacent to the anomalies.

WESTMORELAND

PERCENTAGE SUM DIAGRAM

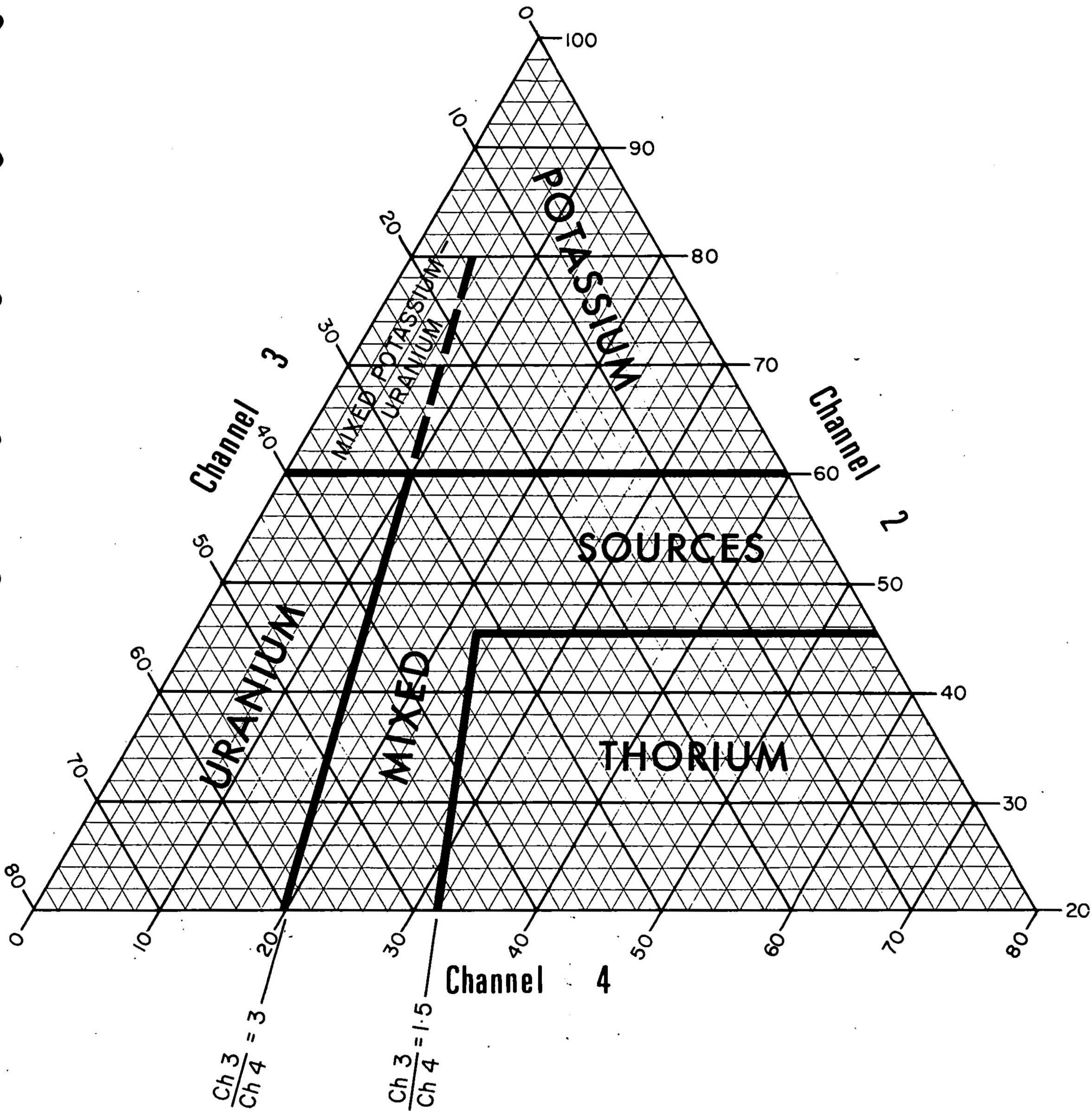
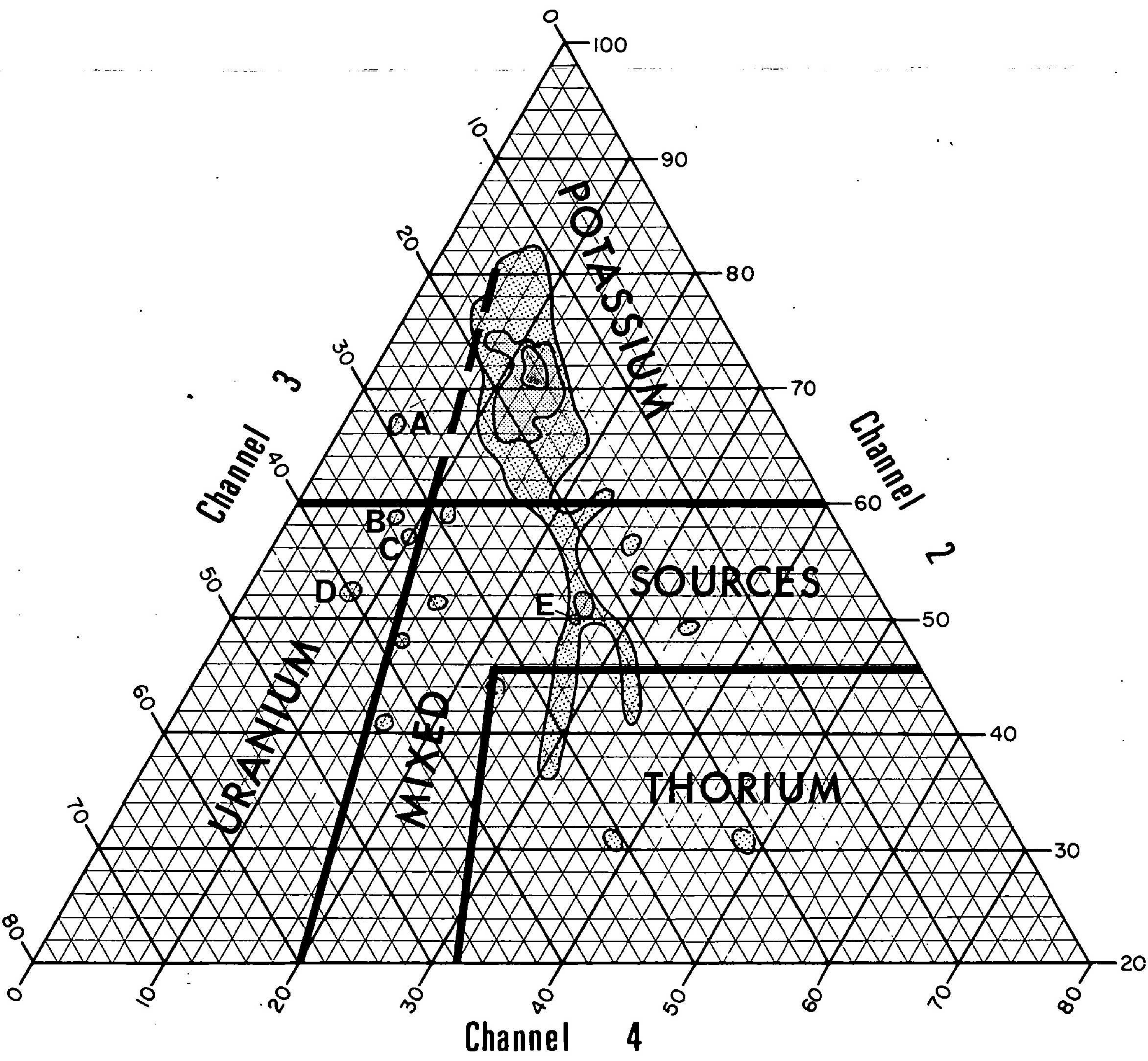


FIGURE 5

WESTMORELAND

PERCENTAGE SUM DIAGRAM



RADIOMETRIC ANOMALY SOURCE DISTRIBUTION

High density

Medium density

Low density

ANOMALIES NEAR KNOWN URANIUM DEPOSITS

A – *Redtree & Namalangi*

B – *Moongooma*

C – *Huarabagoo*

D – *Long Pocket*

E – *Tjuambi*

channels as a percentage of the sum. The position of the plotted point was then used to classify the anomalies into four main kinds:

(1) Predominantly due to potassium
(2) Predominantly due to uranium
(3) Predominantly due to thorium
(4) Mixed sources with no component particularly dominant.

The divisions within the triangular diagram (Fig. 4) 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 method is discussed by Horsfall & Wilkes (1974).

On the interpretation map, ratios of channel 3/channel 4 (uranium/thorium) counts are shown alongside various plotted anomalies. A ratio of 3 or more is regarded as indicating that a source has a uranium contribution of importance.

Results of interpretation

As expected, radiometric anomalies were recorded over the areas of Precambrian sediments on WESTMORELAND. The anomaly source distribution for all anomalies analysed is shown in Figure 5. Most anomalies fall in the "potassium" source classification. The highest-amplitude anomalies were recorded over the Westmoreland Conglomerate, Peters Creek Volcanics, and Cliffdale Volcanics. Those over the Peters Creek Volcanics usually lie on prominent east-west trends, parallel to geological layering and topographic lineations.

Various known occurrences of uranium mineralisation in the Westmoreland Conglomerate were flown over in the course of the survey (Plate 7). Anomalies were recorded over or adjacent to six of them, and the relevant radiometric data are summarised in Table 5 and Figure 5.

In the case of Moongooma, the anomaly was recorded 1000 m south of the occurrence. Presumably the anomalies detected are associated with the known mineralisation or extensions of it. Most of the anomalies fall in the "uranium" classification or in the mixed uranium-potassium classification (high channel 3/channel 4 ratio), but Tjuambi appears to be an exception in that a mixed source is indicated. It appears that channel 3/channel 4 ratios of 3 or more suggest a presence of uranium in the area.

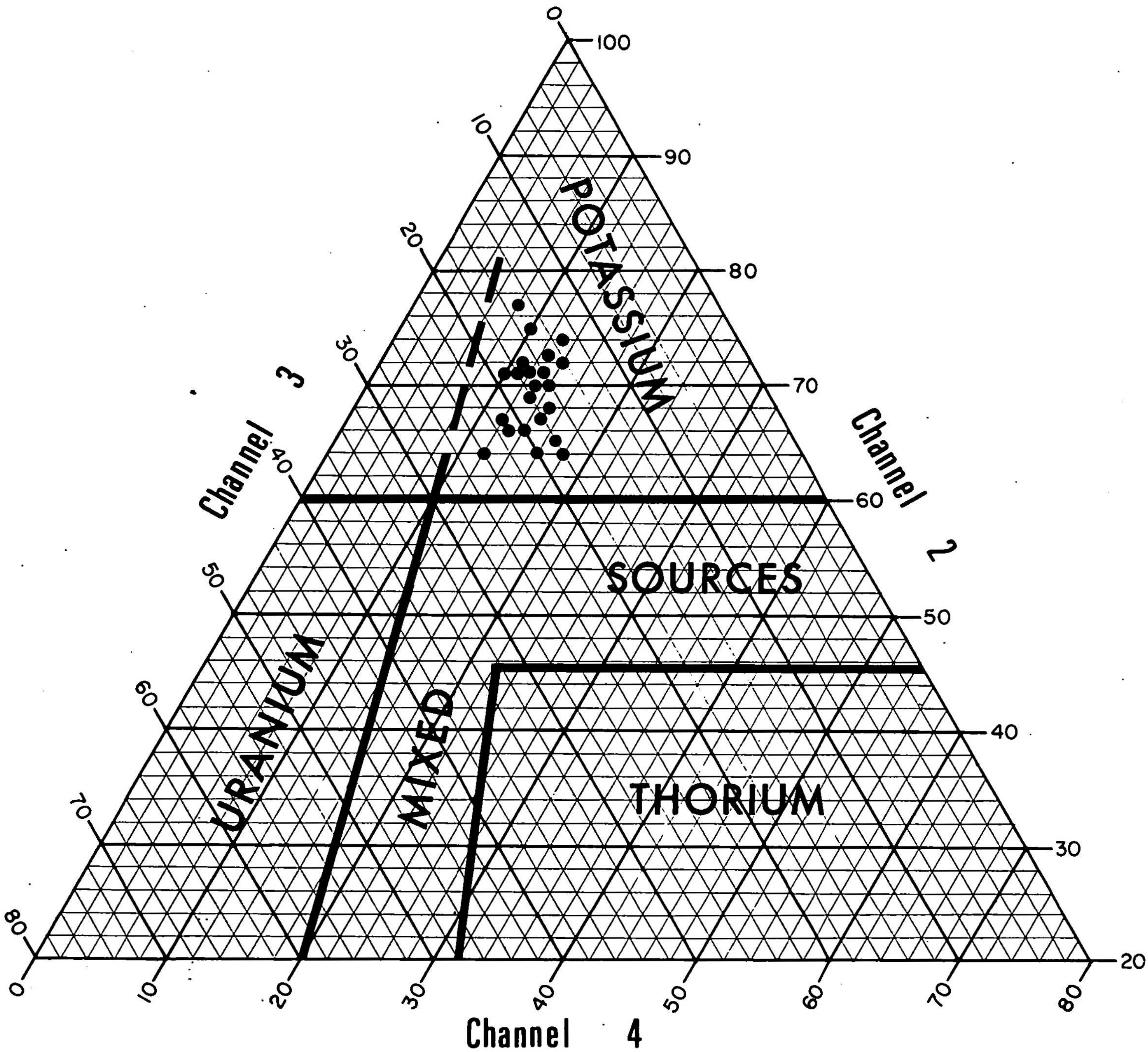
Granite. There are several areas of outcrop of the Nicholson Granite in WESTMORELAND. Prominent anomalies were recorded only over the area of granite immediately south of Cliffdale Creek. A percentage sum diagram for these shows a fairly close grouping in the "potassium" classification (Fig. 6), associated doubtless with the presence of potassium feldspar. Thorium count rate is low.

Westmoreland Conglomerate. As found by the earlier more detailed BMR scintillometer survey reported by Livingstone (1957), numerous radiometric anomalies were recorded over this formation. These have a wide scatter of percentage sum classifications (Fig. 7). Some were recorded over or adjacent to known uranium prospects and most of these fall in the "uranium" classification, but one is in the mixed source classification. This association between the wide scatter of classifications and the presence of uranium mineralisation in a particular rock formation has been reported with respect to the Corella Formation on CLONCURRY (Tucker, 1975), which is host to numerous uranium occurrences including the Mary Kathleen deposit, and may be an important characteristic for recognition of prospective rock units. The scatter might be due to different disequilibrium conditions at various localities in the formation.

The Westmoreland Conglomerate is particularly interesting in that nearly all anomalies were recorded over unit Ptwb or close to the boundary between it and unit Ptwa (Plate 1). Furthermore, on the percentage sum diagram (Fig. 7) the data mainly fall in two groups. Group 1 has a ch3/ch4 ratio of approximately 4, and includes data recorded near known uranium occurrences within unit Ptwb. Group 2 had a ch3/ch4 ratio of approximately 1, and includes a linear belt of thorium anomalies near the southern margin of unit Ptwb.

WESTMORELAND

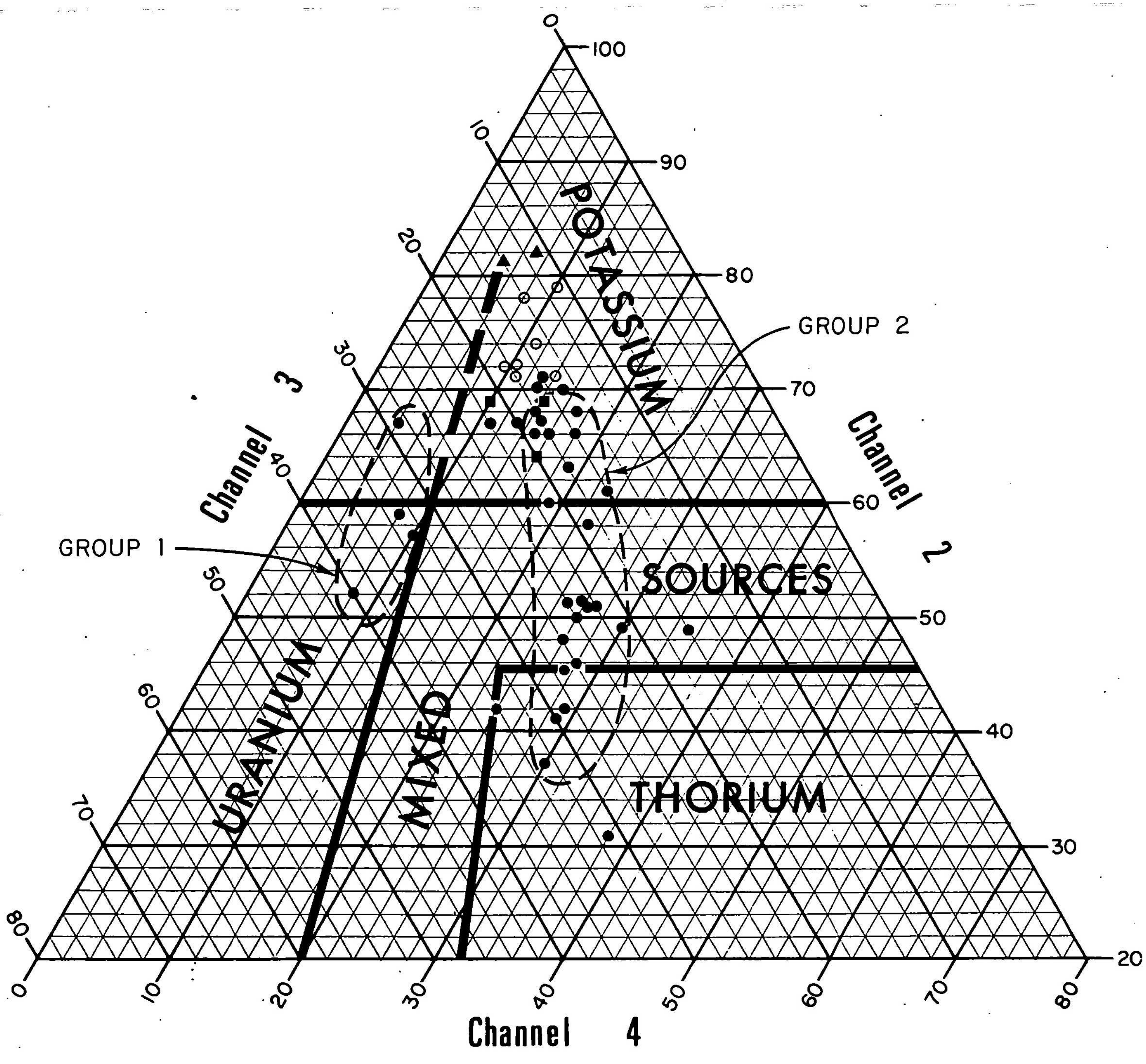
PERCENTAGE SUM DIAGRAM



NICHOLSON GRANITE

WESTMORELAND

PERCENTAGE SUM DIAGRAM

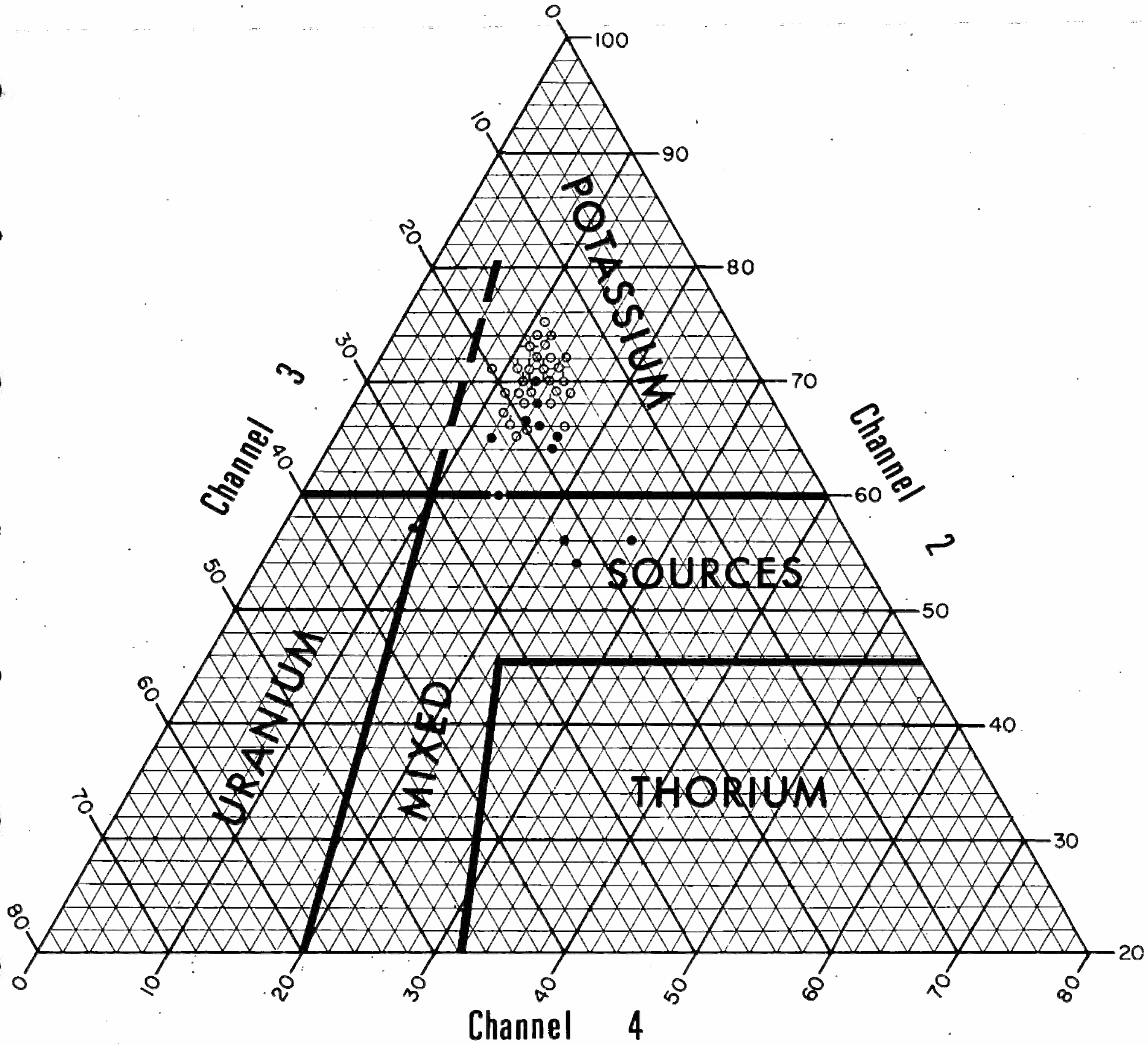


SEDIMENTARY UNITS

○ *Fickling Beds*
● *Westmoreland Conglomerate*
■ *Mc Dermott Formation*
▲ *Wollogorang Formation*

WESTMORELAND

PERCENTAGE SUM DIAGRAM



Number of anomalies occupying field position

o = 1

o = 2

o = 3

o = 4

o = 5

VOLCANICS

o *Peters Creek*

● *Cliffdale*

Fickling Group. Radiometric anomalies recorded over these rocks fall into the "potassium" classification (Fig. 7).

Wollogorang Formation. This formation crops out north of Settlement Creek.

Two anomalies, 627/1080 and 629/1080, recorded in the group of anomalies in the area appear to be associated with the formation. Both lie high in the "potassium" classifications (Fig. 7) and appear to be distinct in character from other anomalies recorded nearby. For example, anomalies over the Hobblechain Rhyolite member have a close grouping, with lower channel 2 percentage and slightly higher channel 4 percentage.

McDermott Formation. Three anomalies recorded to the north of Lagoon Creek over Cainozoic sediments may be caused by McDermott Formation or material derived from it. These anomalies group closely in the "potassium" classification.

Peters Creek Volcanics and Seigal Volcanics. Prominent radiometric anomalies were recorded over the Peters Creek Volcanics (Plate 7). Most were recorded over the rhyolitic units Ptp2, Ptp5, and Ptp7 in the upper part of the formation. They fall in the "potassium" classification, indicating that the rhyolites have a high potassium content (Fig. 8). The other more basic units of the Peters Creek Volcanics have very low radioactivity.

North of the Murphy Tectonic Ridge the equivalent to the Peters Creek Volcanics is the Seigal Volcanics, which lie mainly beneath a plain of Cainozoic sediments near the western end of Lagoon Creek. No prominent anomalies were recorded over the isolated outcrops of Seigal Volcanics.

Cliffdale Volcanics. These volcanics exhibit a variable radiometric character. Some anomalies fall in the "potassium" classification while others are mixed. As was suggested above with respect to the Westmoreland Conglomerate, this variable character might be of some value in prospecting.

The numerous acid porphyry dykes which intrude these volcanics might be the source of some of the radiometric anomalies recorded.

Hobblechain Rhyolite Member. This nearly flat-lying formation crops out north of Settlement Creek (Plate 1). Seven anomalies recorded in the area appear to be associated with this rock unit (Plate 7). Their sources are tightly grouped in the "potassium" classification (Fig. 9). The sources of two anomalies (660/1020 and 1234/1030) recorded over equivalent rocks on CALVERT HILLS to the west are included in Figure 9.

Mesozoic and Cainozoic sediments. These appear to be only slightly radioactive even when close to the Precambrian rocks, where dispersion halos might be expected.

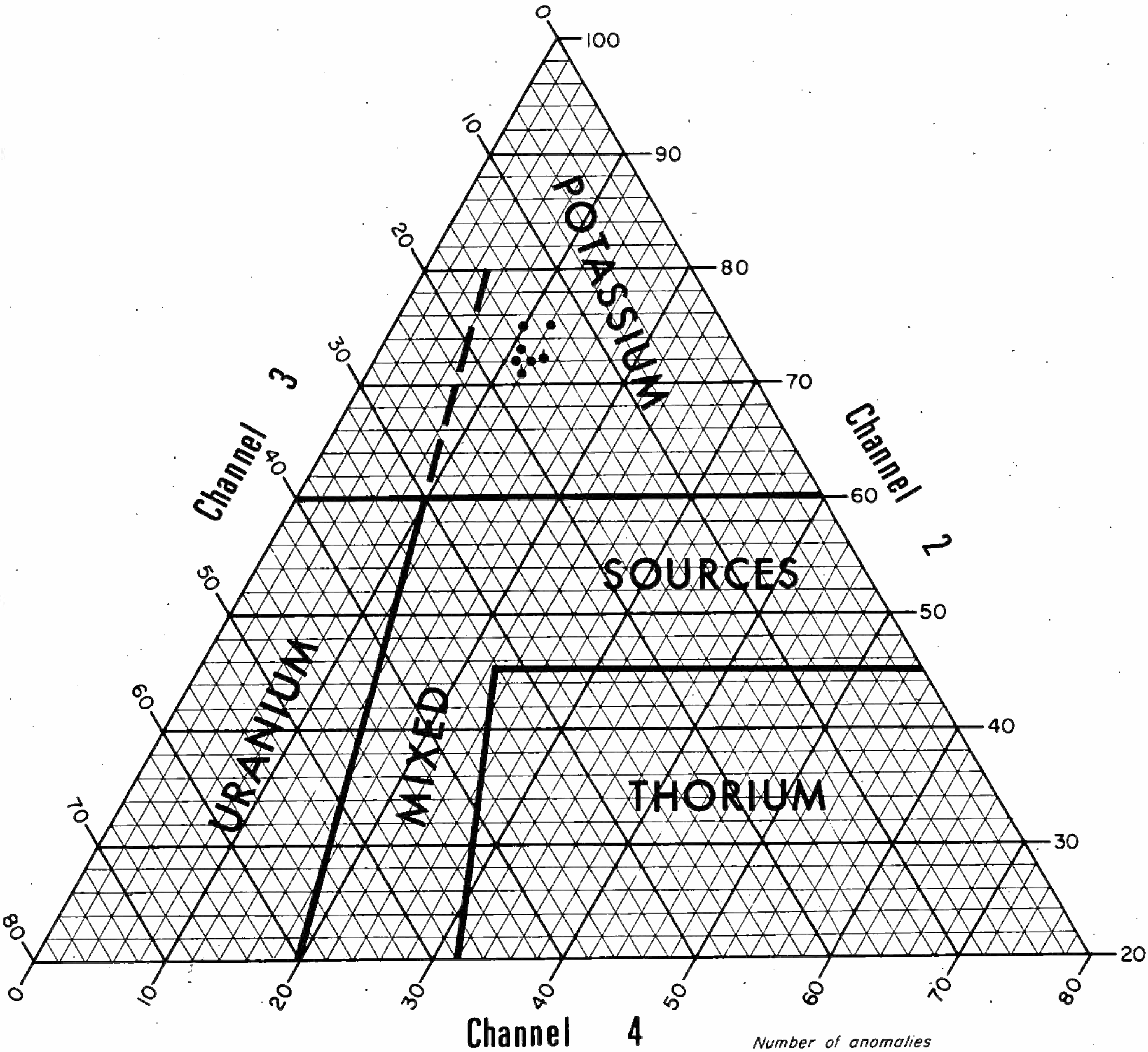
6. CONCLUSIONS AND RECOMMENDATIONS

The airborne survey was successful in providing new geological information, especially in the area covered by Cainozoic sediments. The magnetic data have enabled the interpretation of geological contacts and structures by extrapolation from mapped outcrop.

The main trend direction of aeromagnetic anomalies is east-west, as is the strike of the Precambrian rocks. The Cliffdale Volcanics, Peters Creek Volcanics, and Seigal Volcanics produce the most prominent magnetic anomalies. Linear anomalies of amplitude 200-500 nanoteslas (nT) due to near-surface sources were recorded over these formations. Sediments such as the Westmoreland Conglomerate have few associated anomalies; where anomalies occur their amplitude is usually less than 50 nT. Magnetic susceptibility measurements made on rock samples collected in the area by BMR geologists confirm that the volcanic rocks are magnetic.

Linear magnetic anomalies recorded over Cainozoic sediments to the east of the Precambrian outcrop are attributed to near-surface extensions of the Precambrian rocks. Anomalies attributed to the Peters Creek Volcanics and possibly Seigal Volcanics can be traced right across WESTMORELAND with source depths within a few hundred metres of the surface.

WESTMORELAND
PERCENTAGE SUM DIAGRAM



• Hobblechain Rhyolite Member

Number of anomalies occupying field position

• = 1

• = 2

The Cainozoic sediments in the Lagoon Creek area are probably underlain by Seigal Volcanics at a depth not exceeding 50 m. The depth to magnetic basement under the Cainozoic and Mesozoic cover in most of WESTMORELAND is probably less than 500 m. Depth estimates indicate that the Seigal and Peters Creek Volcanics form magnetic basement highs. These however might not reflect Precambrian basement topography.

Seven anomalies attributable to plug-like bodies were recognised. The localised magnetic anomalies near or over Precambrian outcrop should be followed up on the ground. Three of particular interest are A, B, and G, which are in or near the Westmoreland Conglomerate. The sources of these anomalies are probably basic igneous rocks.

Eight anomalies were found to be associated with faults. These are of interest because they may be associated with unrecognised or unexposed basic rocks. It is recommended that they be investigated further, particularly the anomaly near fault F1.

The magnetic anomalies in Zone 14 and the corresponding Bouguer anomaly high belt, if investigated in detail, might provide further information on subsurface structure in this area. Detailed magnetic and gravity surveys might be required.

Radiometric anomalies were recorded over or adjacent to some of the known occurrences of uranium in the Westmoreland Conglomerate. The survey has identified the main radio-elements present in most of the rock units in the area. Most anomalies recorded were indicative of potassium sources, but those recorded over the Westmoreland Conglomerate show a wide range of classifications. Many of these have been recorded on previous surveys and have been investigated on the ground; nevertheless further ground follow-up of these anomalies and others in WESTMORELAND might be useful.

The Cainozoic sediments were found to be radiometrically inactive.

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APPENDIX 1

Operational Details

Staff

Party leader	:	D. Tucker
Geophysicist	:	R. Taylor
Technical Staff	:	M. Johnson
		S. Wilcox
Draftsman	:	T. Kimber (part-time)
		I. O'Donnell
		L. Hollands (part-time)
Pilot (T.A.A.)	:	F/O L.A.T. Manning

Aircraft

Aero-Commander 500U (VH-BMR)

Airborne magnetometer

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

Base-station magnetometer

Type	:	Proton-precession MNS-1 of BMR design
Cycling time	:	30 seconds
Recorder	:	Esterline-Angus
Sensitivity	:	10 nT/cm
Chart speed	:	15 cm/hour

Timer

Type	:	Solid-state of BMR design

Gamma-ray spectrometer

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

Altimeter

Type	:	Barometric

Tracking Camera

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

Surveying details

Line direction	:	North-south
Spacing	:	1500 m for western third of area
		3000 m for eastern two-thirds of area
Altitude	:	150 m above ground level
Speed	:	Approx. 200 km/h

APPENDIX 2

Magnetic susceptibility and SG measurements on surface rocks

Lab No.	Sampler's number	Location	*Susceptibility cgs x 10^{-6}	Specific gravity	Formation		Comments
74/5	73761239	17°42'S, 137°44'E	290	2.65			
74/6	73761232	17°34'S, 137°44'E	2060	2.89	Seigal Volcanics (Nth of Murphy Tectonic Ridge)	Pt5	
74/7	73761235	17°32'S, 137°47'E	4200	2.77			
74/8	73761238	17°35'S, 137°44'E	4780	2.86			
74/9	HC5-89/3	17°40'30"S, 138°15'45"E	85	2.64			Amygdaloidal basalt
74/10	HC5-87/1B	17°41'30"S, 138°19'30"E	70	2.43			
74/11	HC9-01/4	17°48'45"S, 138°01'40"E	60	2.45	Lower Peters Creek Volcanics (Sth of Murphy Tectonic Ridge)	Ptp1	
74/12	HC5-89/5B	17°40'15"S, 138°16'10"E	1100	2.92			Dolerite sill
74/13	HC5-89/14	17°41'10"S, 138°14'20"E	3710	2.89			
74/14	72762053	17°46'15"S, 138°07'05"E	14	2.44		Ptp2	Feldspar porphyry
74/15	72762057	17°47'05"S, 138°07'45"E	47	2.46	Upper Peters Creek Volcanics (Sth of Murphy Tectonic Ridge)	Ptp5	Amygdaloidal intermediate volcanics (weathered)
74/16	72762061	17°44'30"S, 138°22'15"E	160	2.32		Ptp5	Vesicular flow banded intermediate volcanics
74/17	72762064	17°43'50"S, 138°21'00"E	80	2.50		Ptp5	Altered crystal tuff
74/18	HC2/49/2A	(Hedleys Creek)	<2	2.53		Ptwa	
74/19	HC2/49/2B	(1:100 000)	6	2.53		Ptwa	
74/20	HC2/57/16	"	7	2.46		Ptwa	
74/21	HC1/27/5	"	8	2.48	Westmoreland Conglomerate	Ptwa	Sandstones
74/22	HC1/25/4A	"	8	2.58		Ptwb	
74/23	HC1/25/4B	"	22	2.72		Ptwb	
74/24	CH4/26/6	"	6	2.51		Ptwb	
74/25	W4/48/2	"	10	2.52		Ptwb	
74/26	72762030	"	130	2.58		Pcc5	Rhyolite-minor magnetite, abundant hematite
74/27	HC5/01/6	"	220	2.53		Pcc5	Tuff
74/28	HC3/20/4C	"	380	2.70		Pcc4	
74/29	72762020	"	1850	2.85	Cliffdale Volcanics	Pcc4	Ignimbrite (Magnetite recognised)
74/30	HC5/97/6A	"	350	2.66		Pcca	
74/31	72762013	"	770	2.69		Pcca	(approx. ½% magnetite recognised)
74/32	HC5/96/2C	"	40	2.62		Pcca	
74/33	HC5/95/9	"	180	2.66		Pcca	
74/34	HC5/95/1	"	930	2.68		Pcca	
74/35	HC5/97/34	"	110	2.63		Pcca	
74/36	HC4/65/1	"	50	2.62	Nicholson Granite	Pg	Billicumiji Type
74/37	HC7/76/2	"	20	2.68		Pg	Pandanus Creek Type
74/38	HC4/65/3	"	30	2.60	Acid Porphyry Dykes		From within granite
74/39	HC9/91/7	"	15	2.52	" " "		From within Cliffdale Volcs.

Representative fresh rock samples collected on surface by I. Sweet, P. Slater & J. Mitchell - held by BMR Museum or

APPENDIX 3

DETAILS OF RADIOMETRIC ANOMALIES IN WESTMORELAND

Fiducial	Line	counts/sec ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	Percentages ch2	ch3	** ch4	ch3/ ch4	* Anomaly width (Fiducials)	Classi- fication
534	1010	400	135	26	22	183	74	14	12	1.2	2.5	K
549	1010	340	120	22	21	163	74	14	13	1.1	2	K
554	1010	180	50	11	12	73	68	15	16	1	1	K
646	1020	460	140	28	24	192	73	15	13	1.2	1.5	K
654	1020	450	150	28	24	202	74	14	12	1.2	1.0	K
660	1020	350	110	23	19	152	72	15	13	1.2	1.0	K
991	1030	160	45	17	12	74	61	23	16	1.4	1.0	K
1032	1030	280	90	18	7	115	78	16	6	2.6	1.5	M(KU)
1273	1030	380	120	25	22	167	72	15	13	1.14	1.5	K
302	1041	210	70	15	14	99	71	15	14	1.1	4	K
313	1041	400	160	23	13	196	82	12	7	1.8	3	K
360	1041	300	100	30	15	145	69	21	10	2.1	1.5	K
366	1041	450	150	35	28	213	70	16	13	1.3	3	K
537	1041	470	165	33	22	220	75	15	10	1.5		K
541	1041	370	130	27	12	169	77	16	7	2.3		K
669	1051	380	150	36	22	208	72	17	11	1.6	1	K
670	1051	480	165	28	27	220	75	13	12	1.0	1	K
672	1051	340	125	31	13	169	74	18	8	2.4	1	K
675	1051	450	150	35	26	211	71	17	12	1.4	1	K
680	1051	300	100	24	12	136	74	18	9	2.0	1	K
831	1051	440	150	37	26	213	70	17	12	1.4		K
2325	1060	500	90	38	23	151	60	25	15	1.7		M
2356	1060	340	100	30	22	152	66	20	14	1.4		K
2377	1060	140	35	6	6	47	74	13	13	1.0		K
2396	1060	320	110	20	10	140	79	14	7	2.0		K
2421	1060	310	100	20	15	135	74	15	11	1.3		K
281	1070	380	130	30	22	182	71	16	12	1.4		K
303	1070	160	50	12	7	69	72	17	10	1.7		K
307	1070	200	70	14	7	91	77	15	8	2.0		K
310	1070	210	75	20	11	106	71	19	10	1.9		K
345	1070	340	105	38	19	162	65	23	12	2.0		K
350	1070	250	90	22	14	126	71	17	11	1.6		K
351	1070	250	75	15	14	104	72	14	13	1.1		K

Fiducial	Line	counts/sec					Percentages **				Anomaly width * (Fiducials)	Classification
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4	ch3/ ch4		
352	1070	210	50	16	9	75	67	21	12	1.8		K
407	1020	220	40	12	6	58	69	21	10	2.0		K
482	1070	430	140	32	22	194	72	16	11	1.5		K
611	1080	520	150	36	25	211	71	17	12	1.4		K
627	1080	370	130	22	9	161	81	14	6	2.4		K
629	1080	400	150	20	13	183	82	11	7	1.5		K
694	1080	180	50	16	12	78	64	20	15	1.3		K
813	1080	230	65	24	12	101	64	24	12	2.0		K
825	1080	160	40	12	9	61	66	20	15	1.3		K
851	1080	420	120	30	27	177	68	17	15	1.1		K
869	1080	220	70	17	10	97	72	18	10	1.7		K
874	1080	240	80	14	9	103	78	14	9	1.6		K
916	1080	180	40	12	11	63	63	19	17	1.1		K
960	1090	120	35	13	8	56	63	23	14	1.6		K
990	1090	220	70	18	11	99	71	18	11	1.6		K
994	1090	240	90	13	11	114	79	11	10	1.2		K
1014	1090	380	115	30	30	175	66	17	17	1.0		K
1030	1090	140	50	10	7	67	75	15	10	1.4		K
1035	1090	220	70	16	12	98	71	16	12	1.3		K
1040	1090	340	90	25	23	138	65	18	17	1.1		K
1079	1090	380	100	56	14	170	59	33	8	4.0		U
1530	1100	310	95	22	18	135	70	16	13	1.2		K
1531	1100	430	135	34	30	199	68	17	15	1.1		K
1534	1100	250	70	18	13	101	69	18	13	1.4		K
1537	1100	370	110	22	18	150	73	15	12	1.2		K
1557	1100	390	115	30	26	171	67	18	15	1.2		K
1575	1100	390	120	26	24	170	71	15	14	1.1		K
1737	1110	230	75	19	10	104	72	18	10	1.9		K
1760	1110	380	125	27	24	176	71	15	14	1.1		K
1775	1110	260	80	23	22	125	64	18	18	1.1		K
1797	1110	440	135	32	26	193	70	17	13	1.2		K
832	1110	520	225	96	13	334	67	29	4	7.4		M(KU)
835	1121	280	90	23	14	127	71	18	11	1.6		K
849	1121	240	80	26	15	121	66	21	12	1.7		K

Fiducial	Line	counts/sec					Percentages**				Anomaly width* (Fiducials)	Classi-fication
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4	ch3/ ch4		
1079	1121	130	40	20	8	68	59	29	12	2.5	1	M
1082	1121	130	30	20	5	55	55	36	9	4.0	1	U
1092	1121	360	125	28	19	172	73	16	11	1.5	1.5	K
1104	1121	220	80	17	5	102	78	16	5	3.3	1	M(KU)
1133	1121	530	165	51	40	256	64	20	16	1.3		K
1174	1121	150	40	32	7	70	57	33	10	3.3		U
2491	1130	330	120	28	22	170	71	16	13	1.3		K
292	1140	380	100	31	20	151	66	21	13	1.6		K
703	1150	110	30	13	18	61	49	21	30	0.7		M
735	1150	160	25	22	20	67	37	33	30	1.1		Th
797	1150	260	80	26	16	122	66	21	13	1.6		K
917	1160	90	20	16	6	42	48	38	14	2.7		M(Th U)
991	1160	280	80	23	13	116	69	20	11	1.8		K
999	1160	380	120	27	23	170	71	16	14	1.2		K
1059	1160	160	30	18	18	66	45	27	27	1.0		Th
1087	1160	160	40	13	16	69	58	19	23	0.8		M
1413	1170	140	30	10	21	61	49	16	34	0.5		M
1438	1170	150	30	22	21	73	41	30	29	1.1		Th
1449	1170	380	80	32	32	144	56	22	22	1.0		M
1472	1170	340	110	33	23	166	66	20	14	1.6		K
1492	1170	320	110	24	21	155	71	16	13	1.1		K
1500	1170	380	125	29	21	175	71	17	12	1.4		K
1505	1170	300	100	29	23	152	66	19	15	1.3		K
1720	1180	280	100	24	19	143	70	17	12	1.3		K
1735	1180	440	150	38	25	213	70	18	12	1.5		K
1756	1180	370	120	32	25	177	68	18	14	1.3		K
1782	1180	340	110	32	30	172	64	19	19	1.1		K
1798	1180	140	20	20	24	64	31	31	38	0.8		Th
2160	1190	150	30	23	4	57	52	40	7	5.8		U
2173	1190	150	30	21	23	74	40	28	31	0.9		Th
2188	1190	230	50	20	23	93	54	22	25	0.9		M
2227	1190	410	145	32	23	200	75	16	12	1.4		K
2242	1190	330	105	28	25	158	66	18	16	1.1		K
242	1200	200	40	27	12	79	51	34	15	2.3		M
290	1200	260	70	20	22	112	63	18	20	0.9		K
293	1200	320	100	26	22	148	68	18	15	1.2		K

Fiducial	Line	counts/sec					Percentages		**		*	Classi- fication
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4	ch3/ ch4	Anomaly width (Fiducials)	
295	1200	320	100	22	26	148	68	15	18	0.8		K
309	1200	400	135	28	24	187	72	15	13	1.2		K
349	1200	380	100	28	27	155	65	18	17	1.1		K
364	1200	210	50	24	26	100	50	24	26	0.9		M
714	1210	170	40	18	20	78	51	23	26	0.9		M
732	1210	200	45	20	24	89	51	23	27	0.8		M
749	1210	320	100	26	30	156	64	17	19	0.9		K
750	1210	380	110	32	24	166	66	19	14	1.3		K
783	1210	220	70	16	14	100	70	16	14	1.5		K
788	1210	340	100	24	20	144	69	17	14	1.2		K
798	1210	260	70	15	15	100	70	15	15	1.0		K
1003	1220	300	90	27	17	134	67	20	13	1.6		K
1013	1220	400	125	32	20	177	71	18	11	1.6		K
1022	1220	420	170	37	26	233	73	16	11	1.4		K
1037	1220	300	100	27	17	144	69	19	12	1.6		K
1075	1220	270	60	32	32	124	48	26	26	1.0		M
1434	1230	200	125	31	24	180	69	17	13	1.3		K
1459	1230	170	30	17	18	65	46	26	28	0.9		M
1464	1230	170	50	18	16	84	60	21	19	1.1		M
1476	1230	200	50	22	26	98	51	22	27	0.9		M
1731	1240	230	70	23	11	104	67	22	11	2.1	2	K
1746	1240	280	70	26	16	112	63	23	14	1.6	1	K
1749	1240	370	120	25	27	172	70	15	16	0.9	3	K
1751	1240	370	120	34	20	174	69	20	11	1.7	3	K
1842	1244	180	80	20	22	122	66	16	18	0.9	2	K
2184	1250	240	45	26	37	108	42	24	34	0.7	2	Th
2240	1250	360	130	31	23	184	71	17	13	1.4	3	K
2245	1250	370	130	31	23	184	71	17	13	1.4	2	K
2252	1250	420	140	30	21	191	73	16	11	1.4	2	K
2260	1250	360	110	25	20	155	71	16	13	1.3	2	K
2552	1260	350	110	29	24	163	76	18	15	1.1	4	K
2560	1260	360	120	25	22	167	72	15	13	1.1		K
2567	1260	420	130	33	22	185	70	18	12	1.5		K
246	1270	170	40	15	14	69	60	22	20	1.1	1	M
292	1270	350	110	25	21	156	71	16	13	1.2	2	K

Fiducial	Line	counts/sec ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	Percentages ** ch2	ch3	ch4	ch3/ ch4	Anomaly width * (Fiducials)	Classi- fication
301	1270	420	140	31	25	196	71	16	13	1.2	2	K
308	1270	320	100	26	17	143	70	18	12	1.5	5	K
323	1270	350	85	32	27	144	59	22	19	1.2	1.5	M
335	1270	160	35	11	17	63	56	17	27	0.7	2	M
367	1270	150	35	16	16	68	51	24	25	0.9	1	M
808	1280	450	160	34	26	220	73	15	12	1.3	2.5	K
879	1280	80	20	15	10	45	44	33	22	1.5	1	Th
1661	1291	310	110	31	14	155	71	20	9	2.2		K
1668	1291	440	150	33	23	206	73	16	11	1.4		K
1674	1291	370	130	28	28	186	70	15	15	1.0		K
1552	1300	460	150	35	26	211	71	17	12	1.4	1	K
1553	1300	360	115	29	17	161	71	18	11	1.7	2	K
387	1311	480	160	32	30	222	72	14	14	1.1	1.5	K
396	1311	420	135	35	26	196	69	19	12	1.4	1	K
2382	1320	320	95	22	17	134	71	16	13	1.3	2	K
2384	1320	300	95	25	18	138	69	18	13	1.4	1.5	K
2387	1320	350	110	31	19	160	60	19	12	1.6	2	K
2392	1320	330	110	24	14	148	74	16	9	1.7	2	K
2394	1320	290	100	24	16	140	71	17	11	1.5	1	K
2397	1320	220	70	20	15	105	67	19	14	1.3	4	K
2399	1320	200	60	21	13	94	64	22	14	1.6	4	K
407	1330	320	100	21	15	136	75	15	11	1.4	2	K
413	1330	370	120	26	20	166	72	16	12	1.3		K
921	1340	380	125	24	18	167	75	14	11	1.3	1	K
1116	1350	310	100	19	17	136	74	14	13	1.1		K
1127	1350	380	120	31	24	175	69	18	14	1.3		K
938	1360	330	105	33	19	157	67	21	12	1.7	1	K
939	1360	360	110	35	17	162	68	22	10	2.1	1	K
941	1360	330	100	28	19	147	68	19	13	1.5	1	K
943	1360	310	90	27	19	136	66	20	14	1.4	1	K
1164	1370	200	70	22	13	105	67	21	12	1.7	1	K
1167	1370	340	105	30	21	156	67	19	13	1.4	1	K
1657	1380	230	70	23	15	108	65	21	14	1.5		K
1658	1380	220	70	19	13	102	69	19	13	1.5		K
350	1390	260	85	20	18	123	69	16	15	1.1		K

Fiducial	Line	counts/sec					Percentages **				* Anomaly width (Fiducials)	Classification
		ch1	ch2	ch3	ch4	ch2 +ch3 +ch4	ch2	ch3	ch4	ch3/ ch4		

Classification of Anomaly:

K = Potassium

Th = Thorium

U = Uranium

M = Mixed

* Anomaly width specified if measured

AUSTRALIA 1:250000 GEOLOGICAL SERIES

WESTMORELAND
QUEENSLAND

SHEET SE 54-5

Reference

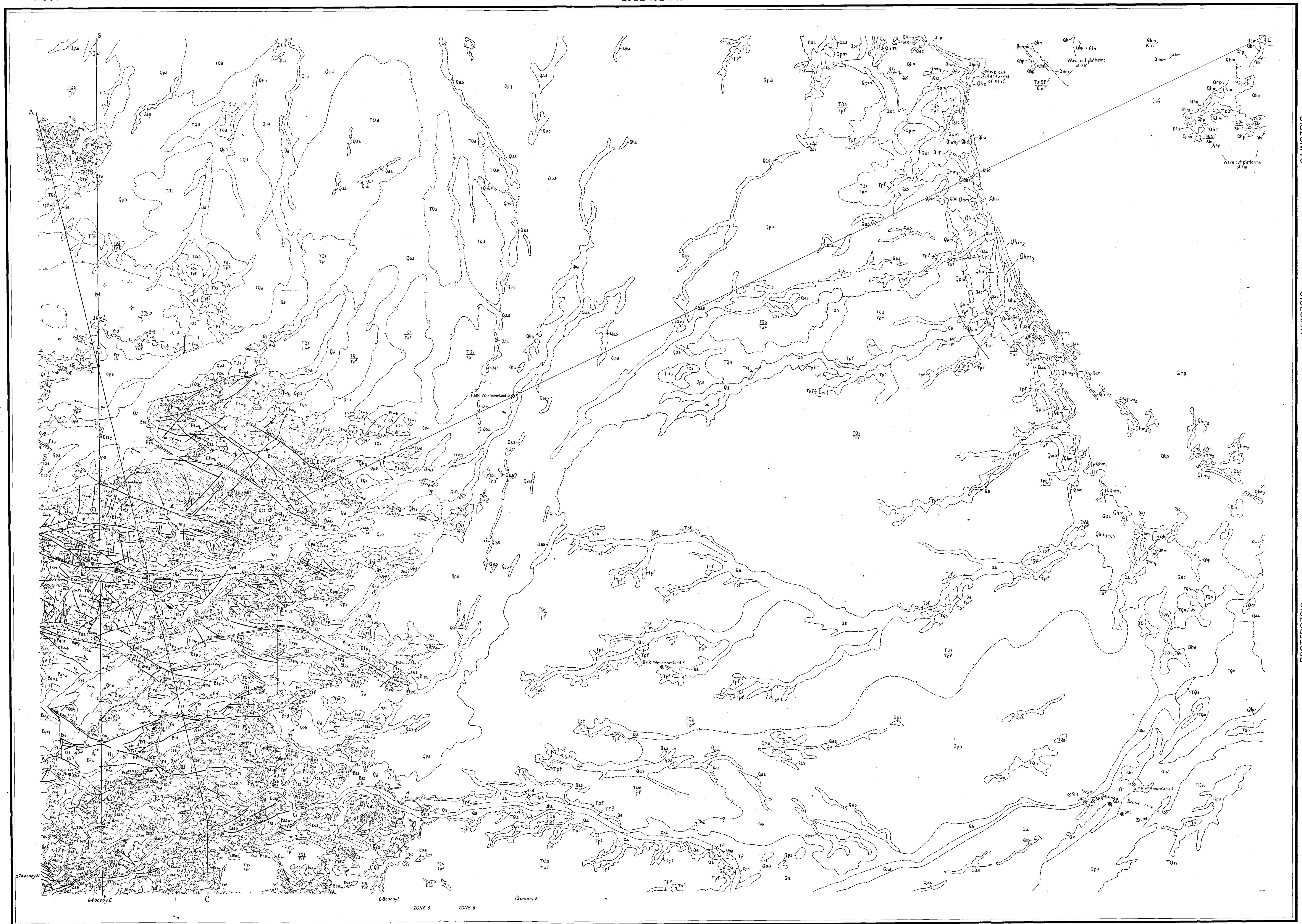
- Boundary
- Anticline, showing plunge
- Syncline, showing plunge
- Fault
- Normal fault

Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

- Strike and dip of strata
- Strike and dip of strata, dip not measured
- Horizontal strata
- Dip < 5°
- Dip 5°-15°
- Dip 15°-45°
- Dip > 45°
- Dip horizontal
- Trend
- Joint
- Lineament

(Dip < 5° to Lineament: airphoto interpretation)

- Type section
- Dyke or vein do-dolerite, Po-porphyry, q-quartz-feldspar
- Macrofossil locality
- Unworked deposit
- Prospect
- ·Sn Minor mineral occurrence
- Cu Copper
- Pb Lead
- Sn Tin
- U Uranium
- Zn Zinc
- ⊗St Stratigraphic hole, SH Scout hole

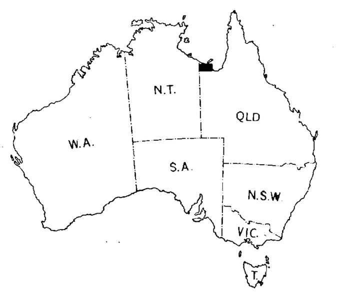


Reference

CAINOZOIC – QUATERNARY	HOLOCENE		Qha	Quartzose sand, silt, clay: stream bed deposits
			Qhe	Clay, silt, sand: meander belt (point bar) deposits
			Qhd	Quartz and calcareous sand: aeolian sand dunes
			Qhp	Sandy clay, silt: tidal flats
			Qhm	Shelly quartzose sand, coquina calcarenite: younger beach ridges
			Qhm_2, Qhm_1	(Subscript numbers indicate sequence of formation, where recognisable)
			Qac	Quartzose sand, silt, clay: undivided coastal deposits
			Qas	Quartzose sand: abandoned river channels
			Qa	Sand, silt, clay: undivided alluvial deposits
	UPPER PLEISTOCENE		Qpm	Quartzose sand: older beach ridges
	LOWER PLEISTOCENE	Armraynald Beds	Qn	Clay, silt, sand: fluvial deposits
			Czs	Quartzose sand and gravel: colluvium and alluvium
	TERTIARY		Tf	Ferruginized colluvium and alluvium, laterite
				Deeply weathered sediments (kaolinised, silicified and ferruginized)
	UPPER CRETACEOUS? OR TERTIARY	Floraville Formation	KTf	Quartzose sandstone, conglomerate, minor mudstone and siltstone
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group: Normanton Formation	Kln	Labile sandstone, siltstone, mudstone
		Allaru Mudstone	Kla	Mudstone, siltstone, minor labile sandstone (Section only)
		Toolebuc Limestone	Klo	Calcareous mudstone, limestone (Section only)
		Wallumbilla Formation	Klu	Mudstone, siltstone, minor labile and glauconitic sandstone (Section only)
			Kl	Quartzose sandstone, sandy claystone, porcellanite
	UPPER JURASSIC TO LOWER CRETACEOUS	Gilbert River Formation	JKg	Quartzose sandstone, siltstone, minor conglomerate. Section only
PROTEROZOIC	ADELAIDEAN	South Nicholson Group: Constance Sandstone	Ꝑsa	White and reddish-brown, medium quartz sandstone; cobble conglomerate lenses
		*Bowthorn Siltstone Member	$Ꝑsa_b$	Laminated micaceous siltstone; quartz sandstone interbeds
		Wallis Siltstone Member	$Ꝑsa_w$	Purplish-brown, micaceous fine sandstone and siltstone, quartz sandstone interbeds
		Pandanus Siltstone Member	$Ꝑsa_p$	Purplish-brown and grey, micaceous siltstone, shale and fine sandstone
	CARPENTARIAN	*Fickling Group: *Doomadgee Formation	Ꝑfd	Fine sandstone, dolomite, dolomitic sandstone and pebble conglomerate
		*Mount Les Siltstone	Ꝑfl	Dolomitic siltstone and shale; dolomite interbeds
		*Walford Dolomite	Ꝑfw	Oomicrite, intramicrite, laminated and stromatolitic dolomite, silicified dolomite; minor sandstone and shale
		Fish River Formation	Ꝑtf	Medium quartz sandstone with pebble and cobble lenses, fine sandstone and siltstone with shaly partings
		Peters Creek Volcanics	$Ꝑtp_7$	Dark red massive porphyritic rhyolite
			$Ꝑtp_d$	Flow-banded porphyritic rhyolite in dome-shaped body; minor tuff
			$Ꝑtp_6$	Vesicular and amygdaloidal basalt; minor tuff, sandstone, conglomerate and rhyolite
			$Ꝑtp_5$	Flow-banded porphyritic rhyolite
			$Ꝑtp_4$	Vesicular and amygdaloidal basalt; minor siltstone and sandstone
			$Ꝑtp_3$	Mudstone; oolitic, stromatolitic and silty dolomite
			$Ꝑtp_2$	Massive pink and brown porphyritic rhyolite
			$Ꝑtp_{1s}$	Lithic sandstone
			$Ꝑtp_1$	Vesicular, amygdaloidal, and massive basalt; minor siltstone and sandstone
		*Wire Creek Sandstone	Ꝑti	Coarse and gritty sandstone; scattered pebbles and conglomerate lenses
		Packsaddle Microgranite	Ꝑgr	Pink porphyritic microgranite
		Tawallah Group: Masterton Formation – Hobblechain Rhyolite Member	Ꝑth	Porphyritic rhyolite
		Gold Creek Volcanic Member	Ꝑtg	Basalt
		Wollogorang Formation	Ꝑto	Siltstone and dolomite
		Settlement Creek Volcanics	Ꝑte	Basalt, siltstone and tuff
		Aquarium Formation	Ꝑtq	Brown siltstone and sandstone
		Sly Creek Sandstone	Ꝑtl	Fine and medium, feldspathic and quartzitic sandstone; minor pebbly sandstone
		McDermott Formation	Ꝑtd	Stromatolitic and oolitic dolomite; dolarenite, sandstone, shale and siltstone
		Seigal Volcanics	Ꝑts	Massive and amygdaloidal basalts
		Carolina Sandstone Member	$Ꝑts_c$	Lithic and quartzitic sandstone
		Westmoreland Conglomerate	Ꝑtw	Sandstone and conglomerate (section only)
			$Ꝑtw_b$	Medium and coarse quartz sandstone with scattered pebbles and conglomerate lenses
			$Ꝑtw_a$	Basal conglomerate lenses overlain by medium sandstone with scattered pebbles
		*Nicholson Granite Complex	$Ꝑgn_c$	Biotite granite
			$Ꝑgn_b$	Biotite adamellite
			$Ꝑgn_a$	Porphyritic hornblende adamellite with xenoliths
		Cliffdale Volcanics	$Ꝑcc_c$	Flow banded and massive rhyolite, and minor tuff
			$Ꝑcc_b$	Ignimbrite, rhyolite and tuff
			$Ꝑcc_a$	Porphyritic rhyolite, massive dacite, ignimbrite and minor tuff

*Name not yet approved

Compiled by the Bureau of Mineral Resources Geology and Geophysics, Department of Minerals and Energy. Issued under the authority of the Hon. R.F.X. Connor, M.P., Minister for Minerals and Energy.
Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50000 scale. Transverse Mercator Projection



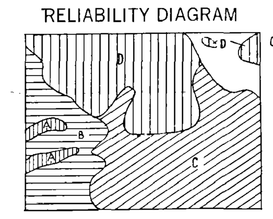
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination 1974

MOUNT YOUNG SD 53-15	PELLEW SD 53-16			RUTLAND PLAINS SD 54-15
BAUHINIA DOWNS SE 53-3	ROBINSON RIVER SE 53-4	MORNINGTON SE 54-1	CAPE VAN DIEMEN SE 54-2	GALBRAITH SE 54-3
WALLHALLOW SE 53-7	CALVERT HILLS SE 53-8	WEST-MORELAND SE 54-5	BURKETOWN SE 54-6	NORMANTON SE 54-7
BRUNETTE DOWNS SE 53-11	MOUNT DRUMMOND SE 53-12	LAWN HILL SE 54-9	DONORS HILL SE 54-10	CROYDON SE 54-11
ALROY SE 53-15	RANKEN SE 53-16	CAMOOWEAL SE 54-13	DOBBYN SE 54-14	MILLUNGERA SE 54-15

Scale 1:250,000

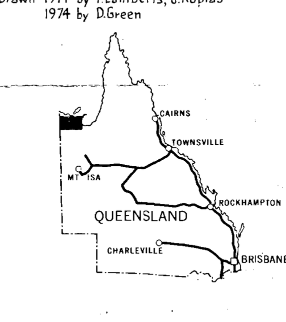
5 0 5 10 15 20 25 KILOMETRES

RELIABILITY DIAGRAM

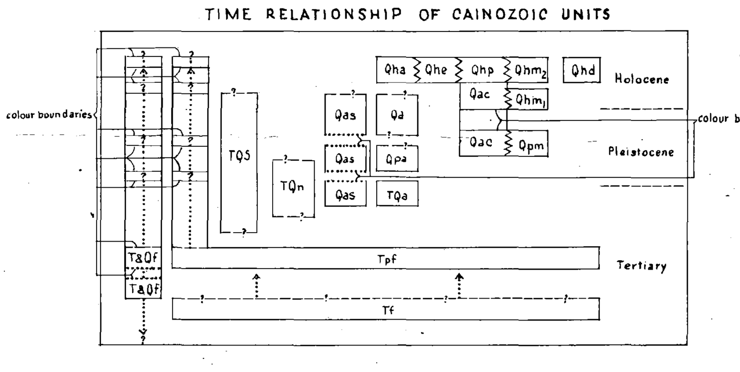


Geology
- A Detailed reconnaissance; detailed mapping
- B Detailed reconnaissance: numerous traverses, and airphoto interpretation
- C General reconnaissance: few traverses, mainly airphoto interpretation
- D Airphoto interpretation

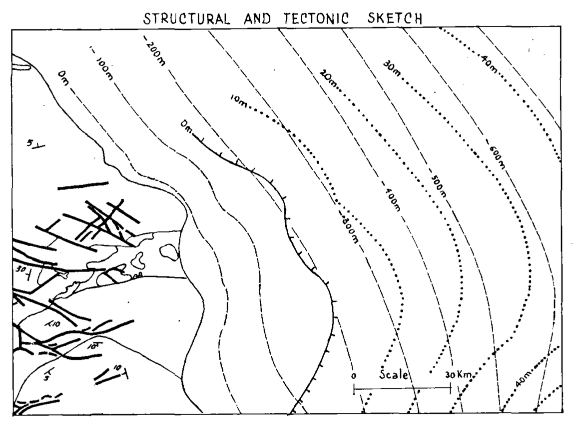
Phanerozoic geology 1970 by K. Grimes, G.S.Q.
Proterozoic geology 1972-73 by I. Sweet, J. Mitchell, J. Ingram, K. Plumb, C. Gardner, B.M.R., P. Slater, G.S.Q.
Compiled 1971-76 by K. Grimes, G.S.Q.
1973-74 by P. Slater, G.S.Q., I. Sweet, B.M.R.
Cartography by Geological Branch B.M.R.
Drawn 1971 by I. Lamberts, J. Kopras
1974 by D. Green



TIME RELATIONSHIP OF CAINOZOIC UNITS



STRUCTURAL AND TECTONIC SKETCH

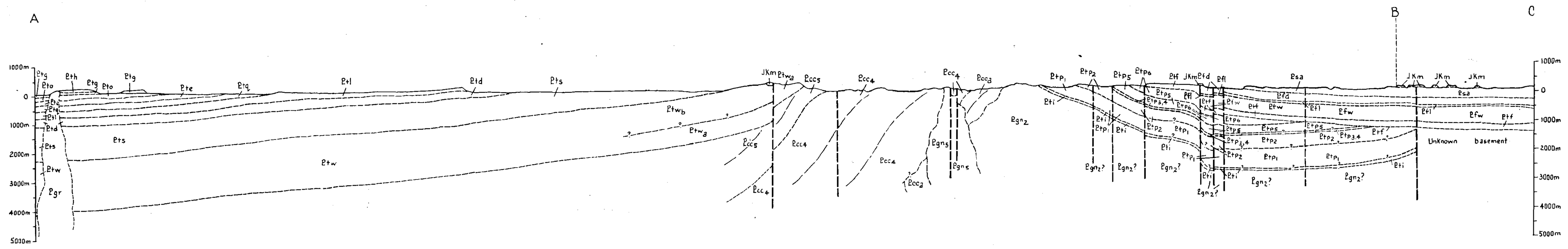


Reference

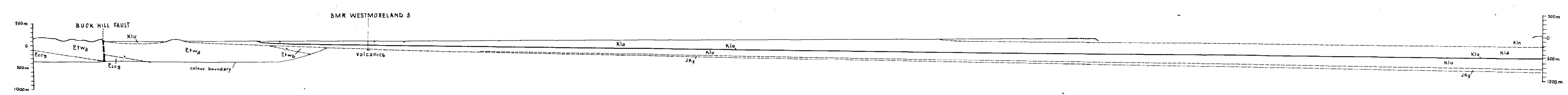
MESOZOIC AND CAINOZOIC
- Carpentaria and Karumba Basins

PROTEROZOIC
- Packsaddle Microgranite
- McArthur Basin
- South Nicholson Basin
- Lawn Hill Platform
- Murphy Tectonic Ridge
- Nicholson Granite Complex
- Cliffdale Volcanics
- Geological boundary
- Fault

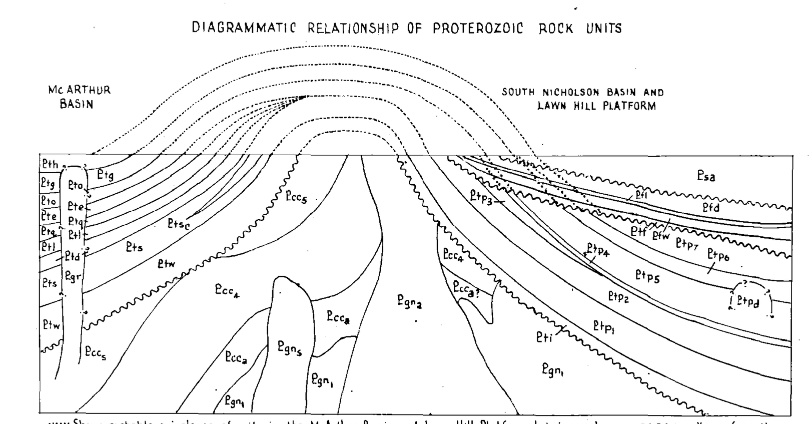
Sections
Cainozoic sediments omitted from sections
Scale: $\frac{V}{H} = 2$
Depth in Metres



Scale: $\frac{V}{H} = 4$



DIAGRAMMATIC RELATIONSHIP OF PROTEROZOIC ROCK UNITS

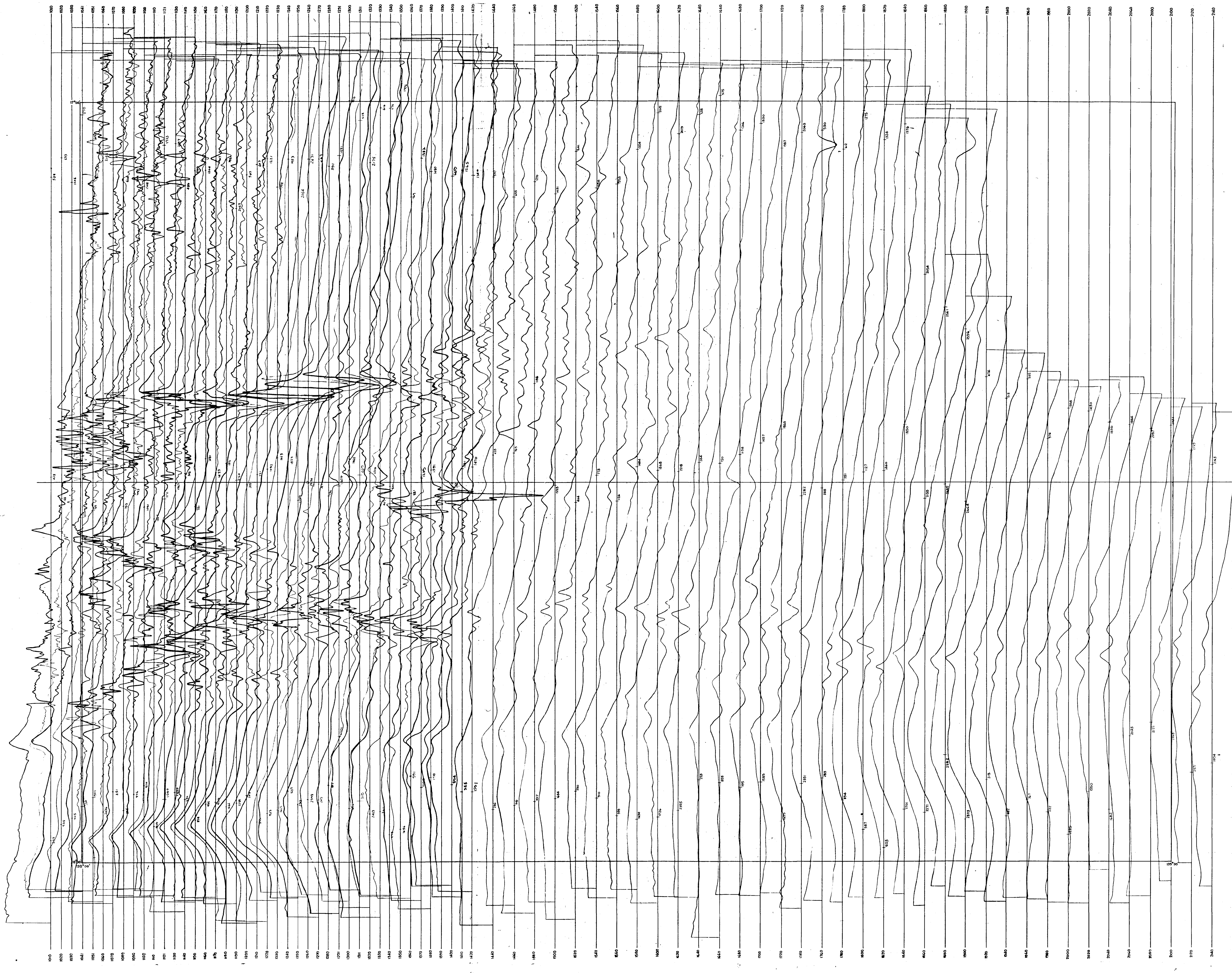


WESTMORELAND
SHEET SE 54-5

E54/B1-83

PLATE 2

WESTMORELAND



PRELIMINARY
TOTAL MAGNETIC INTENSITY PROFILES

REFERENCE TO 1:250 000 MAP SERIES

136°30' — 141°00'; 16°00' — 19°00'

ROBINSON RIVER	MORNINGTON	CAPE VAN DIEMEN
CALVERT HILLS	WESTMORE-LAND	BURKETOWN
MOUNT DRUMMOND	LAWN HILL	DONORS HILL

SCALE 1:250000

5 0 5 10 15 20 25km

APPROX. PROFILE SCALE : 350 gammas per inch

The information contained in this map has been obtained by the Bureau of Mineral Resources, Geology and Geophysics as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources.

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 north-south lines spaced approx. 1·5 and 3·0km apart.

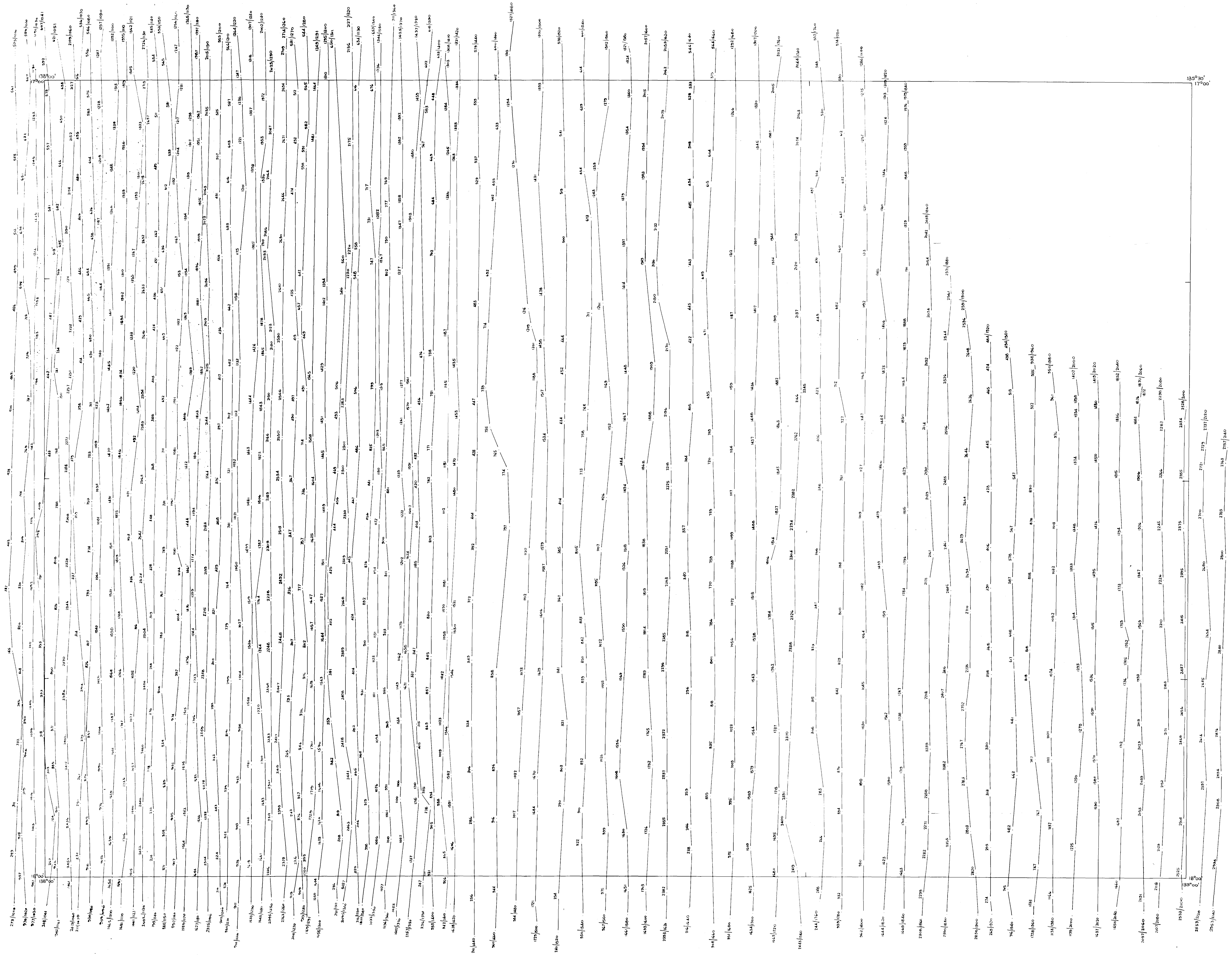
The regional gradient in the total magnetic field has not been removed from the profiles.

This map should be used in conjunction with the flight-line map E54/B1–69.

Record 1980/78

E54/B1–67

WESTMORELAND



PRELIMINARY FLIGHT-LINE MAP

REFERENCE TO 1:250 000 MAP SERIES

136°30' 16°00' — 141°00' — 19°00'

ROBINSON RIVER	MORNINGTON	CAPE VAN DIEMEN
CALVERT HILLS	WESTMORE-LAND	BURKETOWN
MOUNT DRUMMOND	LAWN HILL	DONORS HILL

SCALE 1:250000

5 0 5 10 15 20 25 km

The information contained in this map has been obtained by the Bureau of Mineral Resources, Geology and Geophysics as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources.

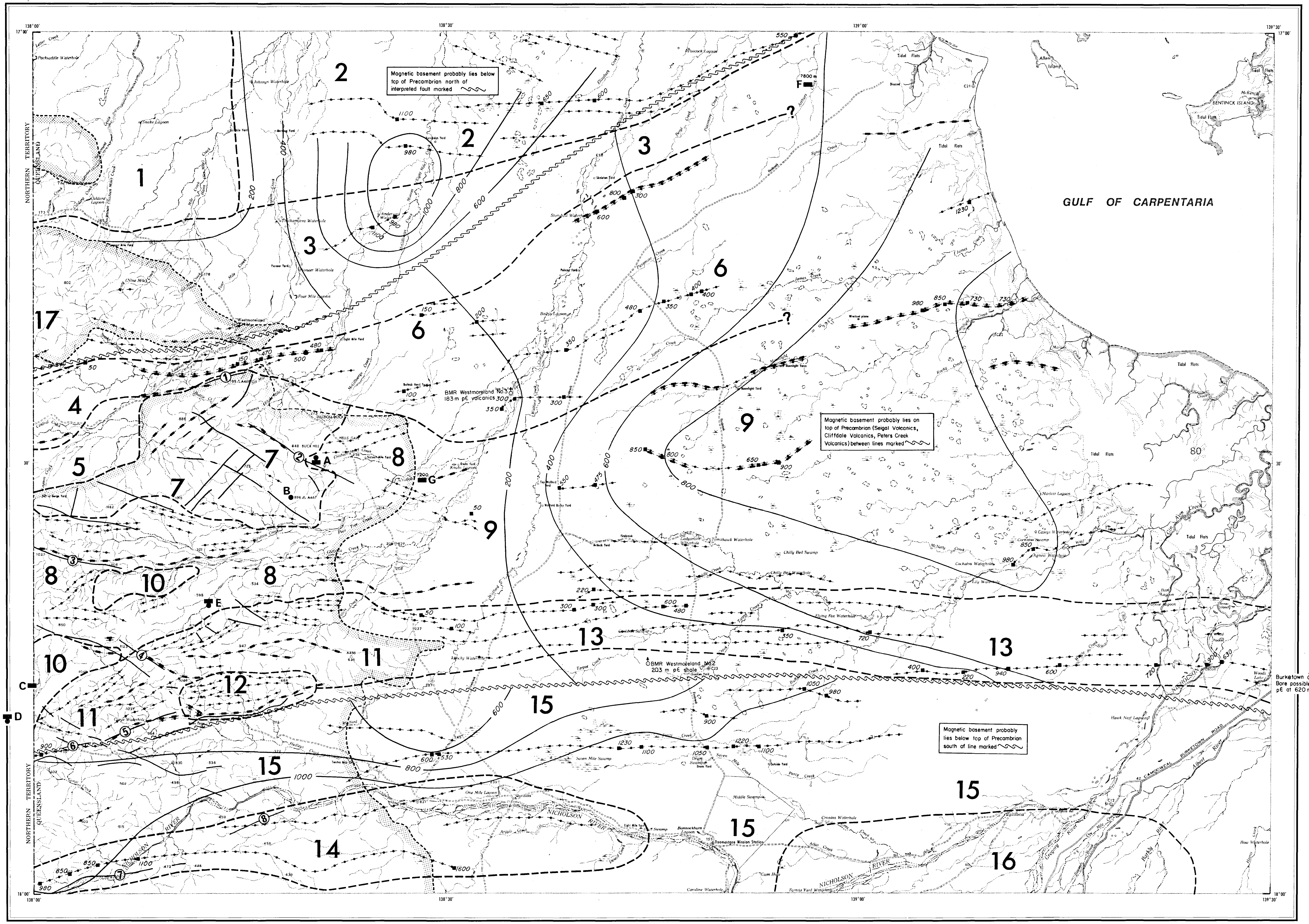
Record 1980/78

03

083005

E54/B1-69

WESTMORELAND



Based on E54/80-34, E54/81-79, E54/81-80

TOPOGRAPHIC LEGEND

- Road sealed surface second class; mileage
- Road unimproved earth; gate; cattle grid
- Control point major, minor; astronomical
- Bench mark; spot elevation in feet — BM·750 ·750
- Mud; gravel; sand
- Waterhole; water tank; dam; dry lake
- Lake; river or stream perennial
- Lake; river or stream intermittent
- Spring perennial, intermittent; ricefields
- Marsh or swamp; mangroves

GEOPHYSICAL LEGEND

- Boundary of magnetic zone (numbered for reference in text)
- Subsurface fault interpreted from magnetic data (see notes)
- Depth of magnetic basement (metres below ground level) — 730
- Generalised magnetic basement contours (metres below ground level) — 200
- Localised positive magnetic anomaly (identified for reference in text) — F
- Localised negative magnetic anomaly
- Localised associated positive/negative magnetic anomaly
- Positive magnetic trend
- Negative magnetic trend
- A Associated positive/negative magnetic trend

GEOLOGICAL LEGEND

- Geologically mapped fault (identified for reference in text) — 5
- Generalised limit of Precambrian outcrop
- Borehole

MAGNETIC INTERPRETATION

SCALE

5 0 5 10 15 20 KILOMETRES

REFERENCE TO AUSTRALIA 1:250 000 MAP SERIES

136°30′ 16°00′ — 141°00′ 16°00′

ROBINSON RIVER	MORNINGTON	CAPE VAN DIEMEN
CALVERT HILLS	WESTMORELAND	BURKETOWN
MOUNT DRUMMOND	LAWN HILL	DONORS HILL

19°00′ 136°30′ — 19°00′ 141°00′

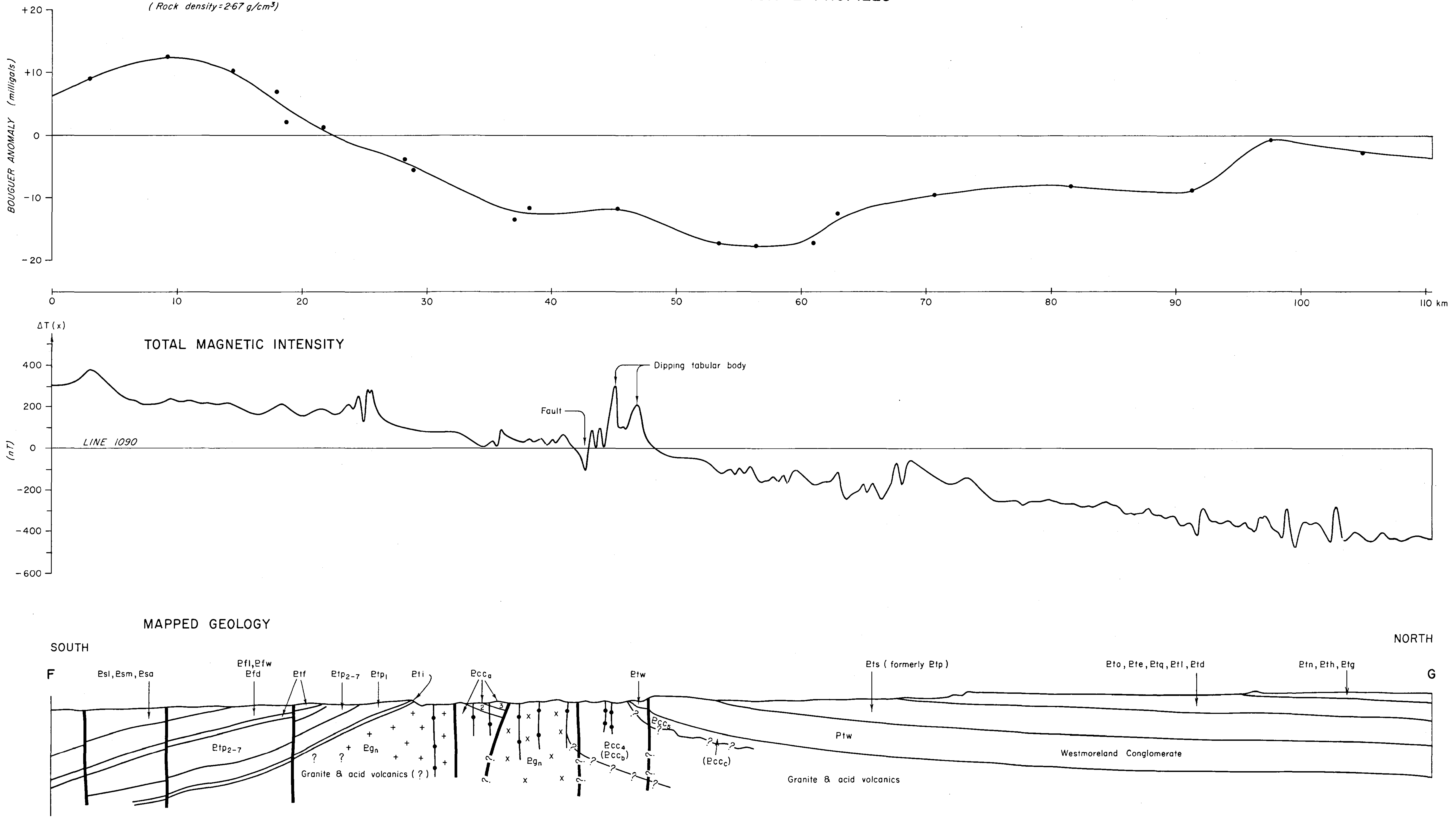
LOCALITY DIAGRAM

WA NT QLD SA NSW VIC Brisbane

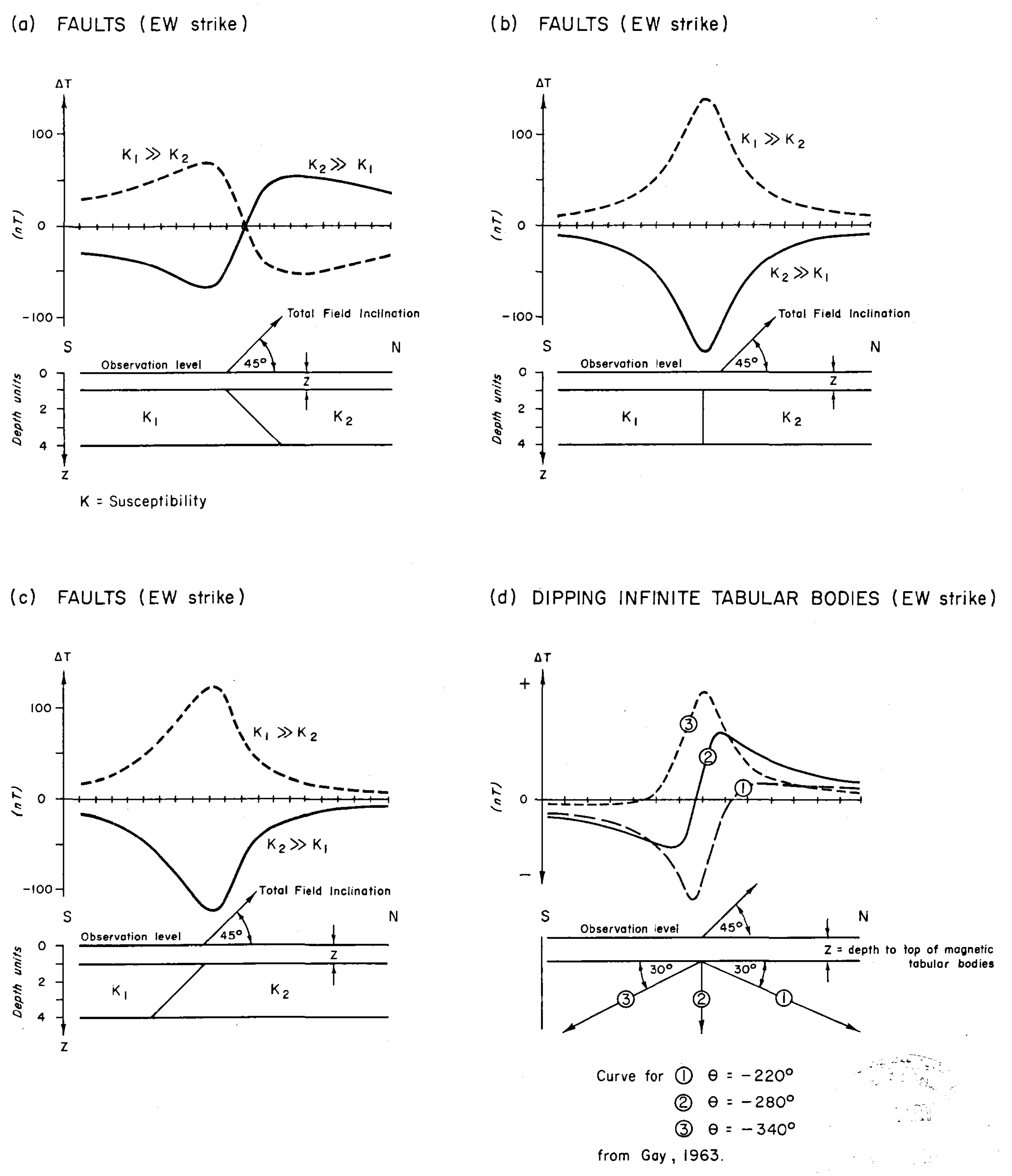
Record 1980/78

E54/B1-81

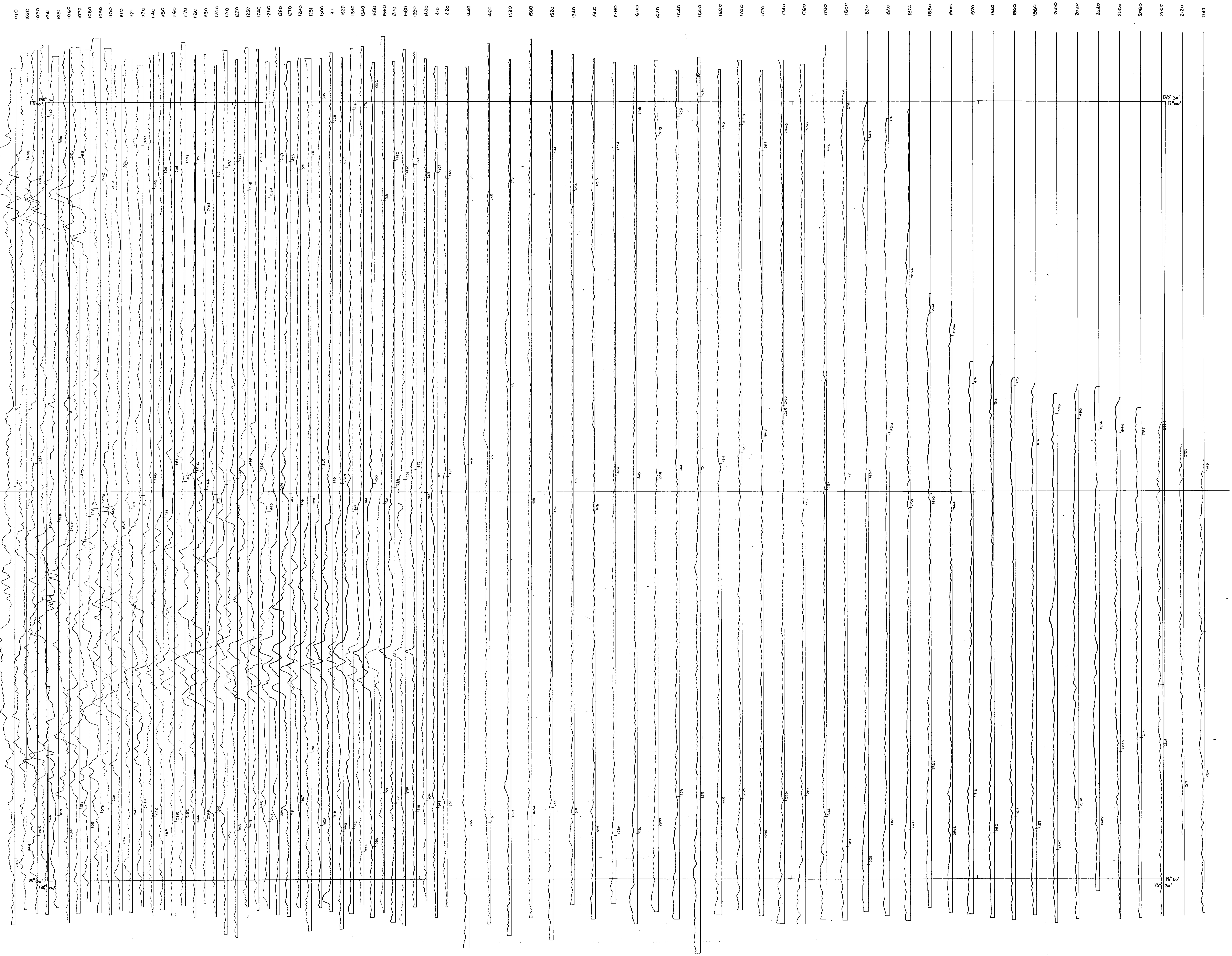
GEOLOGICAL CROSS-SECTION AND GEOPHYSICAL PROFILES



THEORETICAL TOTAL FIELD MAGNETIC ANOMALIES



WESTMORELAND



PRELIMINARY
TOTAL COUNT RADIOMETRIC PROFILES

SCALE 1:250000

5 0 5 10 15 20 25km

APPROX. PROFILE SCALE : 330 counts/s/cm

The information contained in this map has been obtained by the Bureau of Mineral Resources, Geology and Geophysics as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources.

REFERENCE TO 1:250000 MAP SERIES

136°30' – 141°00'; 16°00' – 19°00'

ROBINSON RIVER	MORNINGTON	CAPE VAN DIEMEN
CALVERT HILLS	**WESTMORE-LAND**	BURKETOWN
MOUNT DRUMMOND	LAWN HILL	DONORS HILL

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 north-south lines spaced approx. 1·5 and 3·0km 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).

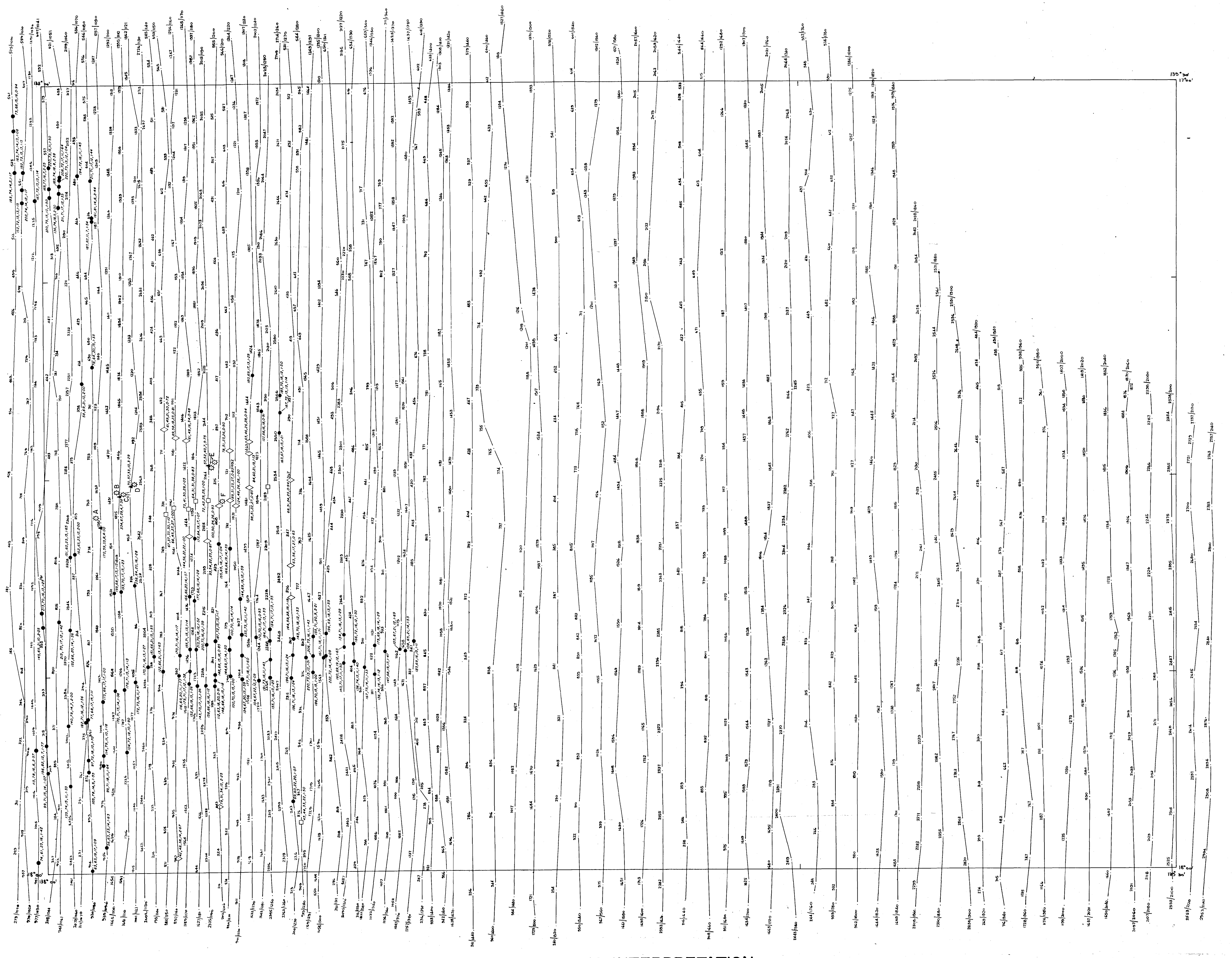
This map should be used in conjunction with the flight-line map E54/B1-69

Record 1980/78

E54/B1-68

WESTMORELAND

PLATE 7



RADIOMETRIC INTERPRETATION

AND

FLIGHT-LINE MAP

REFERENCE TO 1:250 000 MAP SERIES

136°30' 141°00'
16°00' 19°00'

ROBINSON RIVER	MORNINGTON	CAPE VAN DIEMAN
CALVERT HILLS	WESTMORE-LAND	BURKETOWN
MOUNT DRUMMOND	LAWN HILL	DONORS HILL

Major uranium occurrence

A *Moongooma*

B *Redtree*

C *Namalangi*

D *Huarabagoo*

E *Long Pocket*

F *Tjuambi*

5 0 5 10 15 20 25 km

LEGEND

Potassium (K)

Uranium (U)

Thorium (Th)

Mixed sources

U/Th

Th/(K+U+Th) %

U/(K+U+Th) %

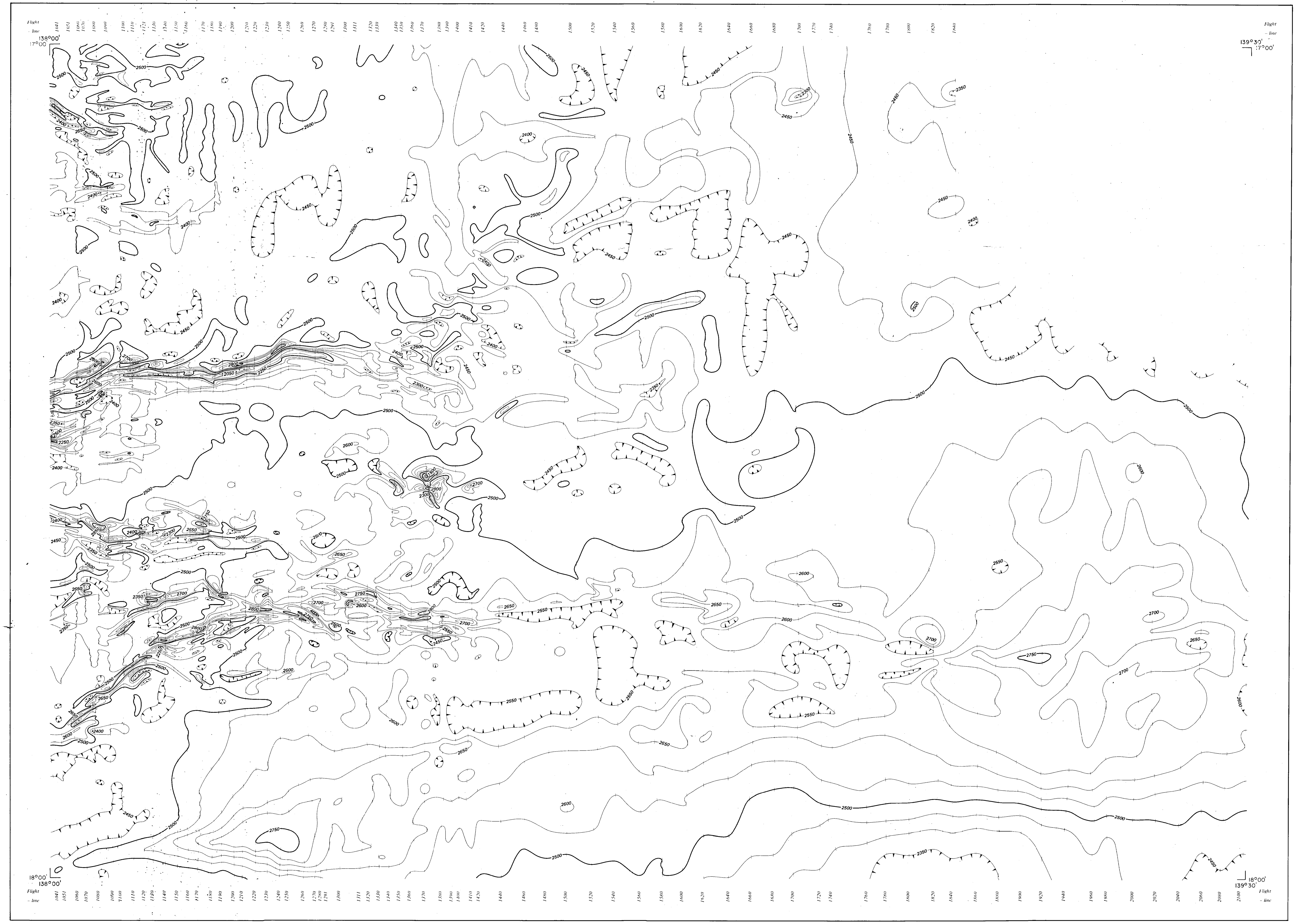
K/(K+U+Th) %

Total count

E54/B1-85

Record 1980/78

WESTMORELAND



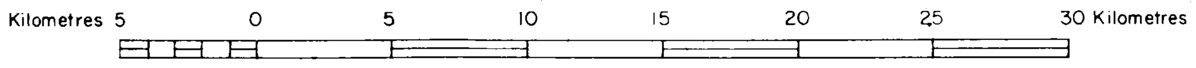
TOTAL MAGNETIC INTENSITY

DATA ACQUISITION

Operator .... BMR
Date of survey 1973
Line spacing .... 1·5km & 3·0km
Altitude .... 150m above g.l.
Sampling interval 60m
Instrument .... proton precession magnetometer

DATA PROCESSING AND PRESENTATION

Along line sampling .... contour level/profile intercepts
Regional gradient removed at ..... IGRF 1965·0
Contour interval 50nT
Magnetic value .... —2500—
Magnetic 'low' ....



The information contained in this map has been obtained by the Bureau of Mineral Resources, Geology and Geophysics as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources.

REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES

136°30' 16°30'		141°00'
ROBINSON RIVER	MORNINGTON	CAPE VAN DIEMEN
CALVERT HILLS	**WESTMORELAND**	BURKETOWN
MOUNT DRUMMOND	LAWN HILL	DONORS HILL
19°00'		

WESTMORELAND, QLD
PRELIMINARY EDITION

E54/BI-82

Record 1980/78