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Record No. 1969 / 33

Central Great Artesian Basin Aeromagnetic Survey,

Queensland 1968

by

D.R. Waller

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ILLUSTRATIONS

SUMMARY

An airborne magnetic survey was flown over the central portion of the Great Artesian Basin during 1968, completing the aeromagnetic coverage of the Eromanga Basin. The magnetic basement was contoured over most of the survey area and magnetic trends were delineated.

Bouguer gravity contours were used extensively to complement the magnetic information. The Galilee Basin, Adavale Basin, Canaway Ridge, and Cooper Basin correspond to magnetic basement features. In addition, structural models have been proposed to explain the magnetic and gravimetric data in the west of the Brighton Downs 1:250,000 map area.

Several magnetic basement 'highs' in the survey area were interpreted as areas of crystalline basement relief, and in the Jundah 1:250,000 map area an area of magnetic basement depression indicates a thickening of the sedimentary section. Further geophysical investigation of these features is recommended.

Correlation with borehole data indicates that magnetic and economic basements coincide over much of the survey area.

1. INTRODUCTION

An airborne magnetic survey was flown over two areas in the centre of the Great Artesian Basin during the period March to June 1968. The survey boundaries are shown in Plate 1 and include parts of the BRIGHTON DOWNS, MANEROO, LONGREACH, JUNDAH, BLACKALL, WINDORAH, ADAVALE, EROMANGA, QUILPIE, THARGOMINDAH, and TOOMPINE 1:250,000 map areas. These areas lie within the Eromanga Basin and their surveying completes the aeromagnetic coverage of this portion of the Great Artesian Basin.

The main purpose of the survey was to define magnetic basement structure to assist the geological mapping of pre-Mesozoic structures and to locate accumulations of Palaeozoic sediments. The magnetic basement lies within Palaeozoic rocks over most of the region but does not represent a single geological horizon. It is thought to be composed of predominantly igneous and metamorphic rock and only over limited areas does it coincide with economic or crystalline basement.

Much geophysical work has been carried out in and around the area. This includes the adjacent airborne magnetic surveys of Cooper Creek (Delhi Australian Petroleum Ltd and Santos Ltd, 1963) flown between latitudes 24°00' and 29°00' south, Tambo-Augathella (Magellan Petroleum Corporation, 1962) flown between latitudes 23°00' and 25°00', Quilpie-Charleville-Thargomindah (Phillips Petroleum Company, 1962) flown southwards from latitude 26°00' to the New South Wales border. The Winton aeromagnetic survey (Catawba Corporation, 1957; Trans Pacific Corporation, 1957) was flown to the north of BRIGHTON DOWNS and MANEROO.

GRAVITY

Several gravity surveys have been made over the area by private companies and the Bureau of Mineral Resources. Plate 6 shows Bouguer anomaly contours at intervals of five milligals based on BMR helicopter gravity surveys (Lonsdale, 1965; Gibb, 1966 and 1967). The steep gravity gradient which strikes north-east through BRIGHTON DOWNS and CONNEMARA is termed the Diamantina Gravity Gradient (Gibb, 1967). It is considered to mark the contact between two different basement rock types rather than to be related to basement topography.

It has been suggested (R.R. Vine, pers. comm.) that over much of this region gravity contour configurations are related to variations in basement lithology rather than to basement structure. Lines of weakness may well be located along these lithological boundaries, and movements may have taken place which are the inverse of those anticipated from a consideration of gravity data alone.

SEISMIC

Seismic coverage has been obtained over much of the survey area and many pre-Mesozoic structures have been delineated. The regional geological structure shown in Plate 6 is based mainly on information obtained from such seismic surveys with additional information provided by boreholes and geological mapping. The main seismic surveys within the northern part of the survey area include the Vergemont survey (Australian Aquitaine Petroleum Pty Ltd, 1964), which covers much of MANEROO and part of BRIGHTON DOWNS: the Rodney Creek survey (Tallis & Fjelstul, 1966), the Wellshot Creek survey (Longreach Oil Limited, 1965) and the Longreach Seismic survey (Cree Oil of Canada Ltd , 1962) in LONGREACH. The West Blackall survey (Marathon Petroleum (Australia) Ltd, 1967) covers the south-east of LONGREACH and the eastern two-thirds of BLACKALL. In the southern part of the survey area complete seismic coverage has been obtained, the more important surveys being the Regleigh survey (Alliance Oil Development, 1966), which covers the portion of the survey area in WINDORAH, and the Tallyabra seismic survey (Farley, 1967), which covers the portion of the survey area in EROMANGA and THARGOMINDAH. In addition, seismic work done by Phillips Australian Oil Company in the Adavale Basin has been reviewed by Slanis and Netzel (1967).

Of the many oil exploration and water bores that have been drilled in the area, those which penetrate beneath the Mesozoic, and which thereby add to the geological understanding of the magnetic results, are shown in Plate 6 and are tabulated in Appendix A.

2. GEOLOGY

Regional

The Great Artesian Basin has been defined as an approximately pear-shaped syncline in Mesozoic and later sediments, widening southwards from the Gulf of Carpentaria (Whitehouse, 1954). The eastern and western margins are regarded as being defined by pre-Mesozoic outcrops ranging in age from Precambrian to Permian. The Great Artesian Basin has been divided into three component sub-basins, the Surat (south-east), Eromanga (central), and Carpentaria (north).

The survey area lies within the Eromanga Basin, whose outlines correspond approximately to those of the Lake Eyre drainage basin. Although correlation between topography and geology is evident on a regional scale, local topography over much of the region is formed of dissected layers of duricrust and bears no relation to bedrock geology.

Structure

Some geologically mapped structures are believed to be surface manifestations of more prominent features at depth, e.g. the Hulton-Rand Structure, north-east of Longreach (Plate 7). Several major features obscured by Mesozoic sediments are known to lie within the survey area. These include the Boulia Shelf, a platform associated with the Cloncurry Fold Belt (Carter, Brooks, & Walker, 1961), which is believed to extend under the western portion of BRIGHTON DOWNS (Gibb, 1967). East of Longreach, bores have penetrated a region of granitic intrusion overlain by approximately 3000 ft of sediments. This appears to be part of a shelf area which includes the Maneroo Platform and the Yaraka Shelf.

The Mesozoic sediments of the Eromanga Basin overlie three older basins which extend into the survey area. The oldest of these is the Adavale Basin, which contains Devonian and early Carboniferous sediments. It has been exhaustively investigated by Phillips Australian Oil Company (Slanis & Netzel, 1967) and has produced encouraging shows of hydrocarbons. To the north of the Adavale Basin, and separated from it by the Blackall Ridge, lies the Galilee Basin of late Carboniferous to Triassic sediments. This basin is believed to extend as far west as the Hulton-Rand and Tara structures in the east of LONGREACH (Longreach Oil Ltd., 1964; Vine et al, 1965). West of the Adavale Basin, and separated from it by the Canaway Ridge, lies the Permo-Triassic Cooper Basin, a known producer of hydrocarbons at Gidgealpa.

Stratigraphy

The oldest rocks cropping out in the survey area are Cretaceous; the stratigraphy is therefore based almost entirely on borehole data. Bores considered to be relevant to the present survey, and descriptions of the rocks in which they bottomed, are given in Appendix A. In BRIGHTON DOWNS, the rocks of the Boulia Shelf are believed to consist of Lower Proterozoic metamorphic and volcanic suites (Gibb, 1966). Elsewhere in the survey area basement as defined by the bores ranges from Precambrian to Carboniferous.

It is probable that Upper Permian sediments represent the first stages of deposition of the Great Artesian Basin. Rocks of this age have been identified over most of the southern three-quarters of the survey area, but are pinched out along the Canaway Ridge. They are unlikely to give rise to magnetic anomalies, as they consist mainly of shale, sandstone, and conglomerate.

Mesozoic sediments cover the whole survey area but are predominantly obscured by a veneer of Cainozoic rocks. The Mesozoic succession is made up of Lower Cretaceous, Jurassic, and Triassic freshwater beds, with a maximum thickness of 3800 ft; these are overlain by Lower Cretaceous marine sediments and Upper Cretaceous fresh-water sediments, whose maximum thickness is approximately 6500 ft (Gregory et al, 1967). None of these rocks is expected to give rise to magnetic anomalies.

Economic

The Mesozoic sediments of the Great Artesian Basin, being partly of marine origin, contain reservoir and source rocks suitable for petroleum accumulations. Many water bores have been drilled, mainly near the margins of the basin; only minor gas flows and occasionally oily scum were encountered. It is thought therefore that the reservoirs have been too thoroughly water-flushed to have retained economic hydrocarbon accumulations in the Mesozoic rocks.

Current economic interest in the Great Artesian Basin is directed towards the Triassic and Palaeozoic sediments which are locally developed beneath the Cretaceous and Jurassic sequence. In the Cooper Basin, Chandos No. 1 produced hydrocarbon shows in Triassic sediments. Oil indications were found to increase with depth, and oil bleeding was obtained from the Permian succession.

Gilmore No. 1 yielded substantial flows of dry gas from Lower Devonian formations. The productive potential in this region of the Adavale Basin is believed to be high, as evidence suggests that the gas column is over 1300 ft. Formation damage is extensive and it is probable that only a small part of the perforated section is producing.

Basement, as far as petroleum exploration is concerned, probably ranges from the base of the Palaeozoic in the west to Upper Devonian formations in the east. The eastern Lower Palaeozoic has been disturbed by orogenic movements associated with the Tasman Geosyncline, but the intensity of deformation decreases westward.

3. MAGNETIC RESULTS AND INTERPRETATION

The magnetic data are shown in Plates 2 to 5. Plates 2 and 3 show all profiles of total magnetic intensity; the profiles have been reduced to an east-west scale of 1:500,000 and are related to a series of east-west lines which approximately represent the flight paths. A north-south scale of 1:250,000 has been used to improve data presentation.

Control points were plotted at approximately 30-mile intervals along the flight lines. The aircraft ground speed was considered constant between any two control points for the reduction of the original profiles by digital computer. Departures from this constant speed introduce positional errors in the presentation of the data. The probable positional error does not exceed $\pm \frac{1}{4}$ mile, and is a function of the distance from the control points.

Plates 4 and 5 show every second profile together with geological mapping to facilitate correlation. Plate 6 shows the Bouguer anomaly contours, and Plate 7 shows the interpretation of the magnetic data. Magnetic basement depth determinations are based on methods discussed in Appendix B.

Magnetic basement contours as shown in Plate 7 do not necessarily represent a single geological horizon, and 'discontinuities' do not therefore necessarily represent faults. The sparsity of anomalies suitable for depth determinations precluded the contouring of magnetic basement in parts of the region, as was the case with the Cooper Creek survey (Delhi Australian Petroleum Ltd. & Santos Ltd., 1963). Although rocks above magnetic basement are generally interpreted to be of sedimentary origin this is not invariably the case. Some acid igneous rocks have low magnetic susceptibilities and cannot be differentiated from sedimentary rocks on the basis of magnetic data. Where intrabasement susceptibility contrasts occur at the basement/sediments interface the magnetic contours provide an accurate indication of basement structure. Magnetic data supplemented by Bouguer anomaly contours indicate broad changes in basement lithology.

Northern area

Gravity measurements indicate that in the north-west of the survey area the Mesozoic sediments are underlain by the Lower Proterozoic rocks of the Cloncurry Fold Belt. Gravity anomalies in this region are believed to be related to density contrasts within the basement rather than to basement topography. The boundary between this unit and the Palaeozoic metamorphic basement encountered in bores further east is believed to lie along the Diamantina Gravity Gradient.

This view is supported by the magnetic data, which show an increase in anomaly magnitude and complexity in the north-west of BRIGHTON DOWNS. Both Bouguer gravity anomalies and magnetic anomalies exhibit two distinct trend directions, one striking north-west and the other north-east. Trends with the latter orientation appear as far east as the west of MANEROO. The rapid variations in total magnetic intensity along profiles indicate complex structure, and several magnetic horizons are probably present. Mutual interference of magnetic anomalies increases the probable error of the depth determinations in this region and magnetic basement contouring has therefore not been attempted. As an indication of structure, zone types have been delineated which have magnetic characteristics as listed below:

Zone	Magnetic characteristics
A	Magnetic anomalies predominantly less than 50 gammas
B	Magnetic anomalies predominantly in the range 50 to 250 gammas
C	Magnetic anoamlies predominantly greater than 250 gammas

In general, it is thought that basement rocks increase in basic content from zones of type A to zones of type C. Zone boundaries are therefore expected to reflect changes in basement lithology.

In the north-west of BRIGHTON DOWNS, Ooroonoo No. 1 lies in the northern section of a Zone C, which is flanked by Zones A and B. The Zone C coincides with the southern end of a gravity 'low', which has been correlated with an outcrop of granite in DUCHESS. Comparisons of the composition and age of this granite with the granite encountered in Ooroonoo No. 1 indicate that they are different bodies. Radioactive dating of the former granite yielded ages of 1399 and 1458 million years (Richards, Cooper, & Webb, 1963), whereas the granite from Ooroonoo No. 1 is 860 million years old (Webb, Cooper, & Richards, 1963). The DUCHESS granite is a gneissic granodiorite, somewhat different in composition from the medium granite of Ooroonoo No. 1.

Because of the granite in Ooroonoo No. 1, the gravity 'low' was attributed by Gibb (1967) to the presence of massive acidic rocks at shallow depth. The magnetic data indicate that a basic body of approximately the same outline underlies the granite at a depth of 10,000 ft below sea level (See Figure 1). At either side of this feature, a predominant magnetic horizon appears to lie at approximately 5000 ft b.s.l. It is possible that this represents the base of the Mesozoic as the Mesozoic section is generally considered to extend to 3500 ft b.s.l. in this region.

Ooroonoo No. 1 is the only bore in BRIGHTON DOWNS to penetrate basement, and direct correlation of magnetic zones with specific rock types is impossible over most of this area. Although the Zone A west of Ooroonoo No. 1 is of unknown significance, the lack of magnetic anomalies in this zone could be interpreted as being due to an acid igneous intrusion. The gravity data do not support this view, however.

A Zone C located along the western boundary of BRIGHTON DOWNS coincides approximately with a gravity 'high'. The causative body is interpreted as consisting of metamorphosed Lower Proterozoic rock with high density and high basicity. The magnetic profiles indicate that in this area at least two magnetic horizons are present.

East of the Diamantina River, a Zone A coincides with a gravity feature known as the Brighton Downs Gravity Low. It is flanked to the west by pronounced magnetic and gravity gradients which are approximately coincident along the line of the Diamantina River. Although the boundary of this zone cannot be accurately defined owing to the extent of the magnetic gradient, it probably represents a major discontinuity. On the basis of the gravimetric data, the Brighton Downs Gravity Low was attributed to granitic rocks of density 2.65 gm/cm^3, but the alternative possibility of its being due to low-density pre-Mesozoic sediments was not discounted (Gibb, 1967). The magnetic data lend strong support to the former interpretation.

The Zone A is bounded to the east by a Zone B, to the east of which lies the Diamantina Gravity Gradient. The Zone B supports the presence of Lower Proterozoic rocks, as interpreted by Gibb (1966). The northern extremity of this unit lies within the Winton survey area (Trans Pacific Corporation, 1957), but it does not extend as far as the

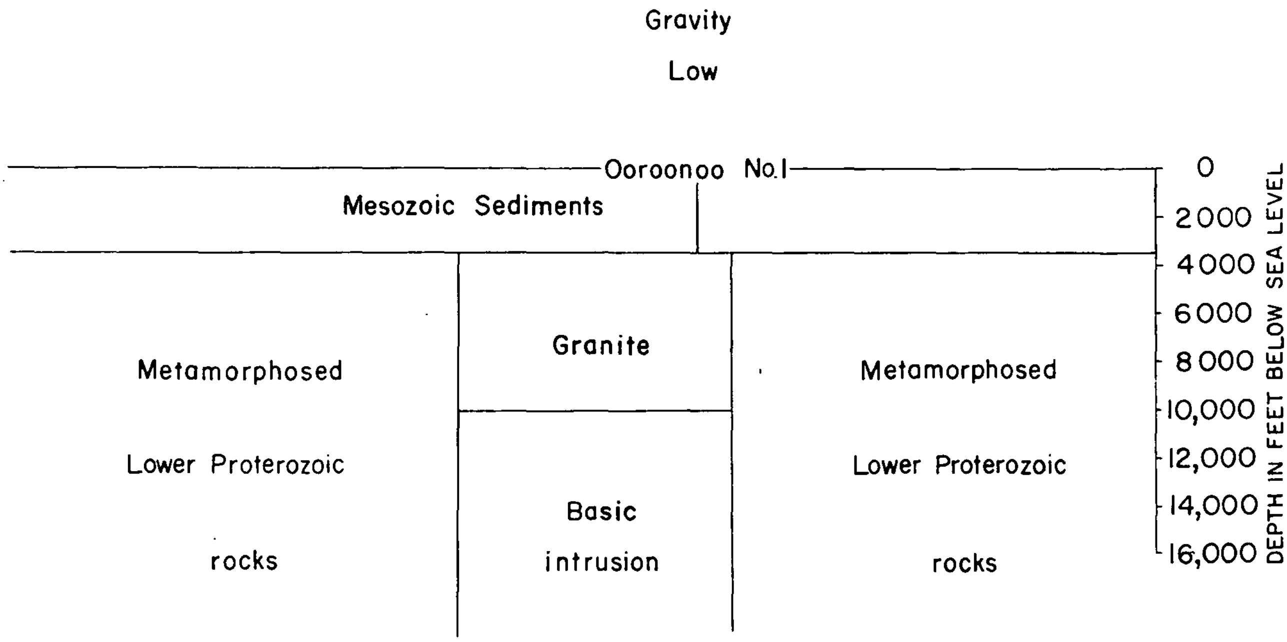

Figure 1. Postulated cross-section along Y-Y' (see Plate 7)

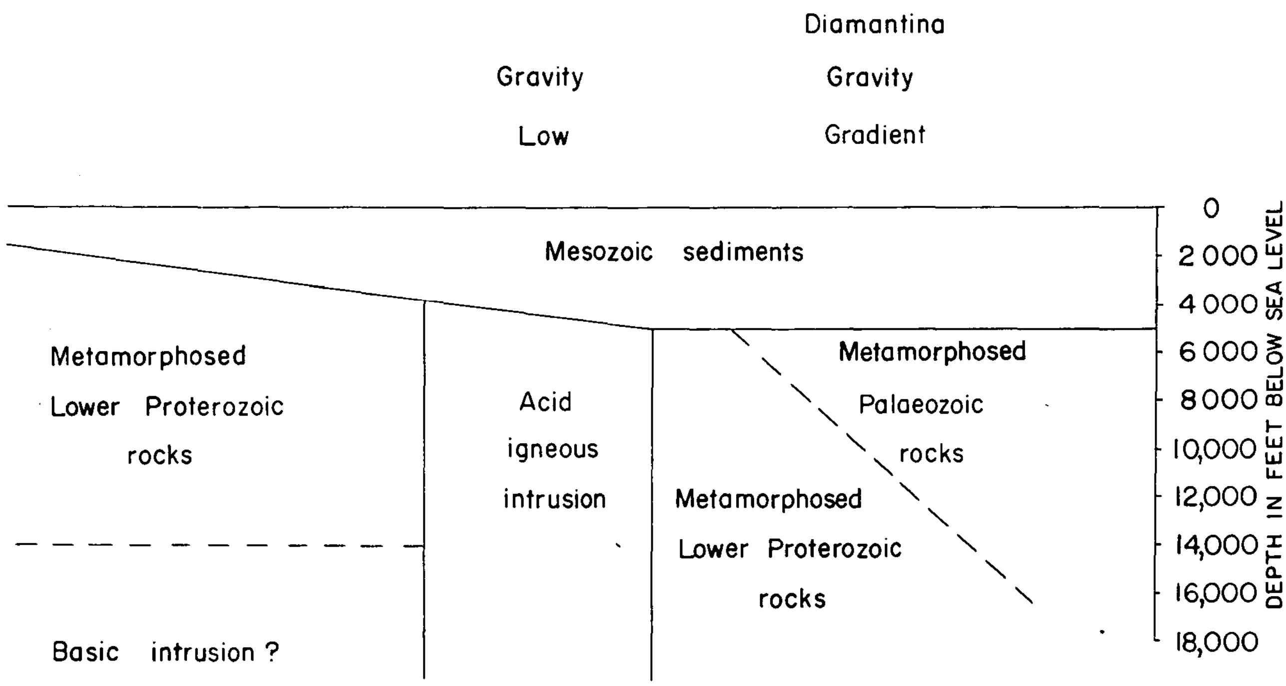

Figure 2. Postulated cross-section along Z-Z' (see Plate 7)

mapped position of the Holberton Structure. No correlation between these features is therefore possible. The probable structure of this region as shown in Figure 2 is modified from that interpreted by Gibb (1966).

Over the remainder of the survey area anomaly trends are predominantly north-south, and few anomalies exceed 150 gammas amplitude.

The interpreted magnetic basement is relatively flat in south-eastern BRIGHTON DOWNS but deepens in the east to form a 'low' on the border with MANEROO. This feature does not exhibit detailed correlation with the gravity data, but correspondence is sufficiently good to indicate that a basement 'low' is involved, rather than intrabasement susceptibility contrasts.

The four bores shown in MANEROO (Maynside No. 1, Fermoy No. 1, Newlands, and Penrith No. 1) bottom at depths compatible with the magnetic basement determinations. It is therefore probable that magnetic and economic basements coincide in this region and consist of phyllites. In the north-west of MANEROO, magnetic depth determinations are sufficiently dense to define magnetic basement with a fair degree of certainty. The magnetic basement contours are consistent with extensive block faulting, which is known to have taken place in this area (Vine et al, 1965), although correlation with gravimetric data is poor.

A magnetic basement 'high' located south-east of Penrith No. 1 is based on two magnetic depth determinations of doubtful accuracy, although this feature is coincident with a gravity 'high'. Vine et al (1965) map a minor depression in the Mesozoic sediments at this location .

No magnetic anomalies suitable for depth calculations were recorded in the south-east of MANEROO and south-west of LONGREACH. In addition, no anomalies were obtained over the Longreach granite, which cannot be regarded as magnetic basement.

The Galilee Basin is reflected in the magnetic basement contours, the depth estimates being compatible with discontinuities or steep gradients along the Tara and Hulton-Rand Structures. Neither Glenaras No. 1 nor Marchmont No. 1 penetrate magnetic basement as contoured. The former bottomed in rhyolite at 4560 ft. However, no significant magnetic anomalies appear to be associated with this rock. Hulton No. 1 and Saltern Creek No. 1 bottom in Lower Carboniferous rocks, several thousand feet above magnetic basement.

Magnetic depth determinations in the vicinity of the Barcaldine Ridge are sparse, but are compatible with the mapped position of the ridge. Magnetic basement appears to deepen to the east along this feature. In the north-east of BLACKALL, magnetic basement and gravity 'highs' coincide. Although the magnetic depth determinations in this region are of doubtful accuracy, the basin is interpreted as being shallower to the south-east. No reliable magnetic depth determinations were obtained along the position of the Blackall Ridge, and the significance of this feature has therefore not been clarified by the present survey.

An isolated magnetic basement 'high' occurs north-east of Longreach on the flank of a gravity 'high'. It rises to a height of 1400 ft b.s.l. and coincides with a 'high' in the Mesozoic sediments interpreted from borehole data; it is thus interpreted to be a basement feature.

Further south, a magnetic basement 'high' rising to 400 ft b.s.l. and a basement depression of 26,000 ft b.s.l. coincide with a prominent gravity 'high'. In the vicinity of the magnetic basement 'high', water bores penetrate to over 2500 ft without encountering bodies likely to produce the magnetic anomalies. Depths may be significantly in error owing to mutual interference of two magnetic anomalies, but it is interpreted that faulting or basic intrusion accounts for the magnetic data. The basement depth of 26,000 ft is attributed to intrabasement susceptibility contrasts, and is of unknown significance.

In JUNDAH there is a prominent magnetic basement depression, extending down to approximately 16,000 ft b.s.l. Although the boundaries of this depression cannot be accurately defined, it is probable that they are the Swan and Stormhill faults to the east, and the Thomson syncline to the west. The coincidence of gravity 'lows' with this magnetic basement depression indicates a thickening of the sedimentary section rather than the presence of an acid igneous intrusion. The occurrence of a gravity 'high' over a known granite intrusion at Warbreccan, to the west, supports this interpretation. A gravity 'low' in south-east MANEROO suggests that this depression may extend further north-east.

Over the eastern portion of JUNDAH and most of BLACKALL a general deepening of magnetic basement to the south-west and south-east is evident. The ridge which separates these two trends coincides with a gravimetric 'high', and is therefore interpreted as a basement structure. At the southern end of the ridge a magnetic basement depth of 13,700 ft b.s.l. was obtained. This value is attributed to intrabasement susceptibility contrasts. The majority of the bores in this region do not penetrate the Permian, and the composition of magnetic basement is therefore doubtful. However, Springleigh No. 3 penetrated Lower Palaeozoic(?) rocks at 6040 ft, which indicates that magnetic and economic basements in this region coincide. The deepening of basement to the south-east is confirmed by gravimetric results and by bores Carlow No. 1 and Fairlea No. 1. The latter entered Middle Devonian rocks at a depth close to magnetic basement.

Southern area

Few magnetic anomalies are suitable for depth analysis in this area. Although over much of the region it has not been practicable to contour magnetic basement, the broad structure of the area has been confirmed. The majority of magnetic trends strike slightly west of north, parallelling known structure. The largest anomalies occur in the southern part of the area, where amplitudes of up to 80 gammas were recorded.

Magnetic basement and gravity 'highs' coincide over the mapped position of the Canaway Ridge. Magnetic data suggest that the ridge narrows to the north, and does not enter the northern position of the survey area. Magnetic basement deepens westward into the Cooper Basin and eastward into the Adavale Basin. Along the Canaway Fault an unconformity in the magnetic basement is probable. West of the Canaway Ridge the rapid deepening of the magnetic basement indicates the possibility of a faulted boundary. Boreholes Chandos No. 1 and Bodalla Warrabin Trough No. 1 lie in the Cooper Basin outside the area contoured. They bottom at 9040 and 8000 ft respectively and are compatible with the neighbouring magnetic basement contours. On the Canaway Ridge, Canaway No. 1 bottomed in phyllites at 4070 ft. It is therefore probable that magnetic basement in this region is phyllite.

In the Adavale Basin only two magnetic basement depths were obtained, and no direct comparisons with borehole data are possible. However, Yongala No. 1 bottomed in phyllites and trachytes at 9520 ft, apparently in magnetic basement. Buckabie No. 1 bottomed at 8330 ft, and is compatible with the magnetic basement depth estimates.

In the extreme south of the survey area, the general decrease in depth to basement indicated by gravity contours is confirmed by the magnetic data. Orient No. 2 bottomed at 3060 ft, which is close to magnetic basement. It is interpreted that magnetic and metamorphic basements coincide in this region.

4. CONCLUSIONS AND RECOMMENDATIONS

The magnetic results interpreted in this Record are based on original and reduced magnetic profiles. Consideration of contour maps when they become available may indicate areas where revision and amplification of the magnetic interpretation is desirable.

Magnetic trends in the area are predominantly north-south except in BRIGHTON DOWNS, where two distinct trend directions were observed. One of these strikes north-east, parallel to the Diamantina Gravity Gradient, the other strikes north-west parallelling the structure of the Cloncurry Fold Belt. Most of the northern area has an adequate density of magnetic depth estimates to determine the form of the magnetic basement.

In the west of BRIGHTON DOWNS, magnetic basement depth determinations are influenced by rapid variations in the magnetic field, and magnetic basement contouring has not been attempted. Two areas of granitic intrusion were proposed by Gibb (1966) to account for gravity 'lows', and this interpretation is supported by the magnetic data. Postulated cross-sections of these features are indicated in Figures 1 and 2. Magnetic basement west of the Diamantina Gravity Gradient is believed to consist predominantly of Lower Proterozoic metamorphic rocks.

The four bores shown in Plate 7 in MANEROO bottomed at depths close to magnetic basement, which is interpreted to consist of phyllites. Magnetic basement variations here and in LONGREACH are believed to be related to metamorphic basement features. Further geophysical investigation of the magnetic basement 'highs' is recommended.

The magnetic data are compatible with basement discontinuities or steep gradients along the Hulton-Rand and Tara Structures, and with the mapped position of the Barcaldine Ridge. The Galilee Basin is interpreted as having a magnetic basement depth of approximately 12,000 ft b.s.l.; basement rises to the south-east.

In JUNDAH, a Lower Palaeozoic trough is postulated, with a depth of approximately 16,000 ft b.s.l. Further investigation of this feature is warranted, as it may contain source beds for hydrocarbons.

In BLACKALL a magnetic basement ridge running south corresponds to a gravity 'high', and may represent a basement structure. Springleigh No. 3 shows that magnetic basement in this region probably consists of Palaeozoic metamorphic rocks rather than crystalline rocks.

In the south, magnetic anomalies suitable for depth estimates were sparse and magnetic basement depth contouring has been limited to two localities.

The Canaway Ridge, Cooper Basin, and Adavale Basin are reflected in the magnetic results, although the Canaway Ridge does not appear to extend as far north as the northern portion of the survey area. Magnetic basement here is interpreted as consisting of Lower Palaeozoic metamorphic rocks.

In the extreme south of the survey area magnetic basement becomes shallower southwards. In this region metamorphic and magnetic basements are thought to coincide, in view of the fair correlation between magnetic, gravimetric, and bore data.

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APPENDIX A

BOREHOLE DATA

Northern area

Name of Bore	Company	Latitude South Longitude East	Depth below sea level (ft)	Bottom formation
Alice River No. 1	Farmout Drillers N.L.	23°37'08" 145°19'15"	4470	Palaeozoic(?) Conglomerate
Carlow No. 1	Phillips-Sunray	24°50'27" 145°25'48"	11,094	Devonian Tuffs
Cleeve Bore No. 1	Longreach Oil Ltd.	23°26'00" 144°23'40"	2370	Silurian Weathered granite
Fairlea No. 1	Sun	24°29'50" 145°19'52"	9260	Middle Devonian
Fermoy No. 1	Australian Aquitaine Petroleum Pty Ltd	23°8'32" 143°3'26"	4460	Cambrian Phyllites, slates
Glenaras No. 1	Phillips Australian Oil Co.	23°05'52" 144°43'23"	4560	Lower Carb(?) Rhyolite
Hascombe No. 1		24°13' 144°44'	3780	Permian
Hulton No. 1	Longreach Oil Ltd	23°23'25" 144°55'20"	1400	Lower Carb(?) Quartzite
Longreach No. 1	Longreach Oil Ltd	23°26'50" 144°15'50"	2590	Lower Palaeozoic Weathered granite
Marchmont No. 1	Longreach Oil Ltd	23°10'15" 144°44'21"	5780	Upper Carboniferous

Northern area, cont.

Name of Bore	Company	Latitude South Longitude East	Depth below sea level (ft)	Bottom formation
Maynside No. 1	Australian Aquitaine Petroleum Pty Ltd	23°35'23" 142°31'11"	4720	Phyllite, quartzite
Newlands	Amerada Petroleum Corporation	23°52'33" 142°57'46"	5160	Phyllites
Ooroonoo No. 1	Conarada	23°10'50" 141°33'09"	3430	Precambrian granite
Penrith No. 1	Associated Australian Oilfields	23°10'20" 143°38'30"	3380	Phyllite
Portland No. 3		24°06' 144°34'	3390	Permian
Ruthven No. 1		24°07'30" 144°04'	3305	Permian(?)
Ruthven No. 2		24°14'35" 144°01'	3815	Permian(?)
Saltern Creek No. 1	Longreach Oil Ltd	23°20'54" 144°56'24"	4200	Lower Carboniferous quartzite
Springleigh No. 3	Stewarts Mooga N.L.	24°34'25" 144°44'40"	6040	Lower Palaeozoic(?)
Warbreccan No. 1	Westland Oil Co. Ltd	24°25'45" 142°46'30"	4670	Granite ?
Wellshot No. 6		23°57'20" 144°16'20"	3120	Permian(?)

Southern area

Name of Bore	Company	Latitude South Longitude East	Depth below sea level (ft)	Bottom formation
Bodalla No. 1	B.P. Petroleum Development Australia Pty Ltd	26°25'43" 143°26'09"	8000	Devonian Sandstone
Buckabie No. 1	Phillips Petroleum Co.	26°11'50" 144°16'15"	8330	Ordovician Phyllite
Canaway No. 1	Alliance Oil Development	25°56'05" 143°57'47"	4070	Palaeozoic Phyllite
Chandos No. 1	Alliance Oil Development	25°50'14" 143°19'36"	9040	Ordovician clastics
Cothalow No. 1	Phillips-Sunray	25°43'34" 144°23'22"	7770	Ordovician(?) Basalt
Gilmore No. 1	Phillips Petroleum	25°21'33" 144°48'38"	13,190	Lower Devonian Shale
Gumbardo No. 1	Phillips-Sunray	25°58'52" 144°41'41"	12,020	Olivine basalt
Leopardwood No. 1	Phillips-Sunray	25°37'10" 144°40'13"	12,790	Lower Devonian Tuff
Orient No. 2	L.H. Smart Oil Exploration Co. Ltd	27°40'30" 143°11'43"	3060	Pre-Mesozoic(?) Sandstone, greywacke
Yongala No. 1	Alliance Oil Development	25°30'19" 143°55'48"	9520	Phyllite Trachyte

APPENDIX B

METHODS OF DEPTH DETERMINATION

For the purpose of interpretation, anomalies were divided into two categories. Those extending across several flight lines were treated as semi-infinite blocks, and those only appearing on one flight line were treated as point sources. For the extended sources, the half-maximum-slope method (Peters, 1949) was used. This assumes that the causative body has vertical sides and strikes approximately north-south. The horizontal distance between the points of half maximum slope varies from 1.2 times the depth of burial for thin sheets to 2.0 times the depth for the edge of a semi-infinite block. Using the average factor of 1.6, a first approximation to the depth was obtained. The distance between the inflection points of the anomaly yeilded the approximate width of the causative body. By dividing the width by twice the depth, a parameter was obtained which could be used to provide a corrected Peters' factor (Moo, 1965). This in turn yielded a second approximation to the depth. Adjacent profiles were compared to obtain the strike of the body. Calculated depths were then corrected for the influence on them by oblique intersections of flight lines with strike directions.

Anomalies only appearing on one profile were generally taken to be due to point sources. In determining the validity of the point source method, consideration was taken of adjacent magnetic basement depths. The depth was taken to be two-thirds of the width of the anomaly at half maximum amplitude. Errors may be considerable in using this method, since it cannot generally be determined whether the flight path crossed the maximum of the point source anomaly. Few cases of point sources were encountered.

Magnetic depth estimates are commonly in error by up to 20%. Prior to estimating these errors it is necessary to add the height of the aircraft above sea level (2000 ft) to the depth determinations, since this is the datum from which depths were calculated.

Several of the bores in the survey area penetrate formations believed to represent local magnetic basements. An absolute check on magnetic depth determinations was thus possible at these points.

APPENDIX C

OPERATIONAL DETAILS

Staff

Party Leader		D. R. Waller
Geophysicist		B. S. Grewal
Senior Radio Technician		P. Ryan
Drafting Assistant		K. A. Barrett
Geophysical Assistants		K. A. Mort
		D. Park
Pilots	Captain	L. Giddens)
	First Officer	J. Lindsay)
Aircraft maintenance engineers		E. Aylward)
		M. Hopkins)

Equipment

Aircraft	D.C.3 VH-MIN
Magnetometers	MFS-6 saturable core fluxgate tail boom installation coupled to "Speedomax" and digital recorders. MFD-4 saturable core fluxgate ground installation for storm warning, coupled to Esterline-Angus recorder.
Barometric altimeter	Pilot Control
Air position indicator	Track recorded by DeVar recorder
Camera	BMR 35-mm strip

Survey specifications

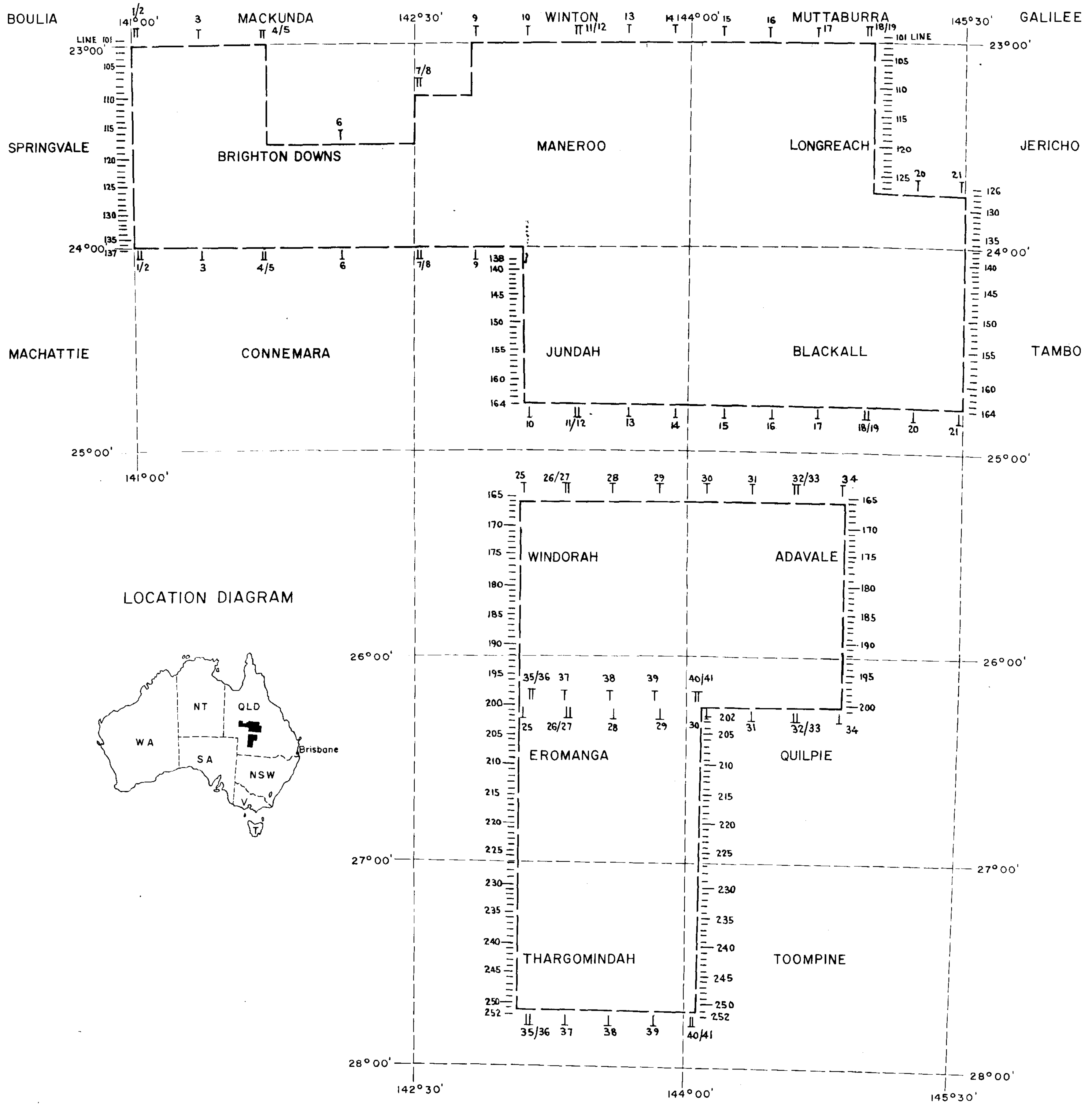
Line spacing	2-mile throughout
Line orientation	East-west
Tie system	North-south, as shown in Plate 1
Altitude	2000 ft above sea level

Navigational control	Aerial photographs
Record sensitivity:	
MFS-6	25 gammas/inch
MFD-4	20 gammas/inch

Survey timetable

Party arrived Longreach	26th to 28th March
Survey flying commenced	28th March
Party moved to Quilpie	22nd to 24th May
Survey flying completed	18th June
Survey office vacated	29th June
Party departed Quilpie	1st July

PLATE I



AIRBORNE SURVEY, CENTRAL GREAT ARTESIAN BASIN, QLD 1968

LOCALITY MAP

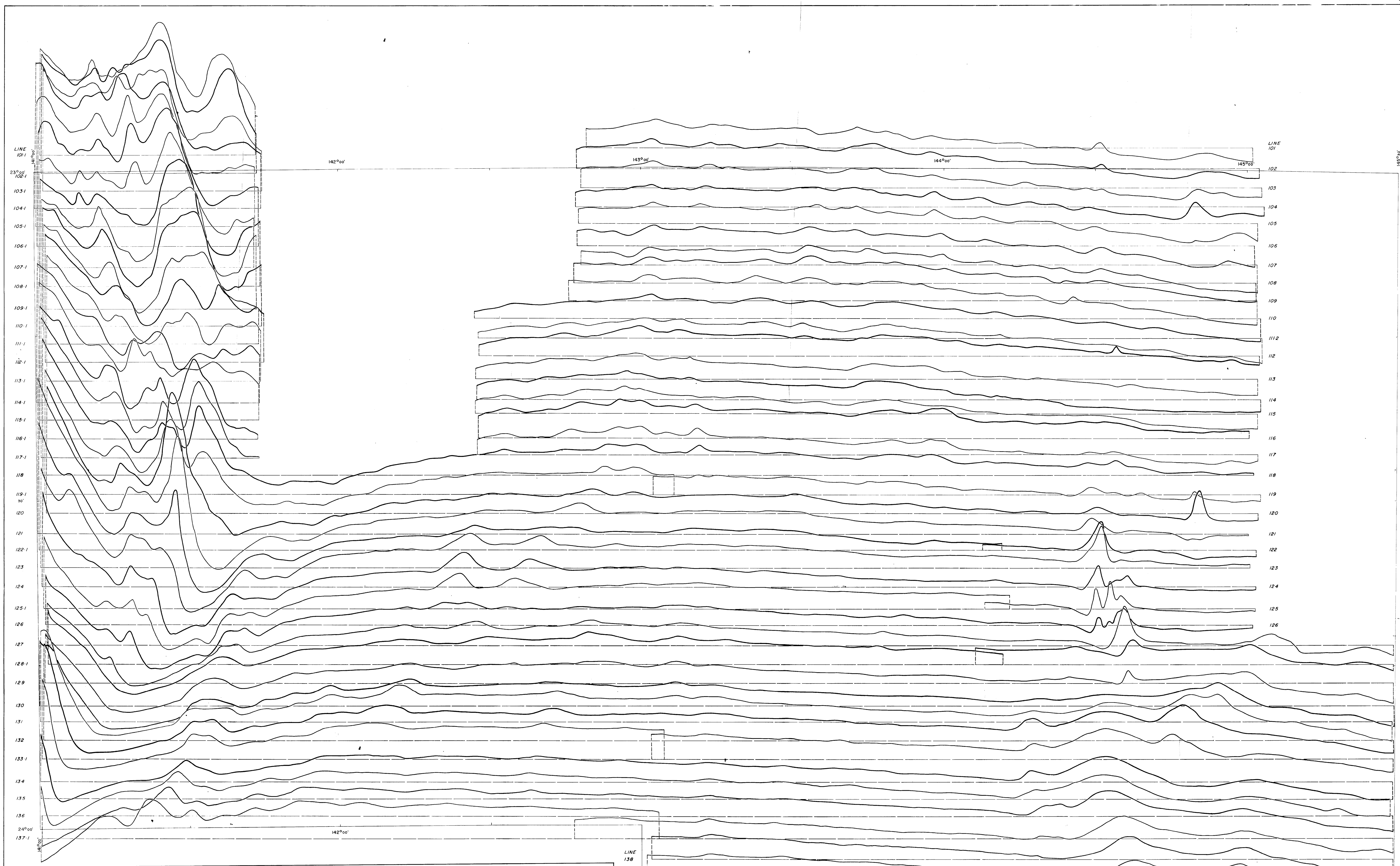
FLIGHT-LINE AND TIE-LINE SYSTEM

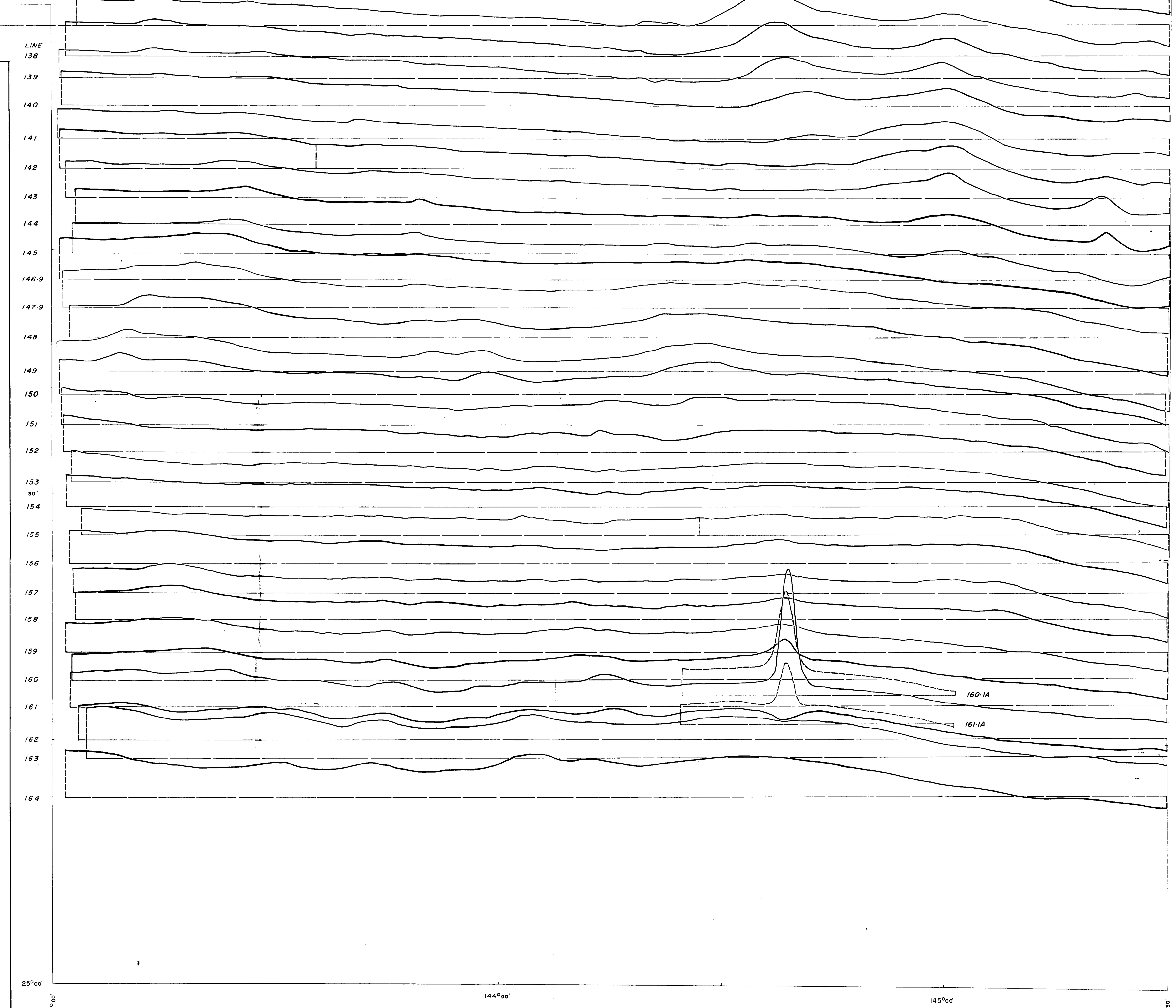
50 0 50 100 150 MILES

50 0 50 100 150 200 KILOMETRES

TO ACCOMPANY RECORD No. 1969/33

G54/BI-3

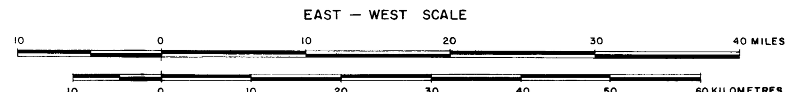




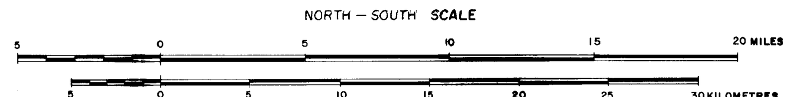
AIRBORNE SURVEY, CENTRAL GREAT ARTESIAN BASIN, QLD 1968, NORTHERN AREA

TOTAL MAGNETIC INTENSITY PROFILES

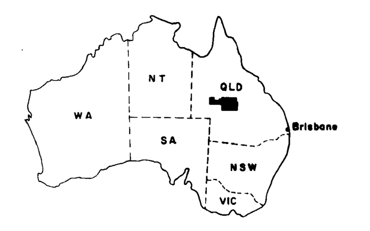
EAST — WEST SCALE



NORTH — SOUTH SCALE



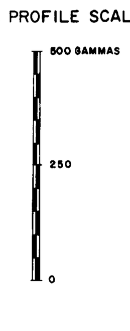
LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

MACKUNDA	WINTON	MUTTABURRA
BRIGHTON DOWNS	MANEROO	LONGREACH
CONNEMARA	JUNDAH	BLACKALL

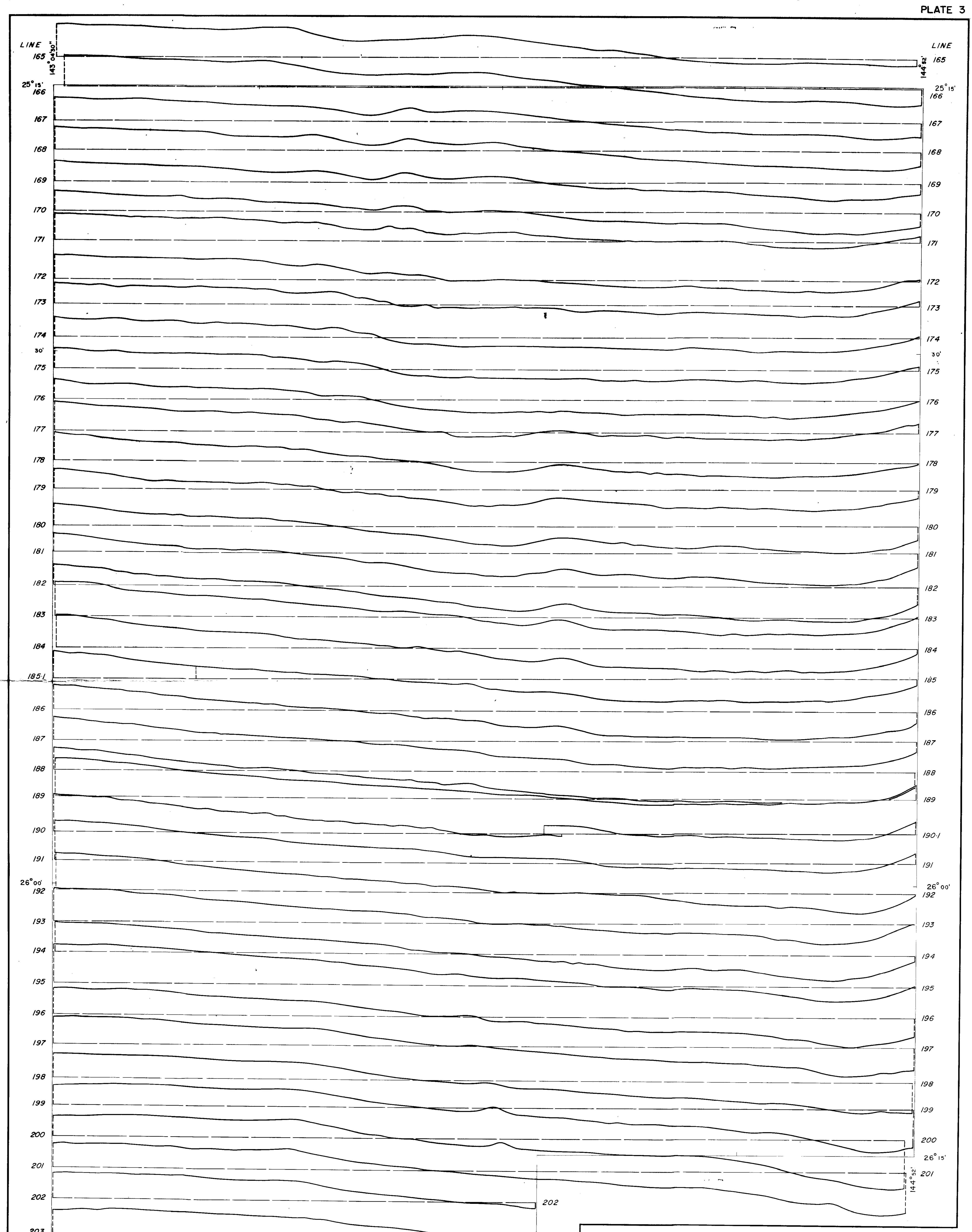
APPROX PROFILE SCALE

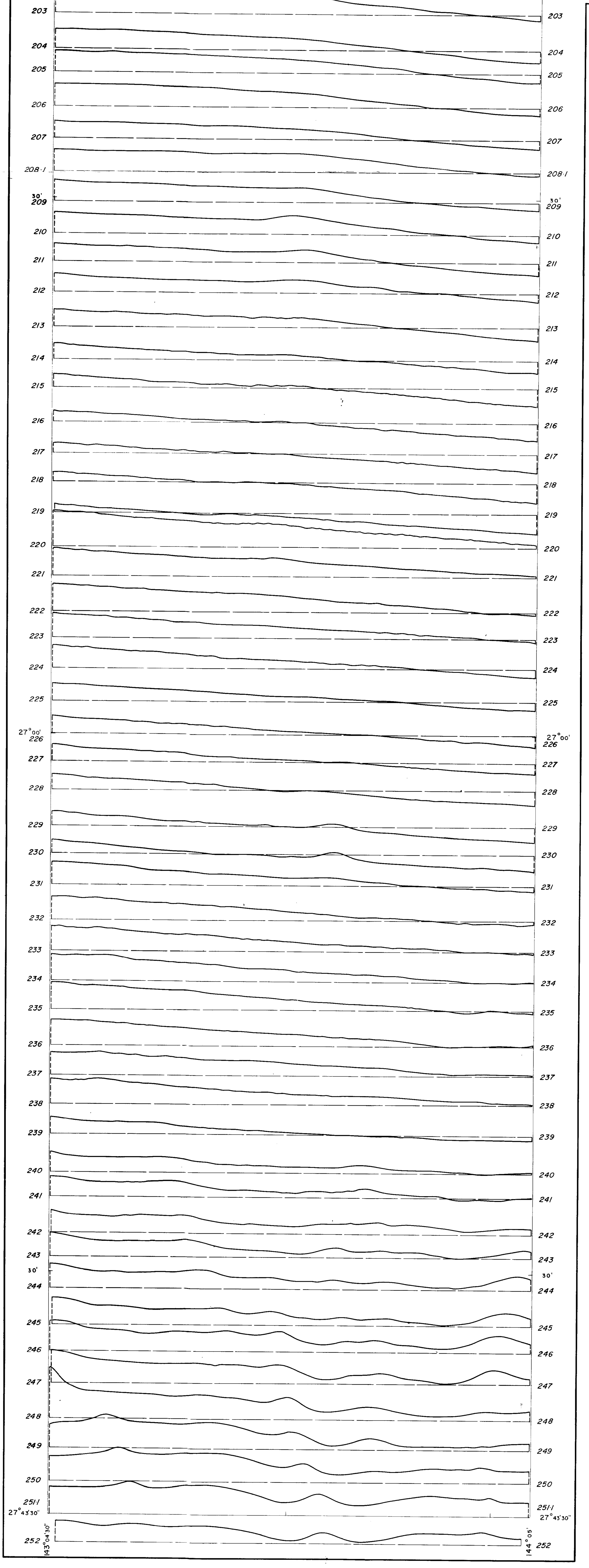


EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC3 AIRCRAFT AT AN ALTITUDE OF 2000 FEET ABOVE SEA LEVEL ALONG EAST-WEST LINES SPACED TWO MILES APART. THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASE LINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ±1/4 MILE.

THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 10 GAMMAS PER MILE.

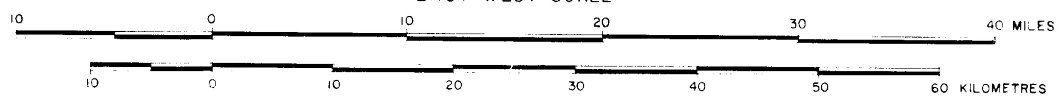




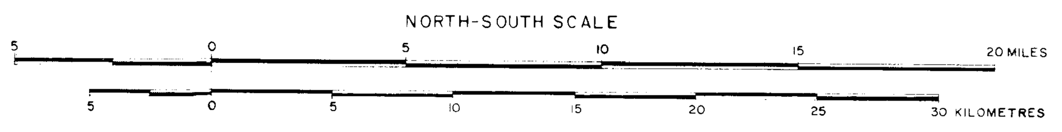
AIRBORNE SURVEY, CENTRAL GREAT ARTESIAN BASIN, QLD 1968, SOUTHERN AREA

TOTAL MAGNETIC INTENSITY PROFILES

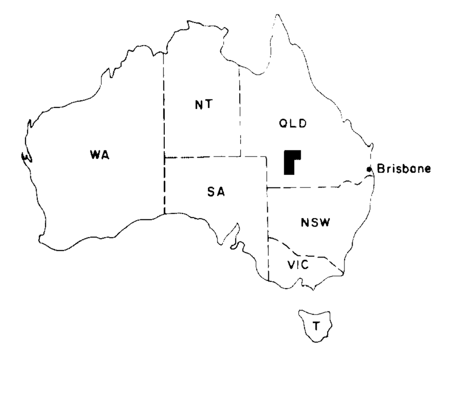
EAST-WEST SCALE



NORTH-SOUTH SCALE



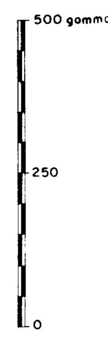
LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

CANTERBURY	WINDORAH	ADAVALE
BARROLKA	EROMANGA	QUILPIE
DURHAM DOWNS	THARGOMINDAH	TOOMPINE

APPROX. PROFILE SCALE



EXPLANATORY NOTES

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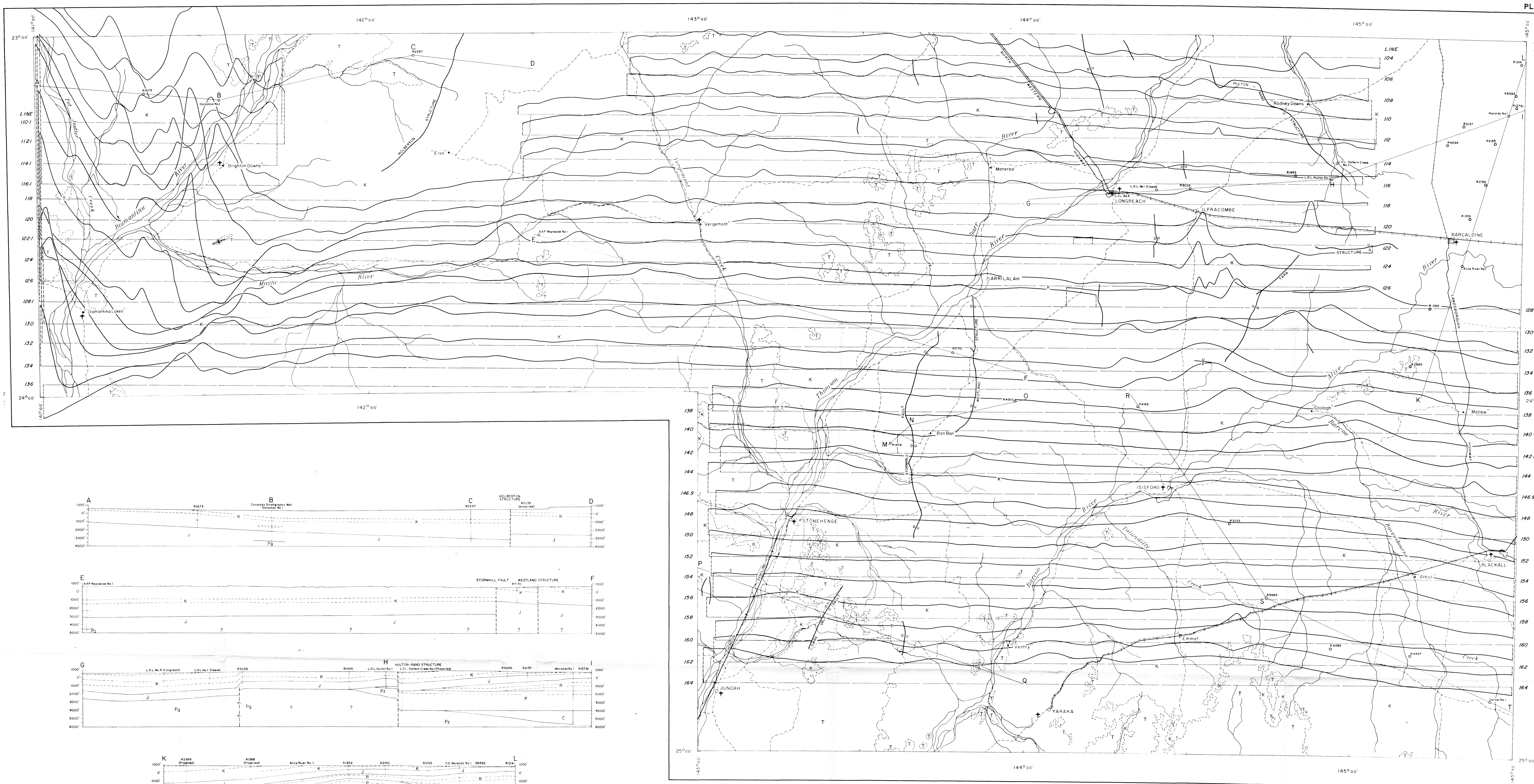
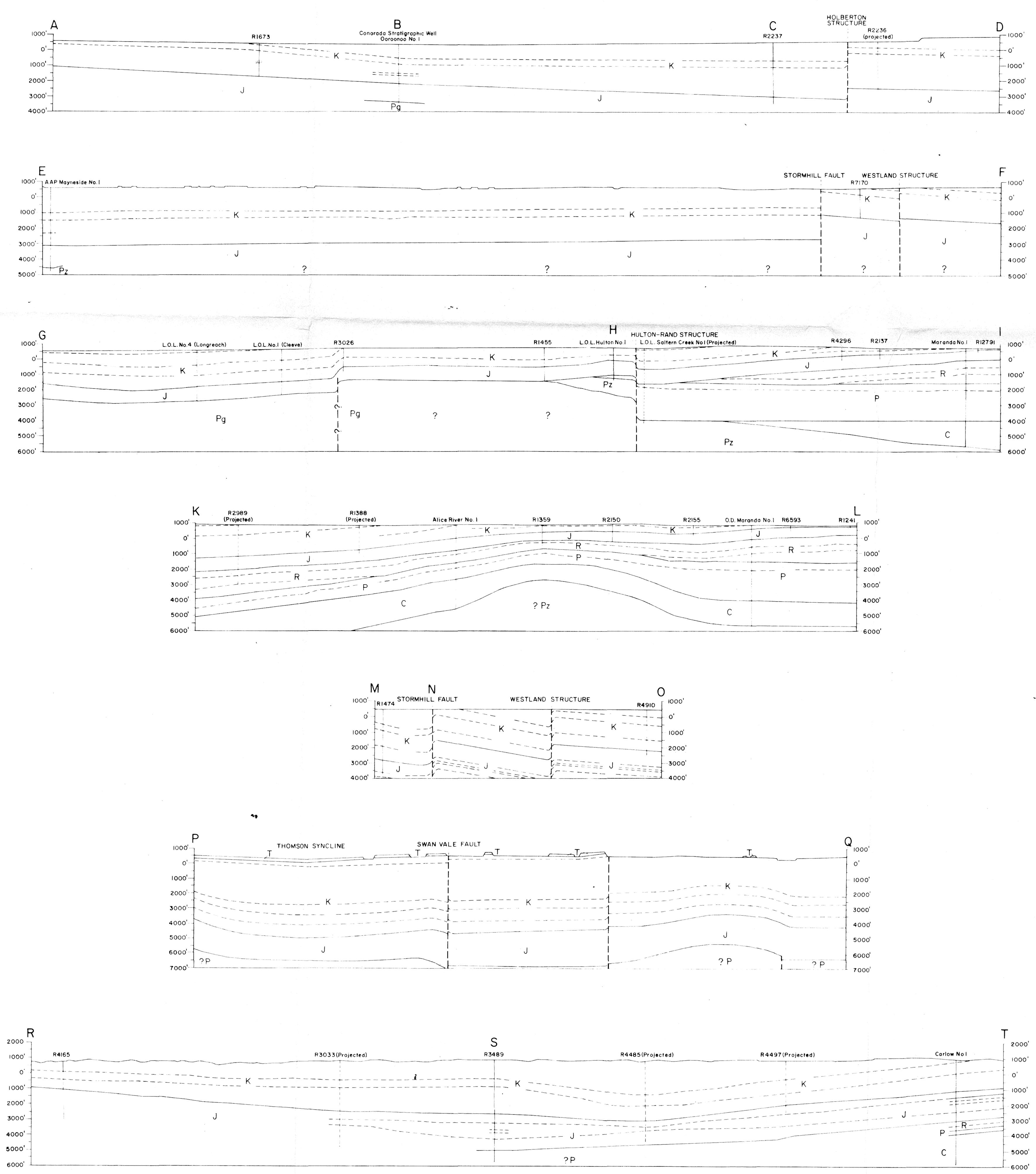
THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 9 GAMMAS PER MILE.

PLATE 4



BASED ON F54/BO-28
BASED ON F54/BO-27
BASED ON F54/BI-33



GEOLOGICAL LEGEND

T	TERTIARY
K	CRETACEOUS
J	JURASSIC (INCLUDING "J-K")
R	TRIASSIC
P	PERMIAN
C	CARBONIFEROUS
Pz	UNDIFFERENTIATED PALAEOZOIC
Pg	GRANITE
	GEOLOGICAL BOUNDARY
	FAULT (D, U indicate relative movement down, up)
	SYNCLINE
o	BORE

GEOLOGY AFTER

BRIGHTON DOWNS: W. JAUNCEY, R.R.VINE, R.J.PATEN

MANEROO: W.JAUNCEY, M.C.GALLOWAY, D.J.CASEY (QUEENSLAND STATE MINES)

LONGREACH: R.R.VINE, W.JAUNCEY, M.C.GALLOWAY

JUNDAH: B.R.SENIOR

BLACKALL: D.J.CASEY (QUEENSLAND STATE MINES)

AIRBORNE SURVEY, CENTRAL GREAT ARTESIAN BASIN, QLD 1968, NORTHERN AREA

TOTAL MAGNETIC INTENSITY PROFILES AND GEOLOGY

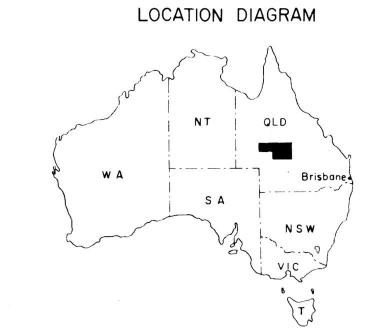
MILES 10 0 10 20 30 40 MILES

KILOMETRES 10 0 10 20 30 40 50 60 KILOMETRES

APPROX. PROFILE SCALE

500 gammas
250
0

LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

BOULIA	MACKUNDA	WINTON	MUTTABURRA	GALILEE
SPRINGVALE	BRIGHTON DOWNS	MANEROO	LONGREACH	JERICHO
MACHATTIE	CONNEMARA	JUNDAH	BLACKALL	TAMBO
BETOOTA	CANTERBURY	WINDORAH	ADAVALE	AUGATHELLA

EXPLANATORY NOTES

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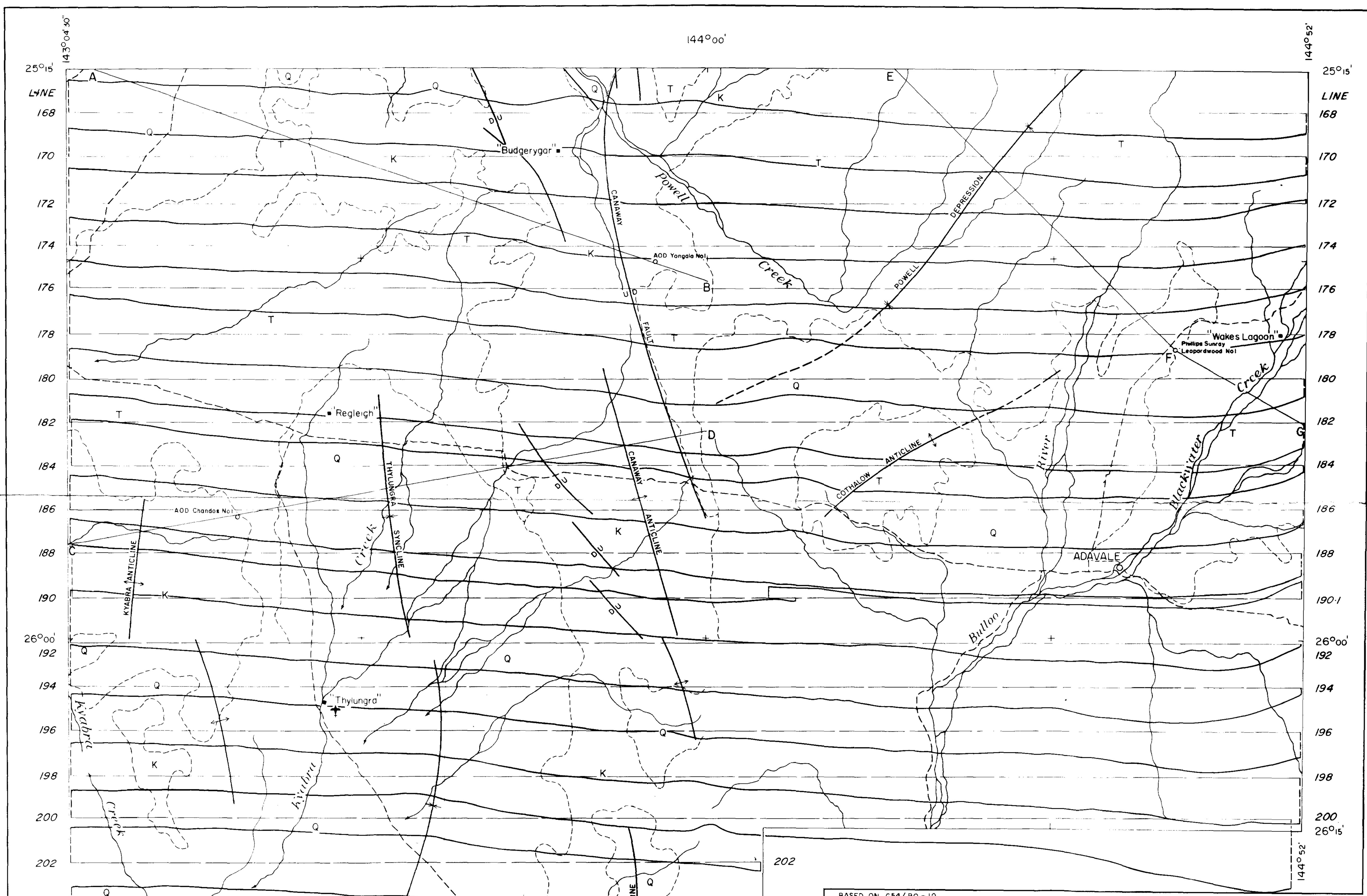
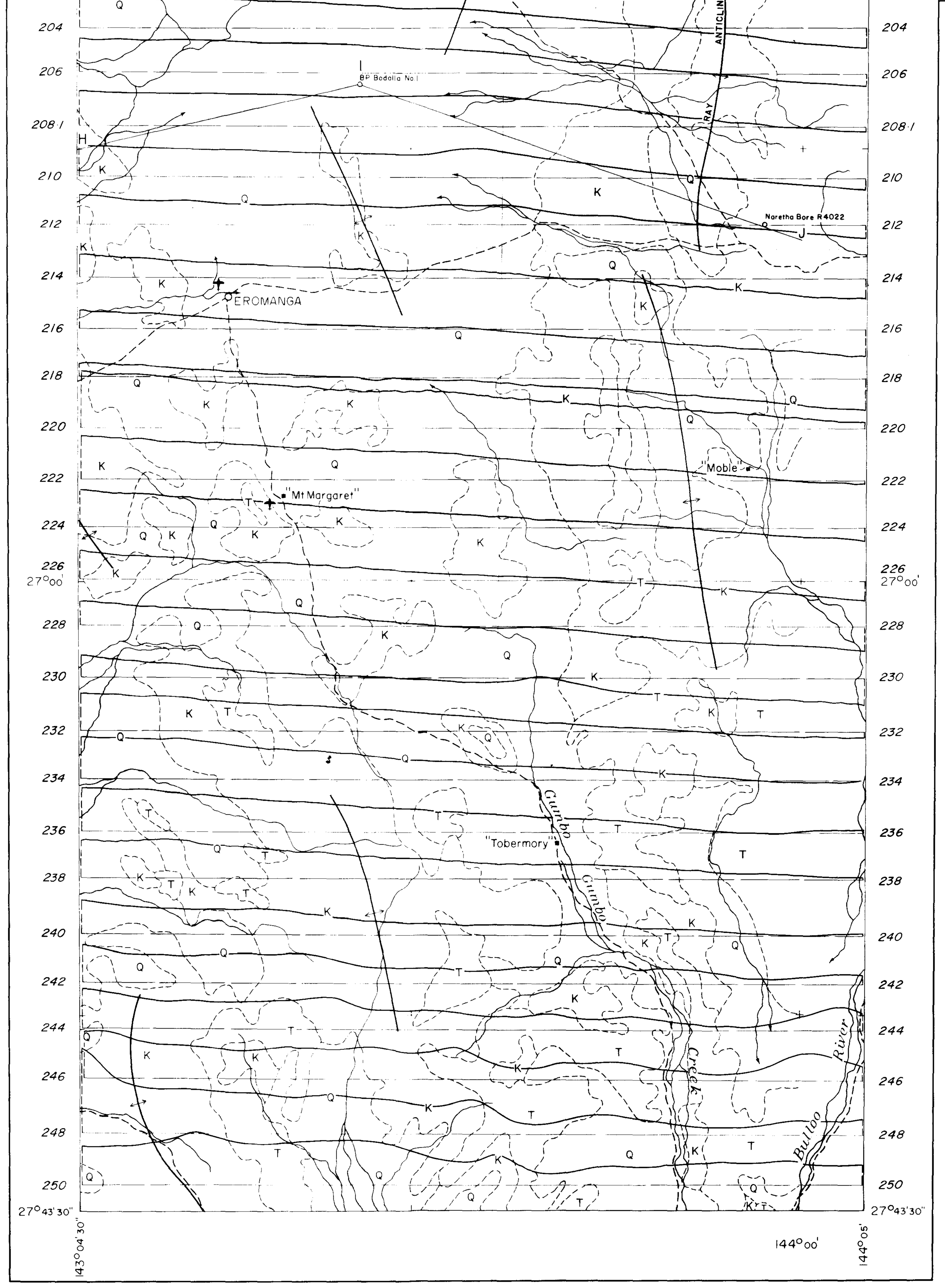
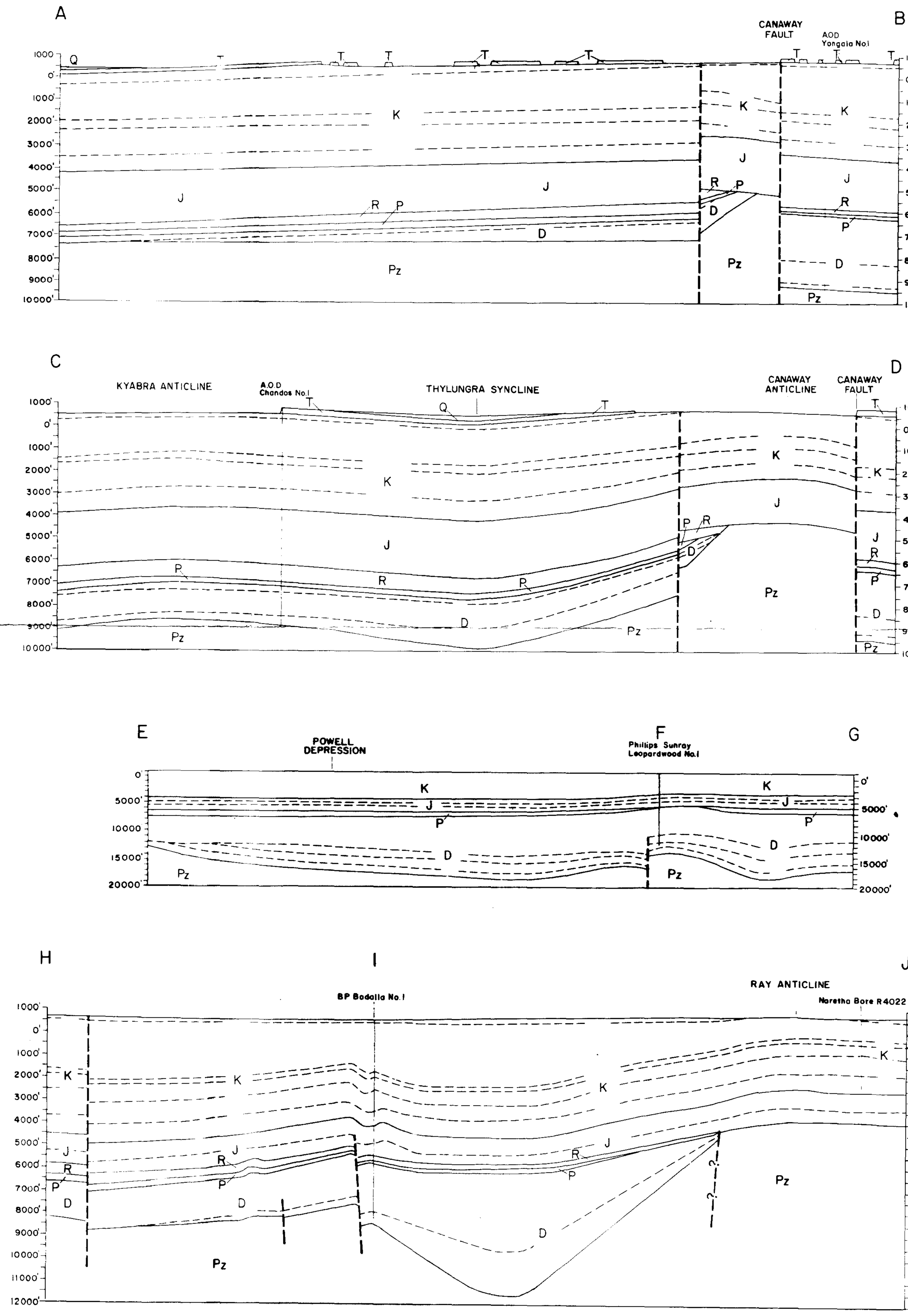
PROFILES RECORDED AT INTERVALS OF FOUR MILES ARE SHOWN ON THE MAP.

THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 10 GAMMAS PER MILE.

TOPOGRAPHICAL LEGEND

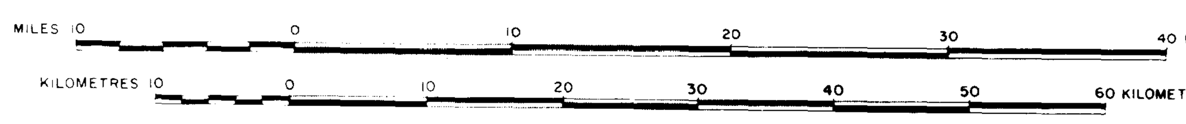
	BUILT UP AREA
o	SETTLEMENT, NAMED PLACE
	RAILWAY, STATION, SIDING
	TRAMWAY
	HIGHWAY
	ROAD OR TRACK
	HOMESTEAD
	AERODROME
	RIVER OR CREEK



AIRBORNE SURVEY, CENTRAL GREAT ARTESIAN BASIN, QLD 1968, SOUTHERN AREA

TOTAL MAGNETIC INTENSITY PROFILES AND GEOLOGY



EXPLANATORY NOTES

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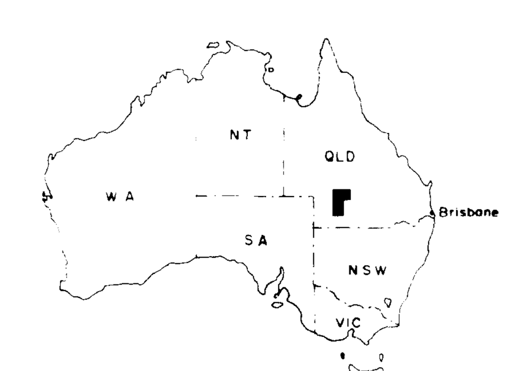
LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

CONNEMARA	JUNDAH	BLACKALL	TAMBO
CANTERBURY	WINDORAH	ADAVALE	AUGATHELLA
BARROLKA	EROMANGA	QUILPIE	CHARLEVILLE
DURHAM DOWNS	THARGO-MINDAH	TOOMPINE	WYANDRA
TICKALARA	BULLOO	EULO	CUNNAMULLA

GEOLOGICAL LEGEND

- Q — QUATERNARY
- T — TERTIARY
- K — CRETACEOUS
- J — JURASSIC (INCLUDING "J–K")
- R — TRIASSIC
- P — PERMIAN
- D — DEVONIAN
- Pz — UNDIFFERENTIATED PALAEOZOIC
- BORE
- GEOLOGICAL BOUNDARY
- FAULT (D, U indicate relative movement down, up)
- SYNCLINE
- ANTICLINE

GEOLOGY AFTER

WINDORAH : C.M. GREGORY

ADAVALE : M.C. GALLOWAY

EROMANGA : J.A. INGRAM

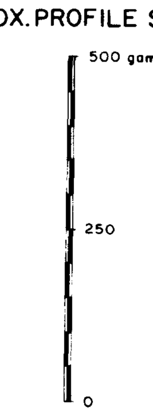
THARGOMINDAH : D.A. SENIOR, B.R. SENIOR

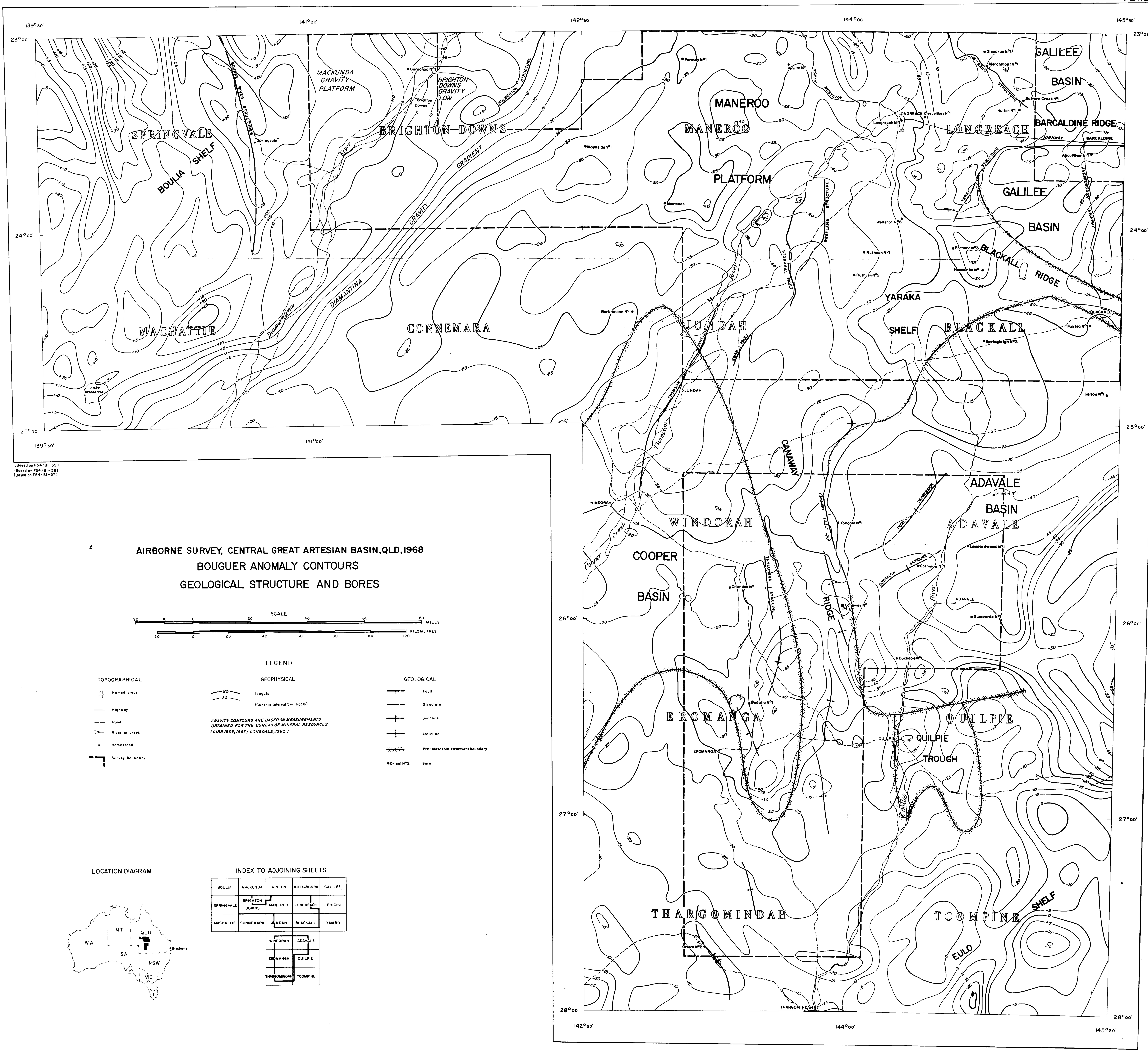
ADDITIONAL INFORMATION FROM R.R. VINE

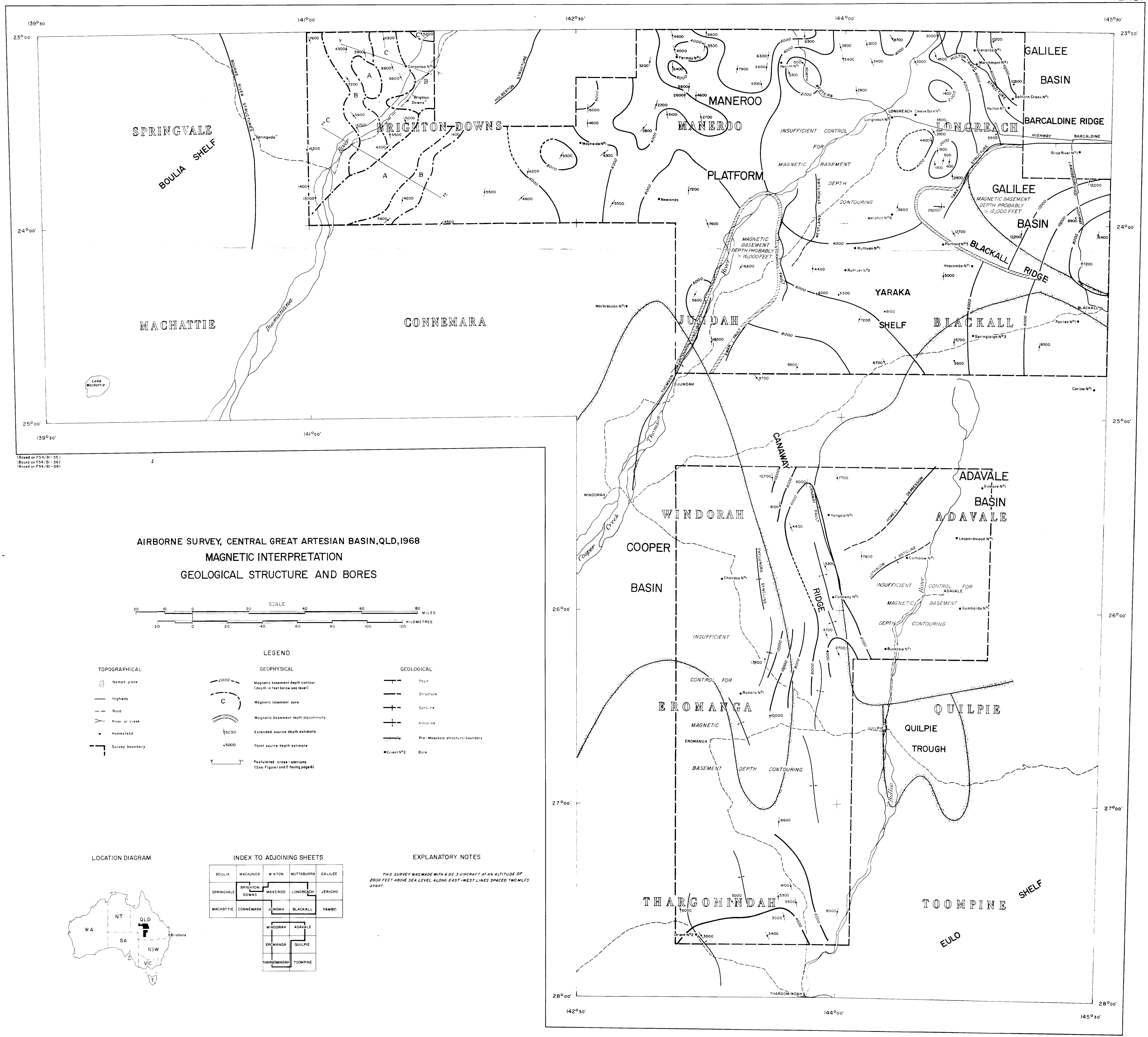
TOPOGRAPHICAL LEGEND

- SETTLEMENT
- HOMESTEAD
- AERODROME
- ROAD OR TRACK
- RIVER OR CREEK

APPROX. PROFILE SCALE




AIRBORNE SURVEY, CENTRAL GREAT ARTESIAN BASIN, QLD, 1968
BOUGUER ANOMALY CONTOURS
GEOLOGICAL STRUCTURE AND BORES
SCALE
MILES
KILOMETRES
LEGEND
TOPOGRAPHICAL
Named place
Highway
Road
River or creek
Homestead
Survey boundary
GEOPHYSICAL
Isogals
(Contour interval 5 milligals)
GRAVITY CONTOURS ARE BASED ON MEASUREMENTS OBTAINED FOR THE BUREAU OF MINERAL RESOURCES (GIBB 1966, 1967; LONSDALE, 1965)
GEOLOGICAL
Fault
Structure
Syncline
Anticline
Pre-Mesozoic structural boundary
Bore
LOCATION DIAGRAM
WA
NT
SA
QLD
NSW
VIC
Brisbane
INDEX TO ADJOINING SHEETS
BOULIA
MACKUNDA
WINTON
MUTTABURRA
GALILEE
SPRINGVALE
BRIGHTON DOWNS
MANEROO
LONGREACH
JERICHO
MACHATTIE
CONNEMARA
JUNDAH
BLACKALL
TAMBO
WINDORAH
ADAVALE
EROMANGA
QUILPIE
THARGOMINDAH
TOOMPINE
(Based on F54/B1-35)
(Based on F54/B1-36)
(Based on F54/B1-37)
SPRINGVALE
BOULIA SHELF
MACKUNDA GRAVITY PLATFORM
BRIGHTON DOWNS GRAVITY LOW
BRIGHTON DOWNS
MACHATTIE
CONNEMARA
DIAMANTINA GRAVITY GRADIENT
MANEROO PLATFORM
MANEROO
LONGREACH
GALILEE BASIN
BARCALDINE RIDGE
BLACKALL RIDGE
YARAKA SHELF
BLACKALL
JUNDAH
CANAWAY
WINDORAH
COOPER BASIN
ADAVALE BASIN
ADAVALE
CANAWAY RIDGE
EROMANGA
QUILPIE
QUILPIE TROUGH
THARGOMINDAH
TOOMPINE
EULO SHELF


AIRBORNE SURVEY, CENTRAL GREAT ARTESIAN BASIN, QLD, 1968
MAGNETIC INTERPRETATION
GEOLOGICAL STRUCTURE AND BORES
SCALE
MILES
KILOMETRES
LEGEND
TOPOGRAPHICAL
Named place
Highway
Road
River or creek
Homestead
Survey boundary
GEOPHYSICAL
Magnetic basement depth contour (depth in feet below sea level)
Magnetic basement zone
Magnetic basement depth discontinuity
Extended source depth estimate
Point source depth estimate
Postulated cross-sections (See Figure 1 and 2 facing page 6)
GEOLOGICAL
Fault
Structure
Syncline
Anticline
Pre-Mesozoic structural boundary
Orient Nº2 Bore
LOCATION DIAGRAM
WA
NT
QLD
SA
NSW
VIC
T
Brisbane
INDEX TO ADJOINING SHEETS
BOULIA
MACKUNDA
WINTON
MUTTABURRA
GALILEE
SPRINGVALE
BRIGHTON DOWNS
MANEROO
LONGREACH
JERICHO
MACHATTIE
CONNEMARA
JUNDAH
BLACKALL
TAMBO
WINDORAH
ADAVALE
EROMANGA
QUILPIE
THARGOMINDAH
TOOMPINE
EXPLANATORY NOTES
THIS SURVEY WAS MADE WITH A DC.3 AIRCRAFT AT AN ALTITUDE OF 2000 FEET ABOVE SEA LEVEL ALONG EAST-WEST LINES SPACED TWO MILES APART.
(Based on F54/B1-35)
(Based on F54/B1-36)
(Based on F54/B1-38)
SPRINGVALE
BOULIA SHELF
BOURKE RIVER STRUCTURES
MACHATTIE
CONNEMARA
BRIGHTON DOWNS
MANEROO
MANEROO PLATFORM
LONGREACH
GALILEE BASIN
BARCALDINE RIDGE
GALILEE BASIN
MAGNETIC BASEMENT DEPTH PROBABLY > 12,000 FEET
BLACKALL RIDGE
YARAKA SHELF
BLACKALL
JUNDAH
INSUFFICIENT CONTROL FOR MAGNETIC BASEMENT DEPTH CONTOURING
MAGNETIC BASEMENT DEPTH PROBABLY > 16,000 FEET
CANAWAY RIDGE
ADAVALE BASIN
ADAVALE
WINDORAH
COOPER BASIN
EROMANGA
QUILPIE
QUILPIE TROUGH
THARGOMINDAH
TOOMPINE
EULO SHELF
Diamantina River
Thomson River
Cooper Creek
Bulloo River
Lake Machattie
139°30'
141°00'
142°30'
144°00'
145°30'
23°00'
24°00'
25°00'
26°00'
27°00'
28°00'