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SOUTHERN QUEENSLAND CONTRACT RECONNAISSANCE GRAVITY SURVEY USING HELICOPTERS, 1964

by

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FOREWORD

The Bureau of Mineral Resources engaged Wongela Geophysical Pty Ltd to make the reconnaissance gravity survey described in this Record. In addition to leading the survey party, Mr. G.F. Lonsdale of Wongela has studied the results and produced the description and interpretation that constitute the greater part of this Record.

SUMMARY

This report presents the preliminary results of the 1964 helicopter gravity reconnaissance survey in southern Queensland conducted by Wongela Geophysical Pty Ltd under contract to the Bureau of Mineral Resources, Geology and Geophysics.

The Bouguer anomalies show good qualitative correlation with the regional geology. On the basis of these anomalies the area is divided into six gravity provinces, viz. the Thomson Regional Gravity Low, the Thargomindah Gravity Platform, the Muttaburra Gravity Ridge, the Anakie-Nebine Regional Gravity High, the Bowen-Surat Regional Gravity Low, and the Coastal Gravity Complex.

The eastern margin of the Eromanga Basin and the eastern and western margins of the Surat Basin are well defined by the gravity data. Within the Surat Basin a reversal of normal gravity geological relations is demonstrated. The continuity as a single structure of the Anakie Structural High and the Nebine Ridge is conclusively revealed.

1. INTRODUCTION

The 1964 helicopter gravity survey in southern Queensland was carried out by Wongela Geophysical Pty Ltd under contract to the Bureau of Mineral Resources, Geology and Geophysics. This report describes the preliminary results of the survey. Approximately 170,000 square miles of southern Queensland were surveyed, covering twenty-nine 1:250,000 map areas (Plate 1). The results of gravity surveys carried out by private companies over an additional 20,000 square miles in the survey area are in progress of being recalculated and will be incorporated with the results of this survey in a later report.

The survey was planned to cover the southern portions of the Eromanga, Drummond, Bowen, and Yarrol Basins, the Maryborough Basin, and the northern portions of the Surat and Moreton (Ipswich) Basins.

The author has drawn extensively on an unpublished confidential BMR report by R.A. Gibb in preparing the following sections dealing with Geology and previous Geophysical work.

2. GEOLOGY

This brief summary of the major structural features of the geology of the area is based on 'The Geology of Queensland ' edited by Hill and Denmead (1960) and 'Geological notes in explanation of the Tectonic Map of Australia' (BMR, 1962).

In broad terms the survey area can be divided into two major structural elements. These are the Great Artesian Basin which occupies more than two-thirds of the area, and the Tasman Geosynclinal Zone which occurs in the eastern part of the area.

Great Artesian Basin

The Great Artesian Basin, which is an extensive Mesozoic basin, is subdivided into several smaller basins which are separated by pre-Mesozoic basement ridges. In the survey area the present concept is that the Eromanga Basin in the west is separated from the Surat Basin in the east by the Nebine Ridge which is thought to be an offshoot of the Eulo Shelf (Plate 2). A spur, the Roma Spur, which extends from north of Roma to Wallumbilla may be an offshoot of the Nebine Ridge.

The Adavale Basin of Palaeozoic sediments has been delineated over much of its area by seismic work and drilling carried out by the Phillips Petroleum Co. Previous BMR gravity surveys suggest the existance of other areas of sedimentation below the Mesozoic blanket of the Great Artesian Basin (Gibb, 1964; Flavelle, 1964). Seismic and gravity results have been correlated along E-W traverses across the Great Artesian Basin with similar findings (Bigg-Wither, in prep.).

Tasman Geosynclinal Zone

The Tasman Geosynclinal Zone extends along the eastern side of the Australian continent. Part of this zone occupies about one-third of the survey area. In this area the outcrops are mainly Palaeozoic, but there is evidence of later igneous activity and several sedimentary basins within the zone contain appreciable thicknesses of Mesozoic and younger deposits. The Zone is a composite structural belt, the broad structural history of which is one of transient troughs, ridges, and basins which were formed and deformed by earth movements differing in intensity and age from place to place. The major geological features are shown in Plate 2 and these will now be briefly discussed.

The southernmost exposed part of the Drummond Basin of Carbo-Devonian age extends on to the Springsure Shelf. The structures within the basin are generally broad simple folds, parallel to the boundary with the Anakie Structural High, but in the Springsure Shelf north-easterly trending structures have been assumed to be reflections of north-easterly trends in the relatively shallow basement there. The Anakie Structural High, the exposed portion of which lies outside the area, may continue at depth to the south as indicated by the gravity and magnetic anomalies on the Emerald 1:250,000 sheet. This structural "high" separates the Drummond Basin from the Bowen Basin in the east.

The Bowen Basin is a large Permo-Triassic basin which passes southwards under the Mesozoic sediments of the Surat Basin, the eastern lobe of the Great Artesian Basin. Recent geological mapping has shown the Bowen Basin to be structurally complex in contrast to its regional synclinal structure. Recent gravity mapping also reflects this complexity.

The Yarrol Basin is a long narrow trough of mainly marine Devonian to Lower Permian sediments. It also contains non-marine Triassic and Jurassic beds. Southwards the basin passes under the Mesozoic sediments of the Surat Basin. Recent mapping has shown that sediments of the Bowen Basin overlap those of the Yarrol Basin. In the south-west the Yarrol Basin is bounded by the Auburn Granitic Complex composed mainly of gneiss, schist, and granite. The eastern boundary of the Yarrol Basin is the South Coastal Structural High which contains metasediments of ?Silurian age with some Precambrian phyllite and greenstone. The western boundary of the South Coastal Structural High with the Yarrol Basin is in part a thrust, but the eastern boundary with the Permian rocks and the Maryborough Basin has not been mapped in detail. The Esk Rift filled with Permian and Triassic sediments occurs within the High. The part of the High east of the Esk Rift is the D'Aiguilar Block, and this feature is succeeded to the south-east by the Beenleigh Block. That part of the High to the west of the Esk Rift is called the Yarraman Block. The D'Aiguilar Block contains the oldest (?Precambrian) rocks in the area and also contains a median mass of serpentine, smaller belts of which occur to the west.

Downwarping and sedimentation commenced at the end of Carboniferous times in the Maryborough Basin. In this basin Permian marine sediments underlie the Mesozoic beds which are the thickest (30,000 feet) Mesozoic strata in eastern Australia.

The Moreton (Ipswich) Basin developed as a non-marine basin early in the Triassic. This basin continues south into New South Wales where it is known as the Clarence Basin. Northwards its sediments are continuous with those of the Esk Rift and Maryborough Basin. Westwards its sediments, from Upper Triassic to Walloon times, are continuous with those of the Surat Basin.

3. PREVIOUS GEOPHYSICAL WORK

Intensive geophysical work has already been done in portions of the proposed survey area by private companies and the BMR (Plate 3). The major results of previous surveys will be briefly discussed in this chapter.

Gravity surveys by organisations other than the BMR (see Table 1)

Shell (Queensland) Development Pty Ltd carried out the first gravity survey in the area between 1940 and 1951 (Shell, 1952). This regional survey gave the first indications of a complex gravity field in the Great Artesian Basin. A series of mainly north-north-east-trending gravity 'highs' and 'lows' indicated areas of high-standing basement rocks and areas of thick sediments respectively.

In 1951-1952 the University of Sydney carried out a regional gravity survey in Eastern Australia (Marshall & Narain, 1954). Four of these regional traverses crossed the survey area. The authors concluded that there is a significant correspondence between gravity 'lows' and 'highs' and the structural elements in Queensland, which warranted further gravity work in the area.

In 1955 a detailed gravity survey in the Warbreccan area was done by H. Narain for Westland Oil Ltd. On the basis of this survey the Warbreccan bores were drilled and proved the presence of a granitic basement ridge. Also in 1955 Associated Australian Oilfields N.L. carried out a semi-detailed but limited gravity survey in the Banana area.

In 1957 Santos Ltd carried out a gravity survey in the Cordillo area which adjoins the western boundary of the survey area. It seems likely that the gravity anomalies in this area are related to structures below the Mesozoic section. However, some residual anomaly features seem to correlate with Mesozoic structure.

Associated Freney Oil Fields N.L. surveyed A.T.P. 56P (Plate 6) in 1958 (Starkey, 1959). Several of the traverses of this survey extended into the 1964 survey area. High gravity anomalies over the Anakie Structural High extend southwards into the survey area in SPRINGSURE.

In 1960 Magellan Petroleum Corp. carried out a reconnaissance gravity survey in the Tambo-Augathella area (Magellan, 1963). Preliminary interpretation indicates that the regional gravity pattern is dominated by a large central gravity 'low' suggesting an area of relatively thick sediments. The gravity results and aeromagnetic results do not agree in this area. The company suggests two possible explanations for this. Firstly, when granites having very low susceptibilities occur near the surface they cause low, broad magnetic anomalies. Secondly, an assumption which is often made in gravity work that the deeper the rocks the higher the density, is not always true. For example indurated sedimentary rocks may have a higher density than granite or schist and their presence would indicate a 'high' although in fact the crystalline basement might be relatively deep. In such conditions a 'low' would actually represent shallow crystalline basement. The results of the survey are thus somewhat inconclusive.

A gravity survey of the Eromanga area was done in 1961 (Smart Oil Exploration Ltd, in prep.). Gravity 'highs' correspond to the Pinkilla, Tallyabra, and Kyabra Anticlines which are known from surface geological mapping. The Tallyabra Syncline is defined by a large gravity 'low'. This anomaly is interpreted as being caused by deep pre-Permian sediments which are absent over the crest of the Pinkilla Anticline. The Pinkilla and Tallyabra Anticlines are thought to be 'bald-headed' structures with ?Precambrian core rocks, whereas the Kyabra Anticline does not appear to be 'bald-headed'.

Several gravity surveys are in progress at the time of writing. These are listed in Table 1. The results are not yet available.

TABLE 1

PREVIOUS GRAVITY SURVEYS BY ORGANISATIONS OTHER THAN THE BMR

Date	Organisation	Area	Type of survey	Reference
1940-51	Shell (Qld) Development Pty Ltd	Network of traverses	Regional	Shell, 1952
1951-52	University of Sydney	Road traverses	Regional	Marshall & Narain, 1954
1955	Westland Oil Ltd	NW Jundah	Semi-detailed	Narain, 1955
1955	Associated Australian Oilfields	Banana area	Semi-detailed	Unpublished
1957	Santos Ltd	Cordillo Downs	Semi-detailed	Cited in Smith & Lodwick, 1959
1958	Associated Freney Oil	Bowen Basin area	Regional	Starkey, 1959
1960	Magellan	Tambo-Augathella	Semi-detailed	P.S.S.A.31
1961	L.H. Smart Oil Exploration Co. Ltd	Eromanga area	Semi-detailed	P.S.S.A. (in prep.)
1963	L.H. Smart Oil Exploration Co. Ltd	Conbar area	Semi-detailed	P.S.S.A. (in prep.)
1963	Amoseas	Blackall-Augathella	Semi-detailed	in progress
1963	Alliance Oil Development	Windorah	Reconnaissance	in progress
1963	Alliance Oil Development	Chesterton	Reconnaissance	in progress

TABLE 2

PREVIOUS GRAVITY SURVEYS BY BMR

Date	Area	Type of survey	Reference
1947-48	Roma	Semi-detailed	Dooley, 1950
1965	Comet-Rolleston	Semi-detailed	Oldham, 1958

TABLE 2 (cont'd)

Date	Area	Type of survey	Reference
1958	Offshore	Regional	Dooley & Goodspeed, 1959
1958	Jundah	Regional traverses	
1959	Windorah-Quilpie	Regional traverses	
1960	Roma-Quilpie	Regional traverses	Langron, 1962
1960	S.E. Queensland	Regional traverses	Langron & van Son (in prep.)
1961	Adavale-Quilpie	Gravity along seismic lines	Darby (in prep.)
1963	Tara	Gravity along seismic lines	Darby (in prep.)

Previous gravity surveys by BMR (see Table 2)

The earliest BMR surveys in the area were detailed surveys at Roma (Dooley, 1950) and in the Comet-Rolleston area (Oldham, 1958). Offshore work (Dooley & Goodspeed, 1959) was done north of the area and only one station falls in the survey area.

In 1958-59-60 regional road traverses were surveyed by the BMR (Langron, 1962; Langron & van Son, in prep.). Gravity readings were made along seismic lines at Adavale in 1961 and at Tara in 1963 (Darby, in prep.).

Previous geophysical work in the Great Artesian Basin has been described by Lonsdale (1962 and 1963), Gibb (1963, 1964 in prep.) and Flavelle (1964).

Seismic surveys

Many seismic surveys have been done in the area by the various leaseholders in an effort to locate sections and structures favourable to the accumulation of oil (Plate 5). Subsidised seismic surveys in the area done up to December 1963 are listed in Table 3.

TABLE 3

PREVIOUS SEISMIC SURVEYS

BOWEN BASIN

Date of Survey	Area	Company
1959	* Arcadia	Associated Australian Oilfields N.L.
1962-63	* Bauhinia Downs	Marathon Petroleum Aust. Ltd.
1962-63	* Mimosa	" " " "
1962-63	* Purbrook Arcadia	Associated Australian Oilfields N.L.
1962	* Rolleston-Springsure	Associated Freney Oilfields N.L.
1962	* Warrinilla-Planet Downs	Planet Exploration Co. Pty Ltd

TABLE 3 (cont'd)

YARROL BASIN

Date of Survey	Area	Company
1963	Cynthia	Amalgamated Petroleum Exploration Pty Ltd
1962-63	Monto	Amalgamated Petroleum Exploration Pty Ltd

MARYBOROUGH BASIN

Date of Survey	Area	Company
1963	Pialba-Fraser Island	Shell Development (Aust.) Pty Ltd

IPSWICH-CLARENCE BASIN

Date of Survey	Area	Company
1962	* Casino	Mid-Eastern Oil N.L.

SURAT BASIN

Date of Survey	Area	Company
1963	* Barakula	B.O.C. of Australia Ltd
1962	* Blythdale-Mooga-Sunnybank	Associated Australian Oilfields N.L.
1961	* Injune-Wallumbilla	" " " "
1961-62	* Merivale	" " " "
1962	* Roma-Injune	" " " "
1963	* Sunnybank-Wallumbilla	" " " "
1960-61	* Cabawin	Union Oil Development Corp.
1960-61	* Dulacca	" " " "
1960	* Glenmorgan	" " " "
1960-61	* Miles	" " " "
1961-62	* Moonie	" " " "
1961-62	* Taroom	" " " "
1961-62	* Theodore	" " " "
1963	* Yuleba	" " " "
1962-63	* Cecil Plains	Phillips Petroleum Company
1962	* Dunmore	" " "
1961-62	* Kogan	" " "
1962	* Kumbarilla	" " "
1962	* Chinchilla	Condamine Oil Ltd

GREAT ARTESIAN BASIN

Date of Survey	Area	Company
1961	* Adavale	Phillips Petroleum Company

TABLE 3 (cont'd)

GREAT ARTESIAN BASIN (cont'd)

Date of Survey	Area	Company
1961	* Blackwater-Langlo	Phillips Petroleum Company
1961	Charleville North	" " "
1963	Gowan Range	" " "
1961-62	* Gumbardo	" " "
1963	Highfields	" " "
1961	* Jundah-Yaraka	" " "
1962-63	Pleasant Creek	" " "
1962	Quilberry Creek	" " "
1959-60	* Quilpie-Thargomindah-Charleville	" " "
1963	Toompine-Wyandra	" " "
1962-63	* Blackall-Mitchell	American Overseas Petroleum Ltd
1963	Bulgroo	Alliance Oil Development Aust. N.L.
1962	* Chesterton	" " " " "
1959-60	* East Roma	Associated Australian Oilfields N.L.
1959-60	* Eumamurrin	" " " "
1962-63	* Roma-Mount Abundance	" " " "
1959	* South-Roma	Associated Australian Oilfields N.L.
1961	* West Roma	" " " "
1959	* Grey Range	L.H. Smart Oil Exploration Co. Ltd
1961	* Stonehenge	Conorada Petroleum Corporation
1963	Ruthven	Marathon Petroleum Corporation Ltd

All surveys marked with an asterisk in Table 3 have been reviewed by Lonsdale (1963) and Gibb (1964).

The results of several seismic surveys in the Bowen-Surat Basin have been integrated and reinterpreted by Schwing (1963) who concludes that the main targets for petroleum prospecting in this area are stratigraphic traps. The importance of onlap in this regard is enhanced by the possibility of a hinge line in the area. Short accounts of surveys not mentioned elsewhere are given below.

In the Yarrol Basin, Amalgamated Petroleum Exploration has done a seismic survey in the Monto area. This work delineated a synclinal structure containing 7000 feet of section between two faults, the Anyarro Fault in the west and the Mulgildie Fault in the east. Anticlinal features were investigated. This survey was followed by fill-in work in the

Cynthia survey. The Mulgildie Fault was confirmed as a low-angle thrust with 5000 feet of sediments in its western block.

In the Maryborough Basin, Shell Development (Australia) Pty Ltd proposes to do a seismic survey in the Pialba (mainland) and Fraser Island area. Here, aeromagnetic results indicate 10,000 feet of section and a probable extension of the basin offshore to Fraser Island.

In the Great Artesian Basin in the Bulgroo area Alliance Oil Development has done a seismic survey over the Canaway Anticline and Kyabra Gravity High. Results indicate closed structures associated with both features. The Mesozoic unconformity coincides with the surface of ?Lower Palaeozoic or older metamorphic basement over the whole area, except in the west where sediments, thought to belong to the Adavale Basin sequence, were mapped below the Mesozoic.

Following its work in the Mayne and Stonehenge areas, Marathon Petroleum Australia Ltd carried out a seismic reflection survey in 1963 in the Ruthven area. Results indicate several anomalies associated with faulting. Detailed shooting defined a drilling target.

<u>Aeromagnetic surveys</u> (Plate 4)

Many BMR reconnaissance lines traverse the area and a report by R. Wells is in preparation on a survey of the Bowen Basin.

Several private companies have done work in the area. Delhi Australian Petroleum Ltd plans to extend its aeromagnetic work in the Cooper Creek area.

Phillips Petroleum Company (1961) has done a survey in the Quilpie-Charleville area. Depth to basement ranges from 0 to 12,400 feet. Areas of shallow and deep basement are well defined.

The Magellan aeromagnetic survey in the Blackall-Augathella area has been mentioned above.

Union Oil Development Corp. has covered most of ATP57P (Plate 6) with aeromagnetic surveys since 1960. The results are given in the Surat and Moree-Miles reports and then are discussed along with the Narran River and Bollon surveys in a combined report on the Bowen-Surat Basin (P.S.S.A. publications in prep.). The hinge line of the basin is clearly illustrated in the north by the anomalies, and its southern extension, the Goondiwindi Fault, is also indicated. The deeper areas of the basin are depicted along with a central cratonic block. In the west the magnetic anomalies suggest that several units may be present in the Nebine Ridge.

In the Yarrol Basin, Amalgamated Petroleum Exploration Ltd has done an aeromagnetic survey in the Monto-Eidsvold area. Mainly surface anomalies were recorded. Strong anomalies are associated with the Yarrol, Mulgildie, and Anyarro Faults. The aeromagnetic data also suggest important cross-faulting in the area, but no depths to basement are given.

Australian Oil and Gas Corporation carried out an aeromagnetic survey in the offshore area between Brisbane and Cairns. The results indicate that magnetic basement is about 5000 feet deep, and the company suggests that Mesozoic basins with possibly some Permian could be present with a total of about 5000 to 6000 feet of section. The report suggests that the Maryborough Basin appears to afford the best prospects for further exploration and that it seems to extend offshore to north-east of Gladstone as a rather narrow trough.

An excellent review of the latest geological and geophysical developments and discoveries in the Maryborough, Bowen-Surat, and Great Artesian Basin is given by Trumpy and Tissot (1963).

4. DESCRIPTION OF GRAVITY RESULTS

The results of the survey are shown in Plate 3 in the form of Bouguer anomaly contours drawn at a scale of forty miles to one inch. Observed gravity values are based on the 1962 values for the Bureau of Mineral Resources pendulum stations at Rockhampton, Longreach, Quilpie, Roma, Brisbane, and Maryborough (Dooley, in press) and on 1964 values for the Bureau of Mineral Resources "Isogal survey" stations at Warwick, Goondiwindi, St George, Bollon, Cunnamulla, Thargomindah, Kingaroy, Miles, Mitchell, Charleville, Windorah, and Barcaldine. For the calculation of Bouguer anomalies a near-surface rock density of 1.9 g/cm^3 has been used to the west of longitude $148^{\circ}30'$ whilst a rock density of 2.2 g/cm^3 has been used to the east of this meridian.

The principal gravity features have been numbered in Plate 3 and in Table 4. The numbering is a convenient form of reference which will be used in the text. Table 4 contains a brief description of each gravity feature as well as proposed names for many of the major features.

The survey area is immediately divisible into six gravity provinces on the basis of Bouguer anomalies and regional geology. These gravity provinces, which are outlined by hachuring in Plate 3, are named as follows:

(a) The Thomson Regional Gravity Low which corresponds closely to part of the Eromanga (or Thomson) Basin (Gibb, in prep.).

(b) The Thargomindah Gravity Platform, which lies to the south of the Thomson Regional Gravity Low.

(c) The Muttaburra Gravity Ridge, a feature developed mainly to the north of the survey area and believed to be produced by shallow basement rocks (Gibb, in prep.).

(d) The Anakie-Nebine Regional Gravity High, which is directly related to the Anakie Structural High and the Nebine Ridge.

(e) The Bowen-Surat Regional Gravity Low, which is directly related to the Bowen and Surat Basins.

(f) The Coastal Gravity Complex which embraces a geologically complex area of structural "highs" and local basins of deposition, and which is a continuation of the Coastal Gravity Complex to the north previously described by Gibb (1964) and Darby (in prep.).

TABLE 4

GRAVITY ANOMALY FEATURES

Thomson Regional Gravity Low

This large gravity "low" covers the western half of the survey area, as indicated in Plate 3. The feature is bounded to the north-west, outside the survey area, by the Cloncurry Regional Gravity High (Gibb, in prep.). The south-westerly boundary of the feature has not yet been defined on the basis of gravity results.

1. North-east-trending gravity "lows" on CONNEMARA, South-east BRIGHTON DOWNS, and west MANEROO and extending farther to the north-east. (described by Gibb, in prep.).	Vergemont Gravity Depression.

2.	North-east to north-west-trending belt of gravity "lows" extending from north WINDORAH through JUNDAH to east MANEROO. (Gibb, in prep.).	Jundah Gravity Depression.
3.	Gravity ridge extending from the west onto CANTERBURY and trending north-east through south-east CONNEMARA, north-west JUNDAH to south MANEROO. (See Gibb, in prep.).	Betoota-Warbreccan Gravity Ridge
4.	North-west-trending gravity "low" in north-east BARROLKA and south CANTERBURY.	Lake Barrolka Gravity Low.
5.	A belt of gravity "highs" extending north-east from north-east DURHAM DOWNS and north-west THARGOMINDAH through east BARROLKA and west EROMANGA, south and north-east WINDORAH, south-west and north-east BLACKALL and into south-west JERICHO (see Darby, in prep.).	Yaraka Gravity Ridge.
6.	North-east elongated deep gravity "low" in east ADAVALE AND extending into north QUILPIE and north-west AUGATHELLA. (see Darby, in prep.).	Adavale Gravity Low
7.	Deep sub-circular gravity "low" in north-west QUILPIE.	
8.	North elongated gravity "low" in east EROMANGA. (see Gibb, in prep.).	Tallyabra Gravity Low
9.	Small gravity "high" in south-east EROMANGA. (see Gibb, in prep.).	Pinkilla Gravity High
10.	Small north-elongated gravity "high" in north-east EROMANGA forming a northerly extension of feature 9. (see Gibb, in prep.).	Grey Range Gravity Ridge.
11.	Sub-circular gravity "low" in south-west QUILPIE (see Gibb, in prep.).	Bulloo Gravity Low.
12.	North to north-east-trending series of gravity "highs" extending from south QUILPIE through south-east ADAVALE, west AUGATHELLA to central TAMBO. (see Darby, in prep.).	Augathella Gravity High.
13.	South-east elongated gravity "low" in east QUILPIE forming an extension of feature 6 and with a north-east-trending extension into west CHARLEVILLE. (see Darby, in prep.).	Cooladdi Gravity Trough.
14.	Small gravity "low" in south CHARLEVILLE (see Darby, in prep.).	Westgate Gravity Low.
15.	Gravity "low" in south AUGATHELLA.	
16.	Gravity "low" in west EDDYSTONE extending into north-west MITCHELL.	

Thargomindah Gravity Platform

This gravity province bounds the Thomson Regional Gravity Low to the south and is characterised by generally east-trending anomalies, more positive in value than those in the Thomson Regional Gravity Low.

17.	Large gravity platform extending west from south-east THARGOMINDAH to beyond west DURHAM DOWNS. (see Barlow, in prep.).	Durham Downs Gravity Platform.
18.	Elongate gravity "low" extending west from north BULLOO to beyond west TICKALARA. (see Barlow, in prep.).	Tenappera Gravity Low
19.	Gravity terrace in south BULLOO and south-east to central TICKALARA. (see Barlow, in prep.).	Naryilco Gravity Terrace.
20.	Gravity "high" open to the south-east in south-east BULLOO.	

Muttaburra Gravity Ridge

A gravity "high" area mainly developed to the north of the survey area (Gibb, in prep.). The gravity province extends from the north-west into east TAMBO, south-west SPRINGSURE, and north-west EDDYSTONE where it forms a wide gravity shelf separating the Thomson Regional Gravity Low from the Anakie-Nebine Regional Gravity High.

Anakie-Nebine Regional Gravity High

This gravity "high" extends southwards from EMERALD across the survey area as a relatively narrow feature to WYANDRA, whence it broadens towards the south and west across TOOMPINE and probably EULO. The southerly extent of this feature is not known.

21.	A zone of predominantly positive anomalies mainly developed farther to the north (Flavelle, 1964; Gibb, 1964 in prep.) and extending into the survey area in north-west SPRINGSURE.	Drummond Gravity Shelf.
22.	Series of irregular gravity "highs" extending into the survey area from EMERALD through SPRINGSURE into north EDDYSTONE (see Gibb, 1964, and Darby, in prep.).	Clermont Gravity Highs.
23.	Local gravity "low" in central SPRINGSURE.	
24.	Narrow south-west-trending zone of anomalies having a value between 0 and -20 mgal extending from central EDDYSTONE through north-west MITCHELL to south-east CHARLEVILLE.	
25.	Gravity "high" area in central WYANDRA and south-east CHARLEVILLE, probably extending southwards into CUNNAMULLA.	
26.	Small gravity "low" in south-west WYANDRA showing a northerly trend towards feature 14. The extent of this feature is unknown.	
27.	North-trending series of gravity "highs" in east TOOMPINE forming the southern extension of feature 12.	
28.	North-trending belt of gravity "lows" in central TOOMPINE, forming a south-easterly extension of feature 11. The southern extent of this feature is unknown.	
29.	Gravity "high" in west TOOMPINE extending towards the south-west.	

Bowen-Surat Regional Gravity Low

This gravity feature extends southward into the survey area from east EMERALD and central DUARINGA. To the north the same feature has been discussed by Gibb (1964) and Darby (in prep.). In the northern half of the survey area the Bouguer anomaly values are predominantly higher than -20 mgal whilst south of a latitude of about

$25^{o}40'$ the anomaly values are predominantly lower than -20 mgal.

30.	North-elongated gravity "high" in east EMERALD and west DUARINGA (see Darby, in prep.).	Comet Gravity Platform.
31.	Extensive north-elongated gravity "low" in west DUARINGA and north-west BARALABA (see Darby, in prep.).	Bluff Gravity Depression.
31A.	North-elongated gravity "low" in east EMERALD (see Darby, in prep.).	Denison Gravity Low.
32.	Gravity shelf area extending south-west from central DUARINGA into east BARALABA and south-west MONTO and terminating in north-west MUNDUBBERA.	
33.	Small gravity "high" in south-west BARALABA.	Warrinilla Gravity High.
34.	Small north-elongated gravity "high" east of feature 32.	Purbrook Gravity High.
35.	Gravity high area in east TAROOM.	Arcadia Gravity High.
36.	South-south-west-trending belt of gravity "lows" extending from central EDDYSTONE into central MITCHELL.	Maranoa Gravity Low.
37.	Gravity platform area in east MITCHELL.	
38.	Gravity spur extending from feature 37 into west ROMA (see Dooley, 1950).	
39.	Arcuate belt of gravity "lows" extending south-east from extreme south-west TAROOM to central ROMA, thence south-west to south ROMA and west-north-west into south-west ROMA.	
40.	Gravity "low" forming a northerly extension of feature 39 and extending from north ROMA into central TAROOM.	
41.	Gravity spur extending southwards in east TAROOM.	Mimosa Gravity Spur.
42.	Small gravity "low" in east ROMA.	
43.	Group of irregularly shaped gravity "highs" in central and south-west SURAT.	
44.	Gravity "low" in east-central SURAT.	
45.	Narrow gravity ridge extending from south-east ROMA southwards through east SURAT (see Gibb, in prep.).	Meandarra Gravity Ridge.
46.	Gravity "low" in north-west DALBY.	

47. Gravity "low" of unknown extent extending southwards from south DALBY.

Coastal Gravity Complex

The Coastal Gravity Complex is a broad zone of irregular gravity "highs" and "lows" extending southwards into the survey area from east DUARINGA and ROCKHAMPTON. The northern portion of this province has been discussed by Gibb (1964) and Darby (in prep.). The gravity values in this zone average about +20 mgal and range from about -30 to +60 mgal.

48. A narrow zone of high positive anomalies extending into the survey area from ROCKHAMPTON and continuing south through central MONTO into west-central MUNDUBBERA (see Darby, in prep.).	Marlborough Gravity Ridge.
49. A gravity spur extending south from feature 48 into north-east BARALABA and north-west MONTO.	
50. Small gravity "low" in west MONTO.	
51. Gravity "low" extending south-east from central ROCKHAMPTON into north MONTO.	Bajool Gravity Low.
52. Deep gravity "low" in east MONTO and west BUNDABERG.	
53. Gravity "low" extending from feature 52 into north-west BUNDABERG.	
54. Coastal gravity "highs" in north-west and central BUNDABERG, separated by feature 53.	
55. Gravity "low" area in west MARYBOROUGH extending into south-west BUNDABERG.	
56. Belt of Gravity "highs" in east MUNDUBBERA extending into south-east MONTO and south-west into central CHINCHILLA.	
57. Narrow gravity trough extending south from south MONTO to south MUNDUBBERA.	
58. A large gravity "low" extending south to south-west from south-west MARYBOROUGH through west GYMPIE and east CHINCHILLA into east DALBY.	
59. Gravity "high" in central MARYBOROUGH.	
60. Region of generally low gravity values in east MARYBOROUGH.	Maryborough Gravity Low
61. Series of gravity "lows" extending south from central MARYBOROUGH to south-east GYMPIE.	

62.	Gravity "high" in north GYMPIE forming a southern extension of feature 59.	
63.	Group of gravity "lows" in south GYMPIE and west IPSWICH.	
64.	Gravity "low" in central IPSWICH extending south-east beyond the survey margin.	Moreton Gravity Low.
65.	Small gravity "high" in central IPSWICH.	
66.	Intense gravity "high" in north-east IPSWICH.	
67.	Gravity "low" in east IPSWICH and west BRISBANE.	
68.	Coastal gravity "high" extending from east WIDE BAY through east GYMPIE and east BRISBANE. This "high" becomes more intense towards central BRISBANE.	
69.	Coastal gravity "high" in west WIDE BAY and South-west SANDY CAPE becoming more intense towards central SANDY CAPE.	

5. DISCUSSION OF GRAVITY RESULTS

On the basis of the gravity results the area may be divided, as already explained, into six gravity provinces (Plate 3). These correspond to geological units. In this report the results will be discussed briefly for each gravity province in turn. A future report will discuss the results in greater detail.

Thomson Regional Gravity Low

The Thomson Regional Gravity Low which corresponds to part of the Eromanga (or Thomson) Basin is a zone of negative gravity anomalies. In general there is some correlation between the gravity "lows" in this zone and known areas of thick sediments. The dominant gravity trend in this zone is towards the north-east, which is in marked contrast to the strong north-west trend direction of the Cloncurry Regional Gravity High (Gibb, in prep.). However, a secondary trend towards the north-west is apparent in some features in this zone, e.g. the northern portion of feature 2, feature 4, and the western portion of feature 12.

In the extreme north-west of the survey area the results of this gravity survey have completed the reconnaissance gravity coverage of the Betoota-Warbreccan Gravity Ridge, feature 3. This feature, which extends from BETOOTA north-east to MANEROO, indicates high-standing basement and has been discussed elsewhere (Gibb, 1963 and in prep.). Feature 3 separates the Vergemont Gravity Depression, feature 1, a previously postulated zone of thick sediments (Gibb, 1963 and in prep.), to the north-west from the Jundah Gravity Depression, feature 2, to the east. However, it is now thought that the residual anomaly in the Vergemont Gravity Depression is caused by structure within the Lower Palaeozoic metamorphic basement (Gibb, in prep.). From the magnitude and form of the Jundah Gravity Depression it is considered to be the gravity expression of a pre-Mesozoic sub-basin similar to the Adavale Basin to the south-east. A similar interpretation is placed on the Lake Barrolka Gravity Low, feature 4.

Features 2 and 4 are terminated eastwards by a series of gravity "highs" which form the Yaraka Gravity Ridge, feature 4, trending in a north-easterly direction from north-east DURHAM DOWNS to south-west JERICHO. This Gravity Ridge probably represents a basement "high" which may separate the postulated pre-Mesozoic sediments in the area of features 2 and 4 from those known in the Adavale Basin.

Feature 6, the Adavale Gravity Low, corresponds closely with the Adavale Basin in which, as remarked previously, Mesozoic sediments are underlain by Palaeozoic sediments (Darby, in prep.). Similar small sub-basins containing Palaeozoic sediments probably produce the gravity "lows", features 4, 8, and 11. The postulated Palaeozoic sediments in the area of feature 7 are separated from the Palaeozoic sediments indicated by seismic results in the area of feature 8, the Tallyabra Gravity Low, by a basement ridge, feature 10, the Grey Range Gravity Ridge. The Canaway No. 1 bore drilled on this feature encountered metamorphic basement directly below the Mesozoic section. Feature 9, the Pinkilla Gravity High, forms a southern extension of the Grey Range Gravity Ridge. The Bulloo Gravity Low, feature 11, centred on Quilpie is coincident with a north-north-east-trending syncline.

The Adavale Gravity Low and the Bulloo Gravity Low are bounded to the east by a gravity "high" region, feature 12, on which are superimposed several culminations. This feature, the Augathella Gravity High (Darby, in prep.), extends from north-east TOOMPINE to north-east AUGATHELLA and is interpretated as a basement "high" area. South-east of this feature, in the extreme south-eastern portion of the Thomson Regional Gravity Low, are two intense gravity "lows", the Cooladdi Gravity Trough, feature 13 and the Westgate Gravity Low, feature 14 (Darby, in prep.). These gravity features appear to form a south-eastern extension of the Adavale Gravity Low. Recent drilling and seismic work by Phillips Petroleum Company (personal communication) indicate the presence of thick Palaeozoic section beneath the Mesozoic sediments in these areas.

Features 15 and 16, two areas of low gravity values lying to the north of feature 14, may similarly represent areas of thicker sedimentary section. It is possible, however, that the easternmost feature, feature 16, may be produced by low-density basement rocks on the western flank of the Nebine Ridge.

Thargomindah Gravity Platform

The Durham Downs Gravity Platform terminates the Thomson Regional Gravity Low to the south and is considered to represent a high-standing basement feature somewhat similar to the Nebine Ridge. Hence this feature is considered to deliniate the southern extent of Palaeozoic sedimentation in the Eromanga Basin, though later sedimentation was probably continuous over this postulated feature.

The Tenappera Gravity Low, feature 18, to the south of the Durham Downs Gravity Platform is thought to represent a generally west-trending area of thicker sedimentary section. The gravity feature is open to the west and hence may develop considerably in that direction. Furthermore, from borehole evidence farther to the west, it is tentatively suggested that the postulated sediments may be Permian.

The Naryilco Gravity Terrace, feature 19, which bounds the Tenappera Gravity Low to the south is considered to be a relatively high-standing basement area, probably linked to the Eulo Shelf. Several small gravity "lows" on this feature may represent isolated pockets of sediments similar to those postulated for feature 18, or they may represent areas of thicker Mesozoic section.

A small gravity "high", feature 20, open to the south-east may be associated with granite intrusion on the Eulo Shelf.

The features within this gravity province have also been described by Barlow (in prep.).

Muttaburra Gravity Ridge

This gravity feature lies mainly to the north of the survey area and has been described elsewhere (Gibb, 1963 and in prep.; Flavelle, 1964). Gibb and Flavelle consider that the feature reflects a relatively high-standing basement area.

Anakie-Nebine Regional Gravity High

This gravity province extends southwards as a continuous feature from CHARTERS TOWERS, north of the survey area, across the area to WYANDRA. North of the survey area the "high" may be divided into three portions: the Drummond Gravity Shelf (feature 21) to the west, the Clermont Gravity Highs to the east and the Charters Towers Gravity Plateau to the north (Gibb, in prep.). It appears that the Drummond Gravity Shelf does not extend for any great distance into the survey area, and probably terminates in north-west SPRINGSURE. This feature has been discussed fully elsewhere (Gibb, in prep.). The eastern portion (Gibb's Clermont Gravity Highs) continues south into central EDDYSTONE. Superimposed on this feature are several gravity "highs", feature 22, which indicate major culminations of the structural "high", and a sub-circular gravity "low", feature 23, which is probably produced by a comparatively shallow grante intrusion.

The magnitude of the gravity "high" decreases to the south of central EDDYSTONE, feature 24, but increases again in the extreme south of CHARLEVILLE and on WYANDRA, feature 25. In this latter area the feature corresponds to the Nebine Ridge and hence the results of the gravity survey reveal conclusively the continuity of the Anakie Structural High and the Nebine Ridge as a single structural feature. Future gravity coverage over EULO and CUNNAMULLA should establish the nature of the southern portion of the Nebine Ridge and its relation to the Eulo Shelf, farther to the west. It is expected that this gravity coverage will reveal the association of gravity "high" features with the known granite outcrop areas on EULO and hence indicate that the gravity "highs" features 25, 27, and 29 and the gravity "lows" features 26 and 28 reflect areas of comparatively shallow and deeper granite basement respectively.

Bowen-Surat Regional Gravity Low

Within the survey area this extensive gravity "low" corresponds in general with the Mesozoic Surat Basin and the underlying Upper Palaeozoic Bowen Basin. These basins are usually regarded as separate units, but regional aeromagnetic and seismic work by Union-Kern-AOG has proved their continuous nature and they will be discussed here as a single structural unit.

Feature 30, the Comet Gravity Platform, which extends from the north into western BARALABA, separates the Bluff Gravity Depression, feature 31, to the east, from the Denison Gravity Low, feature 31A. These features correspond to two Permian troughs separated by the Comet Platform, an area of high-standing basement known from seismic results (Darby, in prep.). The Denison Gravity Low, feature 31A, does not extend into the survey area but the Bluff Gravity Depression, Feature 31, extends south into central BARALABA and shows some continuity with feature 40 in central TAROOM. This continuity will be discussed later. The Comet Gravity Platform extends south into south-west BARALABA as a somewhat irregular feature with several culminations. Two of these are the Warranilla Gravity High, feature 33, and the Purbrook Anticlines respectively. Farther to the south the Arcadia Gravity High, feature 35, correlates approximately with the Arcadia Anticline. The relation of feature 35 to the Comet Gravity Platform is not clear and it is possible that the gravity platform does not extend into TAROOM.

To the east of the Bluff Gravity Depression, feature 31, is a gravity platform area, feature 32, extending from DUARINGA to MUNDUBBERA. This feature coincides with an outcrop area of Upper Palaeozoic sediments which includes the Mimosa Syncline, a north-south-trending structure in which is found the maximum development of Triassic rocks in the Basin. These rocks are denser than the younger Mesozoic sediments which crop out further to the west but less dense than the igneous and metamorphic rocks which crop out to the east. Thus the anomalies associated with the rocks in the Mimosa Syncline are intermediate between those of the Coastal Gravity Complex and those of the younger Mesozoic sediments farther to the west. Farther to the south the Mimosa Syncline is coincident with the gravity spur, feature 41, indicating that the rocks in the syncline are denser than those rocks constituting the basement on its flanks. This reversal of the usual density relation is important in the interpretation of gravity data throughout the southern portion of the Bowen-Surat Regional Gravity Low. For example the Meandarra Gravity Ridge, feature 45, is coincident with the Meandarra Syncline which contains the thickest sediments in the Surat-Bowen Basin (Gibb, in prep.).

Similarly, the arcuate gravity "low", feature 39, in western ROMA is coincident with the Roma Spur, an area of shallow granite basement.

Feature 36, the Maranoa Gravity Low, has been interpretated elsewhere as reflecting thick sediments (Bigg-Wither, in prep.). However, it is possible that this feature has a similar interpretation to feature 39 and reflects comparatively shallow granitic basement.

The gravity "highs", feature 43, possibly thus represent areas of thick sediments whilst the gravity platform, feature 37, and its spur, feature 38, possibly represent areas of thicker sediments than those likely in the areas of features 36 and 39.

The relation between the gravity "low" feature 40 and the "lows" features 31 and 39 is complex. To the south, feature 39 is probably produced by shallow granite basement whilst to the north, feature 31 is associated with increased sedimentary section. Furthermore the gravity "highs" to the west and east of feature 40 are associated with the Arcadia Anticline and the Mimosa Syncline respectively. Feature 40 appears to be in the density transition zone and may have no structural significance.

The gravity lows, features 44, 46, and 47, probably arise from differing causes. Feature 44 probably reflects thinner sediments when compared with the section known to be associated with feature 45 and postulated in the area of feature 43. Feature 46 probably lies in the transition zone between normal and reversed density relations and hence may have no structural significance. Feature 47 is poorly known at present but may represent a thickening of the sediments.

Coastal Gravity Complex

In their discussions of gravity results to the north of the survey area Gibb (1964) and (Darby, in prep.) have postulated that many gravity anomalies within the Coastal Gravity Complex arise from the distribution of high- and low-density igneous rocks. It will be shown that a similar relation exists within the present survey area.

One of the major gravity features of this zone is the Marlborough Gravity Ridge, feature 48, and its smaller spur, feature 49. These features correlate to the north of the survey area with outcrops of ultrabasic rocks and it would seem probable that a similar relation exists in this area. Over ROCKHAMPTON and the northern half of MONTO the gravity ridge is coincident with the northern portion of the Yarrol Basin (Darby, in prep.). Tertiary volcanic activity occurred in this area, and it is postulated that basic igneous rocks associated with this activity are present at comparatively shallow depth beneath the Basin sediments (Darby, in prep.). In southern MONTO and MUNDEBBERA the gravity ridge is coincident with a portion of the Auburn Granitic Complex, and it would seem likely that the high anomalies reflect basic rocks intruded into and forming part of the Complex.

The gravity "low", feature 50, lying to the west of the Marlborough Gravity Ridge in west MONTO is coincident with an anticline mapped in Tertiary volcanic rocks, and suggests the present of a granite mass at shallow depth, the intrusion of which caused doming in the overlying rocks.

The Bajool Gravity Low, feature 51, is coincident in northern MONTO with a large granite outcrop and it is postulated that this granite extends beneath the Yarrol Basin sediments northwest into south ROCKHAMPTON. (Gibb, 1964, and Darby, in prep.). The gravity "low" features 52 and 55 are similarly associated with granite outcrops.

The belt of gravity "highs", feature 56, at least partially coincide with the axis of the southern portion of the Yarrol Basin and are probably produced by basic igneous rocks, associated with Tertiary volcanic activity, underlying the Basin sediments.

Between this belt of gravity "highs" and the Marlborough Gravity Ridge is a north-elongated gravity "low", feature 57, which probably reflects an extensive granite intrusion within the Auburn Granitic Complex.

The gravity expression of the Yarraman Block, in west GYMPIE and east CHINCHILLA, is one of relatively low gravity values. Individual gravity "lows" in this area such as features 58 and 63 probably represent granite intrusions in the Block.

The Esk Rift, lying to the east of the Yarraman Block, is not well expressed in the gravity results. However, the small gravity "high", feature 62, may represent a basic igneous mass at shallow depth in the northern portion of the Rift. This feature appears to be an extension of a large gravity "high", feature 59, which is partially associated with Tertiary basic volcanic rocks and may represent comparatively shallow basic igneous rocks. To the south of this feature the gravity "lows", feature 61, are probably produced by granite intrusions within the northern portion of the D'Aiguilar Block.

Further south again, an intense gravity "high" in north-eastern IPSWICH, feature 66, corresponds with an outcrop area of Proterozoic and

Lower Palaeozoic rocks and probably reflects the presence of an extensive basic igneous mass at shallow depth beneath these rocks. The smaller gravity "high", feature 65, to the west of feature 66 may also be due to shallow basic igneous rocks.

The Moreton Gravity Low, feature 64, corresponds with the Moreton (Ipswich) Basin. The small gravity "low" immediately east of Toowoomba may reflect increased section in the Basin or the presence of a granite intrusion beneath it. The southern extent of this feature is not known.

Coincident with the Queensland coast is a belt of gravity "highs", features 54, 69, and 68, which increase in intensity towards the east. These gravity "highs" probably reflect thinning of the sial layer as the edge of the continental shelf is approached. This belt of gravity "highs" is broken by the areas of comparatively low gravity, features 53 and 60. Feature 53 is coincident with an outcrop area of granite and Lower Palaeozoic rocks which probably produce local thickening of the sial layer and corresponding lowering of the Bouguer anomalies. Feature 60, the Maryborough Gravity Low, corresponds to the deeper portion of the Maryborough Basin. In the south of this belt of gravity "highs" the small gravity "low", feature 67, is possibly of no structural significance, being produced by the contrast between normal anomalies and the intense gravity "high", feature 66.

6. CONCLUSIONS

The gravity results on preliminary analysis suggest that:

(1) The eastern margin of the Eromanga Basin is well defined by the gravity data.

(2) An east-west-trending gravity platform on DURHAM DOWNS and THARGOMINDAH suggests that the Eromanga Basin is terminated to the south by this feature and may need redefinition geologically.

(3) Within the Eromanga Basin there is excellent agreement between gravity anomalies and geological structure.

(4) The Nebine Ridge and Anakie Structural High are a single continuous structure.

(5) The eastern and western margins of the Surat Basin are well defined by the gravity data.

(6) Many gravity-anomaly/geological-structure relations within the Surat Basin are reversed; e.g. the Meandarra Gravity Ridge corresponds to the Meandarra Syncline.

(7) Within the Coastal Gravity Complex gravity "highs" correspond to known structural "highs", except for the granites (some of which are postulated) which produce gravity "lows" and the Yarrol Basin which coincides with gravity "high" regions over most of its extent.

(8) There is a general easterly increase in gravity values at the Queensland coast, which is considered to reflect thinning of the sial layer as the continental shelf is approached.

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APPENDIX 1

SURVEY STATISTICS

New Readings	4,076
Grid Stations	3,089
Control Stations	1,151
Total New Stations	4,240
Loops (normal)	643
Loops (follow-up)	31
Area Covered	170,000 square miles
Helicopter Hours	1,067
Total Helicopter Days	251
Days Lost -	
Unserviceability	31
Not Required	-
Weather	9
Other	-
Days Available -	211
% U.S.	12.3%
Loops/day	3.2
New Readings/hour	3.9
Grid Readings/hour	2.9

APPENDIX 2

SURVEY STAFF AND EQUIPMENT

The field operations were carried out by a private geophysical contractor, Wongela Geophysical Pty Ltd. The method of operation used by the contractor was identical with procedures adopted by the Bureau of Mineral Resources on previous helicopter gravity surveys (Vale, 1962). All traversing was done using the cell method (Hastie & Walker, 1962).

Some details concerning the party organisation are listed below:

Staff (Wongela Geophysical Pty Ltd)

Supervisor	L.N. Ingall
Party Leader	G.F. Lonsdale
Party Manager	M. Brulhart
Chief Meter Operator	F.S. Clements
Meter Operators	G.L. Devlin; N.G. Mattocks; G.C. Phipps; J. Almekinders; J.J. Nichols
Draughtsman	A. Potter (Mapping Systems Pty Ltd)
Senior Computer	T. Magub

Helicopter staff of 2 pilots and 2 engineers

Casual staff comprised 1 Cook, 2 Field Assistants

Bureau Representative R.A. Gibb

Geophysical Equipment

Two Gravity Meters: Worden No. 581
Sharpe No. 154

Calibration details are:

Meter	Date	Place	Calibration factor
Worden 581	2. 3.64	Brisbane	0.09724 mgal/sc.div.
	3. 7.64	Brisbane	0.09715 "
	1.10.64	Brisbane	0.09713 "
Sharpe 154	17. 3.64	Brisbane	0.11003 "
	3. 7.64	Brisbane	0.10994 "

Four Mechanisms Barometers: Nos. 62/506, 62/507, 62/508 and 63/306, calibrated in millimetres of mercury.

Helicopters	Bell 47G2 - VH-AHF	Rotor-Work Pty Limited
	Bell 47D - VH-UTL	Helicopter Utilities Pty Ltd
	Hughes 269A VH-IHB	Helicop-Air Pty Ltd

Vehicles
3 x Toyota 4 x 4
2 x Land Rovers 4 x 4
1 x 16 feet Office Trailer

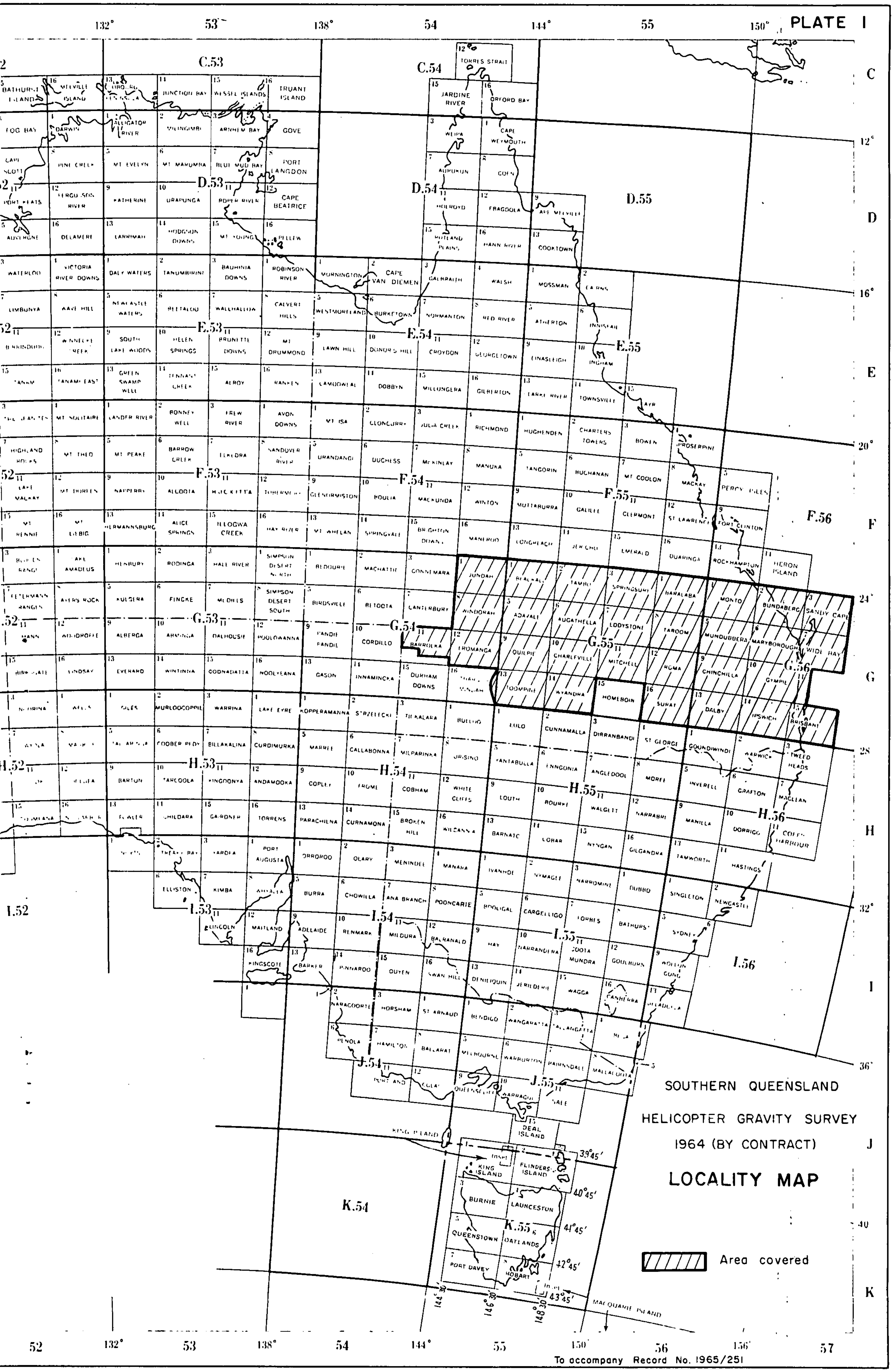
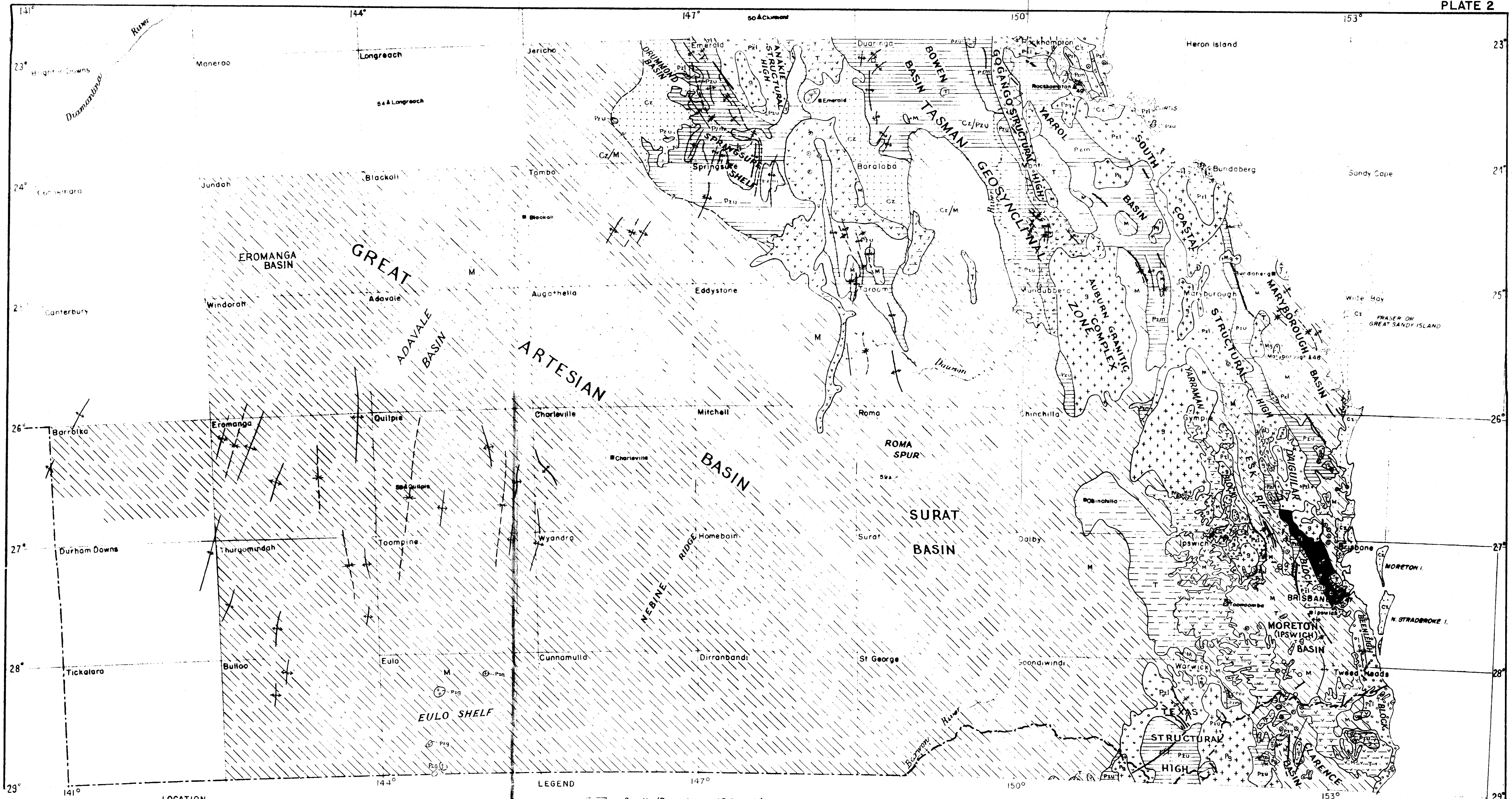


PLATE I
SOUTHERN QUEENSLAND
HELICOPTER GRAVITY SURVEY
1964 (BY CONTRACT)
LOCALITY MAP
Area covered
To accompany Record No. 1965/251

PLATE 2



LEGEND

Cz	Cainozoic (undifferentiated)
T	Tertiary "
M	Mesozoic "
Pzu/Pzm	Palaeozoic (Upper and Middle)
Pzl	" (Lower)
	? Proterozoic
S S S	Serpentine
	Granite (Precambrian and Palaeozoic)
	Acid / Intermediate / Basic — Volcanic rock
	Acid / Alkaline / Basic — Volcanic Centre
	Anticline
	Syncline
	Fault
▲ 48	BMR Pendulum station

SOUTHERN QUEENSLAND

HELICOPTER GRAVITY SURVEY 1964

(BY CONTRACT)

GEOLOGY

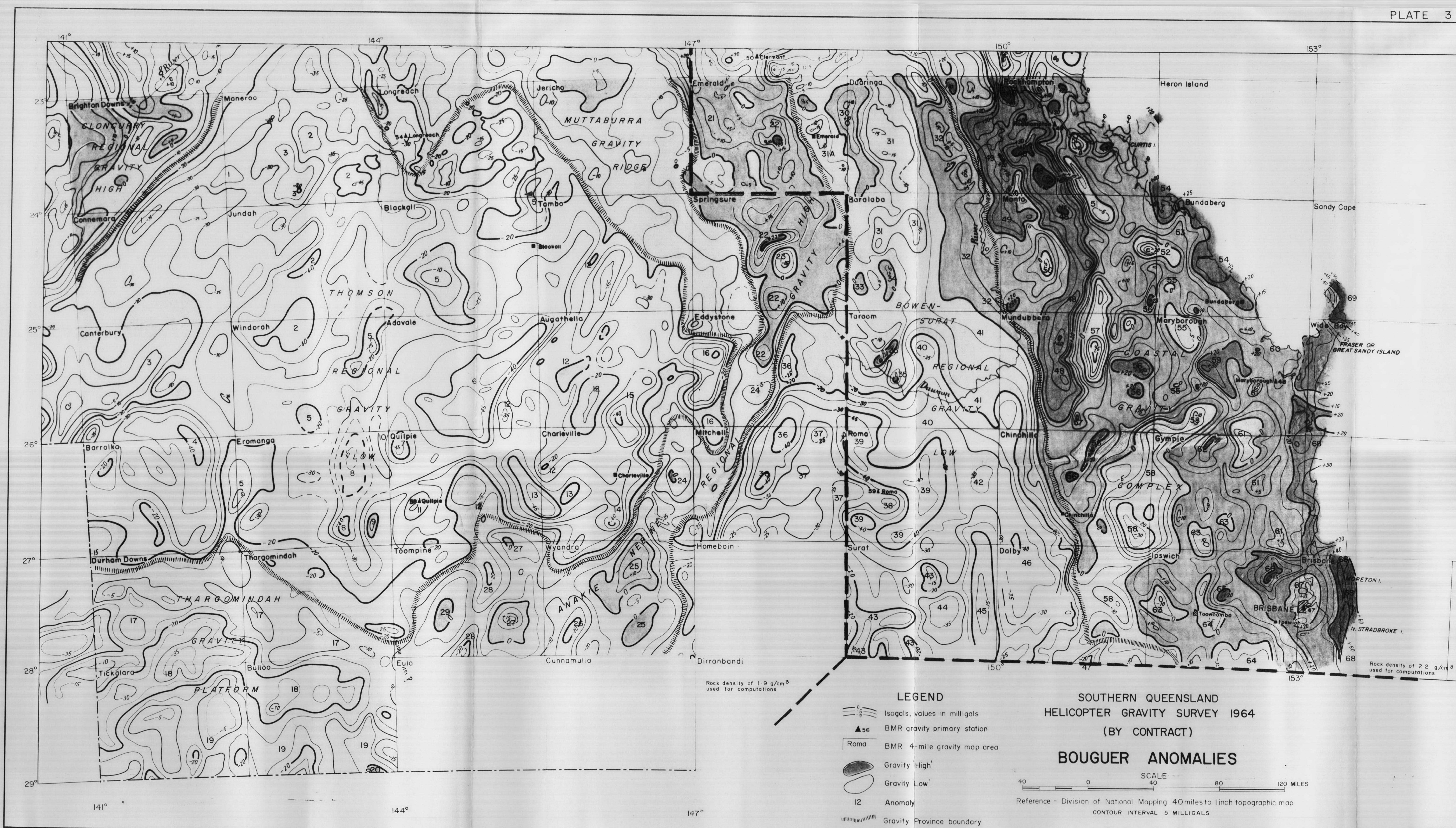
SCALE

40 0 40 80 MILES

Geology after Tectonic Map of Australia

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G56/B2-22

To accompany Record No. 1965/251



To accompany Record No. 1965/251