DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1975/87

BOUGUER ANOMALIES OF THE SURAT & DALBY 1:250 000 SHEET AREAS, QUEENSLAND, AND THEIR GEOLOGICAL INTERPRETATION

by

F. Darby

Record 1975/87

BOUGUER ANOMALIES OF THE SURAT & DALBY 1:250 000 SHEET AREAS, QUEENSLAND, AND THEIR GEOLOGICAL INTERPRETATION

by

F. Darby

CONTENTS

TEXT FIGURES

FOREWORD

This report was written by Mr Darby before 1970. Therefore the subject matter is not up to date. Reference may be made to Reiser (1971), Mond (1973), and Exon (1974, and in press) for more recent discussions on the geology of the area of the report.

The nomenclature of gravity provinces, units, and sub-units is not that presently adopted by BMR. The current nomenclature of gravity features of redefinition of their boundaries are given by Fraser, Darby & Vale (in prep.).

SUMMARY

The Bouguer anomaly features in the SURAT and DALBY 1:250 000 Sheet areas have been interpreted in terms of both known and inferred geological structures in the Surat Basin, in the underlying Bowen Basin, and beneath the Bowen Basin. On the shelf areas in the east and west there is a good correlation between depth to basement as indicated by borehole evidence and 30-minute mean Bouguer anomaly values. The 'residual' Bouguer anomaly features in these shelf areas are correlated with density changes within the basement. The Meandarra Gravity Ridge, which is associated with the axis of the Bowen-Surat Basin, is interpreted as being caused by a thick sequence of at least 3660 m of Lower Bowen Volcanics (Kuttung Formation) which were deposited during the initial period of subsidence of the basin.

INTRODUCTION

During 1963, 1964, and 1968 the Bureau of Mineral Resources, Geology and Geophysics (BMR) conducted reconnaissance gravity surveys over the eastern part of Queensland and northeastern part of New South Wales, between latitudes 20°S and 33°S. (Fig. 1). Preliminary interpretations of the results of these surveys have been presented by Darby (1966), Lonsdale (1965), and Darby (1969). The present report discusses the gravity anomalies in SURAT* and DALBY and attemps to interpret the Bouguer anomaly high which correlates with the axis of the Bowen-Surat Basin in eastern SURAT.

---

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

GEOLOGY

The area falls entirely within the Surat Basin and can be divided into three main structural elements (Fig. 2), namely the Southern Roma Shelf, the Mimosa Syncline, and the Dalby Shelf.

The stratigraphy of the area is mainly known from bore-hole data and is shown in Table 3 of Thomas & Reiser (1968). The structural geology (Thomas & Reiser, 1968) of the area is mainly derived from geophysical information.

The Mimosa Syncline contains about 4500 m of Permian and younger sediments and is deepest in the north of the area. To the west the pre-Permian basement gradually rises, forming the gently sloping Southern Roma Shelf which is covered by 1200 to 2100 m of mainly Mesozoic sediments. In this area the Southern Roma Shelf is generally composed of regional metamorphic rocks of the Timbury Hills Formation.

In the Mimosa Syncline there is at least 1200 m of Permian and Triassic sediments, related to the development of the Bowen Basin, which are overlain unconformably by the Jurassic and Cretaceous sequence of the Eromanga Basin. Basement in the Mimosa Syncline, where known, is a dominantly volcanic sequence, the Kuttung Formation, probably of Carboniferous age. On the Southern Roma Shelf the Bowen Basin sequence is either absent, or present as a veneer overlying basement.

The eastern flank of the Mimosa Syncline is dominated by major faulting - the Goondiwindi-Moonie Fault Zone - which affects all of the sedimentary units and basement. To the east of the fault zone the prevailing geology is similar to that on the Southern Roma Shelf. There is a gradual thickening of the sedimentary sequence towards the Mimosa Syncline. This area is here named the Dalby Shelf. Basement on this eastern shelf of the Surat Basin is usually Kuttung formation. However, an exception to this is that Triassic sediments have been found in boreholes around Cecil Plains, 45 km south of Dalby.

ROCK DENSITIES

The density values tabulated below (Table 1) have been obtained from core samples from wells subsidized by the Australian Government under the Petroleum Search Subsidy

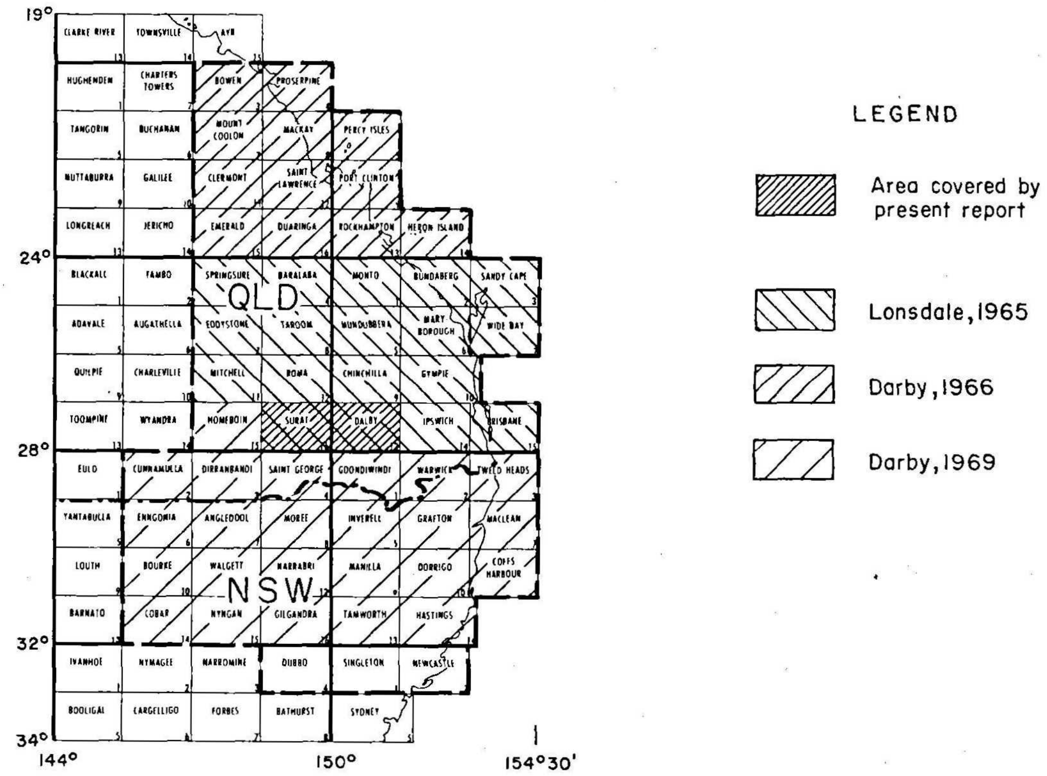


Fig. 1 LOCALITY MAP

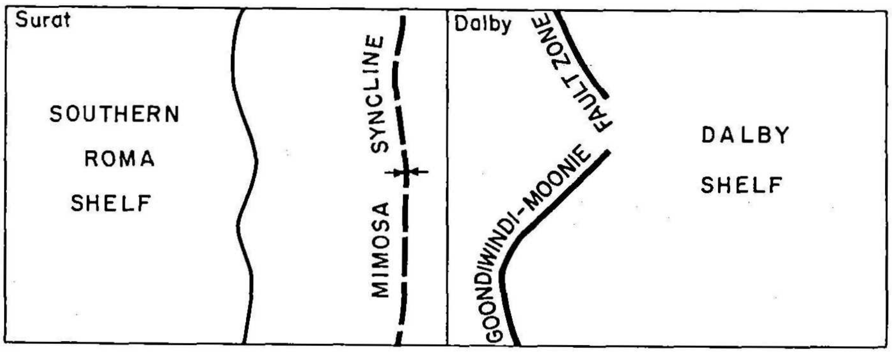


Fig. 2 STRUCTURAL ELEMENTS

Acts. These wells have been mainly located within the Bowen-Surat Basin, but some values have been obtained from samples from wells within the Adavale, Eromanga, and Galilee Basins outside the area covered in this report. Well locations are shown in Plate 1.

TABLE 1

Formation Densities

Formation	Number of Samples	Density Range (tm^{-3})	Average Density (tm^{-3})	Average Depth (m)
Roma*	16	1.95 - 2.26	2.15 ± 0.08	114
Blythesdale	21	2.16 - 2.48	2.31 ± 0.07	787
Walloon	10	2.24 - 2.39	2.30 ± 0.04	911
Hutton	19	2.21 - 2.62	2.32 ± 0.11	1380
Evergreen	6	2.28 - 2.54	2.39 ± 0.09	1597
Precipice	48	2.29 - 2.54	2.39 ± 0.06	1385
Wandoan	31	2.31 - 2.67	2.52 ± 0.09	1460
Rewan	57	2.37 - 2.78	2.53 + 0.09	1927
Blackwater	13	2.32 - 2.61	2.48 ± 0.07	1413
Back Creek	47	2.41 - 2.75	2.61 ± 0.07	2529
Kuttung				
Timbury Hills	7		2.63	1387

There are probably several density discontinuities within the sedimentary succession, and certain formations can be grouped together and considered to have equal densities. The densities shown in Table 2 below can be considered fairly representative for gravity interpretation.

TABLE 2

Densities used for interpretation of gravity features

Formation	Density (tm^{-3})	Density Contrast (tm^{-3})
Roma	2.15	+ 0.15
Blythesdale Walloon Hutton	2.30	
		+ 0.10
Evergreen Precipice	2.40	
		+ 0.10
Wandoan Rewan Blackwater	2.50	
		+ 0.10
Back Creek	2.60	

There is a general increase in density with age of the rocks. Malahoff & Moberly (1968) present a curve showing the general increase in density of sediments with depth of burial. This curve is reproduced in Figure 3 together with the average formation density and depth of burial for the sediments of the Bowen-Surat Basin. In the Bowen-Surat Basin the increase in density with depth of burial is thought to be greater than the idealized case. A plot of density/depth of burial for the Rewan Formation is also included in Figure 3. In this case there is an increase in density with increase in depth of burial but the increase is less than the idealized case.

The above disucssion suggests that three methods of gravity interpretation may be valid:

1. Assume a constant density for a formation regardless of its depth of burial.

2. Assume a layered density configuration of the sediments in the Bowen-Surat Basin regardless of the formation structures.

3. A combination of the above.

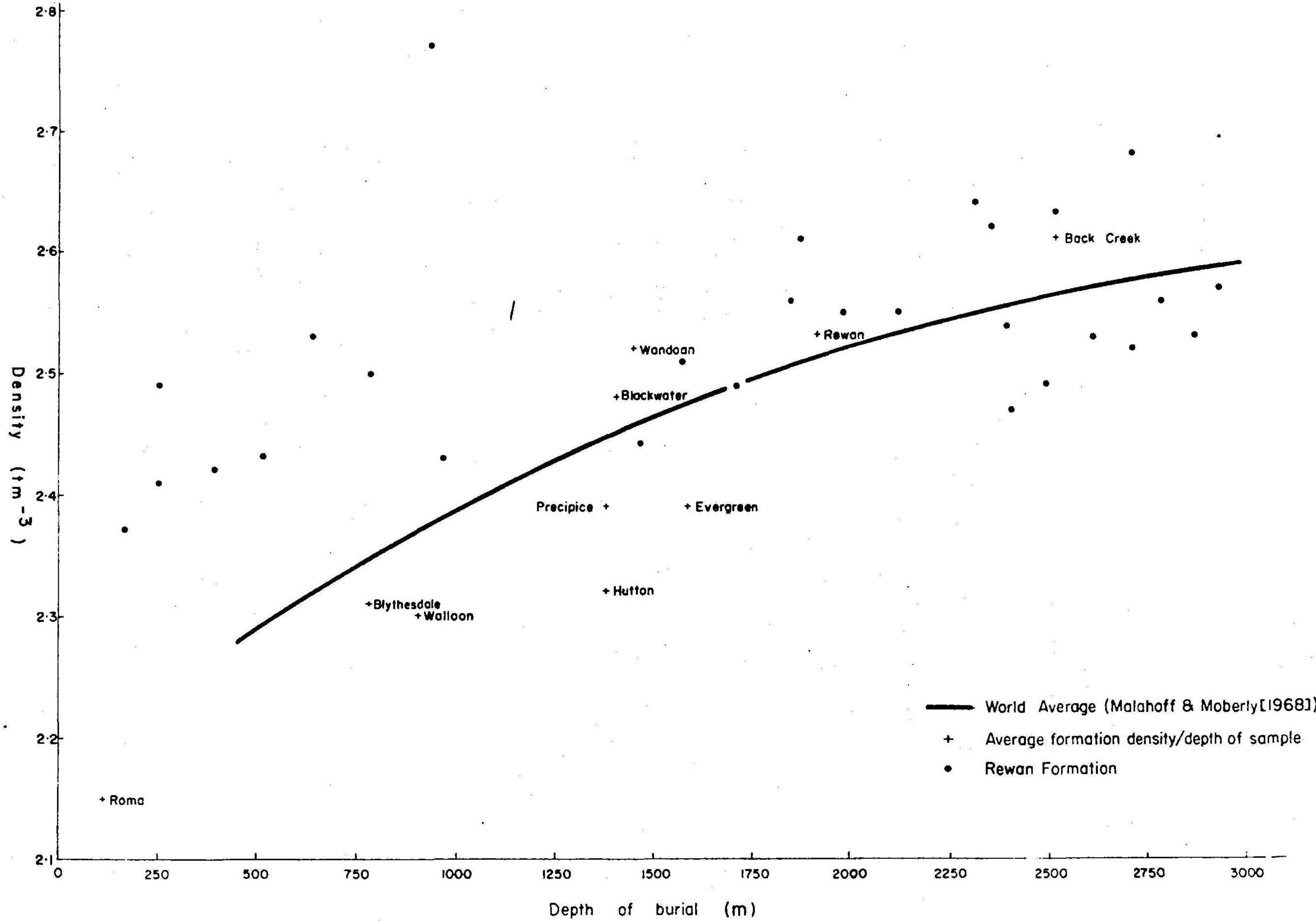


Fig. 3 DENSITY VERSUS DEPTH OF BURIAL

Record No. 1975/87

G65 - 228 A

The densities of the sediments are known and do not differ greatly from average densities of similar sediments in other parts of the world. Unfortunately not many sample densities are available from either the Timbury Hills or Kuttung formations. The density of 2.63 tm^{-3} for the Timbury Hills Formation is based on seven samples from Bony Creek No. 1 well and is probably not truly representative of the whole formation throughout the area. An important point to note is that on north SURAT a granitic intrusion within the Timbury Hills Formation contributes to a Bouguer anomaly low; this indicates that the granitic mass has a density less than the Timbury Hills Formation. Bott & Smithson (1967) give a minimum density for granite of 2.58 tm^{-3} and Gibb (1968) considers that 2.64 tm^{-3} is a reasonable world average for granite. From these considerations it would be reasonable to assign a higher density of at least 2.65 - 2.70 tm^{-3} to the bulk of the Timbury Hills Formation.

GRAVITY ANOMALY FEATURES

Bouguer Anomalies

Bouguer anomalies, computed using a Bouguer density of 2.2 tm^{-3} are presented in Plate 1 at a scale of 1:500 000 and in Figure 4a at a scale of about 1:2 500 000. The main Bouguer anomaly features of the area were originally qualitatively interpreted by Lonsdale (1965) and tentatively redefined by Darby (1969). No attempt is made here to redefine or rename the Bouguer anomaly provinces but some of the individual gravity features are assigned names for ease of description in the following discussion. The main Bouguer anomaly gravity features on SURAT and DALBY shown in the 30-minute mean Bouguer anomaly map (Fig. 4b) are as follows:

1. Balonne Gravity Platform
2. Surat Gravity Low
3. Meandarra Gravity Ridge
4. Tara Gravity Low
5. Dalby Gravity Shelf

Subsidiary Bouguer anomaly features have been labelled in Figure 4a and are assigned names below.

1A. Wanganui Gravity High

2A. Yalebone Gravity Low

2B. Weribone Gravity High

2C. Coomrith Gravity Low
5A. Kogan Gravity High
5B. Cecil Plains Gravity Low
5C. Willis Gravity High
5D. Zig Zag Gravity Low
5E. Millmerran Gravity High.

Free Air Anomalies

The 15-minute mean Free Air anomalies are illustrated in Figure 4c. The anomalies are presented for the sake of completeness and no detailed interpretation of them will be attempted. As is expected, in an area of little topographic relief such as the SURAT and DALBY areas, the mean Free Air anomaly features correspond closely to the mean Bouguer anomaly features shown in Figure 4b.

The free air anomaly features over the Surat Basin are very close to zero and suggest isostatic compensation. However on the eastern flank of the basin, towards the exposed older rocks of the Tasman Geosyncline, the Free Air anomalies become distinctly positive, possibly indicating an uncompensated mass excess associated with this part of the Tasman Geosyncline.

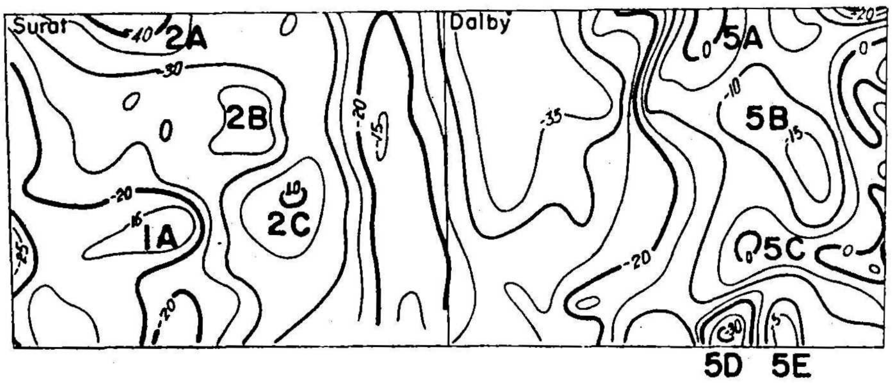
INTERPRETATION OF BOUGUER ANOMALIES

Possibly the most appropriate means of conducting a broad interpretation is to consider the three main structural elements separately and then to consider a number of east-west profiles.

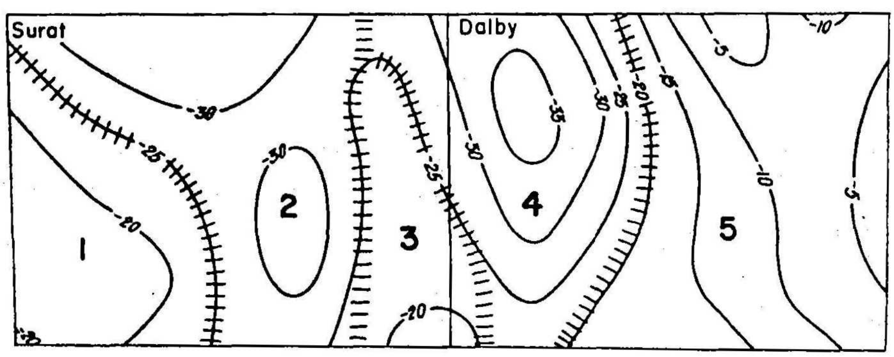
Southern Roma Shelf

The Southern Roma Shelf correlates in part with the Balonne Gravity Platform and the Surat Gravity Low.

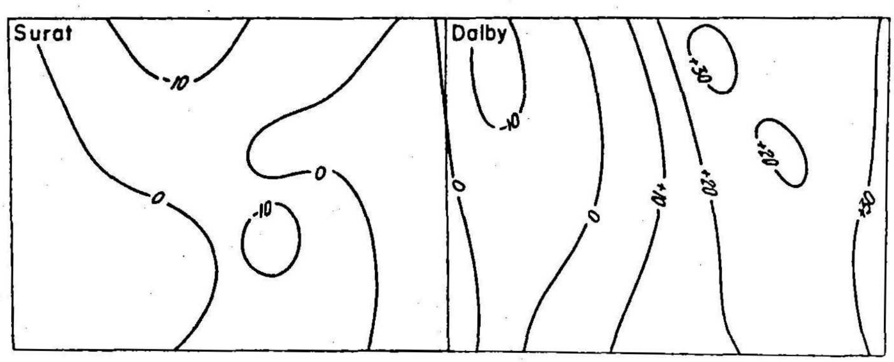
Basement on the Southern Roma Shelf is known, from borehole and seismic evidence, to deepen towards the east. The basement is generally composed of regional metamorphic rocks of the Timbury Hills Formation. Depths to basement in wells are plotted against observed Bouguer anomaly values in Figure 5 and against 30-minute mean Bouguer anomaly values in Figure 6. Both plots show a general decrease in Bouguer anomaly values with increased depth to basement, i.e. normal correlation. If a mean density contrast between sediments and basement, i.e. normal correlation. If a mean density contrast between



(a) BOUGUER ANOMALIES



(b) 30 MINUTE MEAN BOUGUER ANOMALIES



(c) 15 MINUTE MEAN FREE AIR ANOMALIES

Fig. 4 BOUGUER AND FREE AIR ANOMALIES

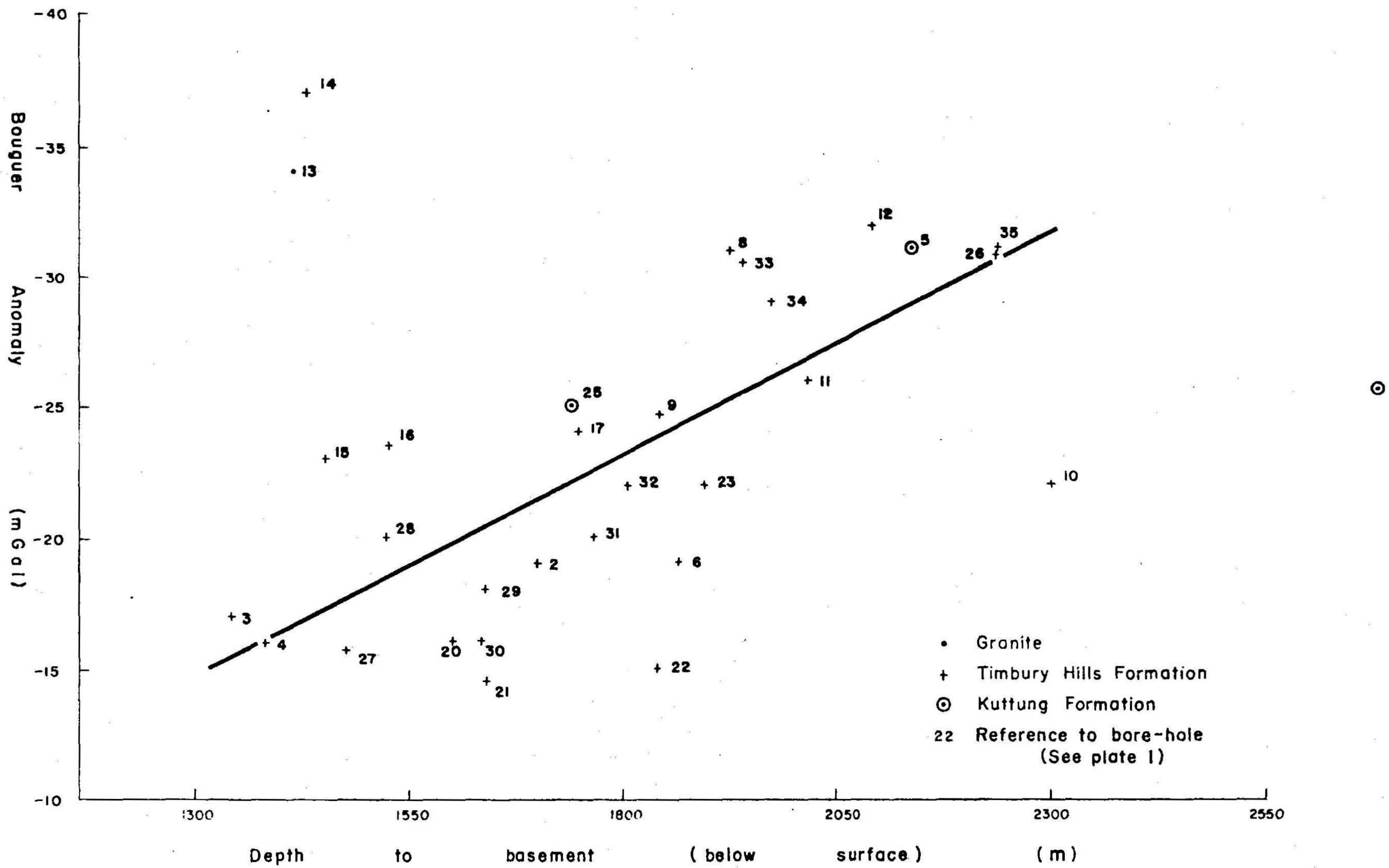


Fig. 5 CORRELATION BETWEEN BOUGUER ANOMALY AND DEPTH TO BASEMENT ON THE SOUTHERN ROMA SHELF

Record No. 1975/87

G65-229A

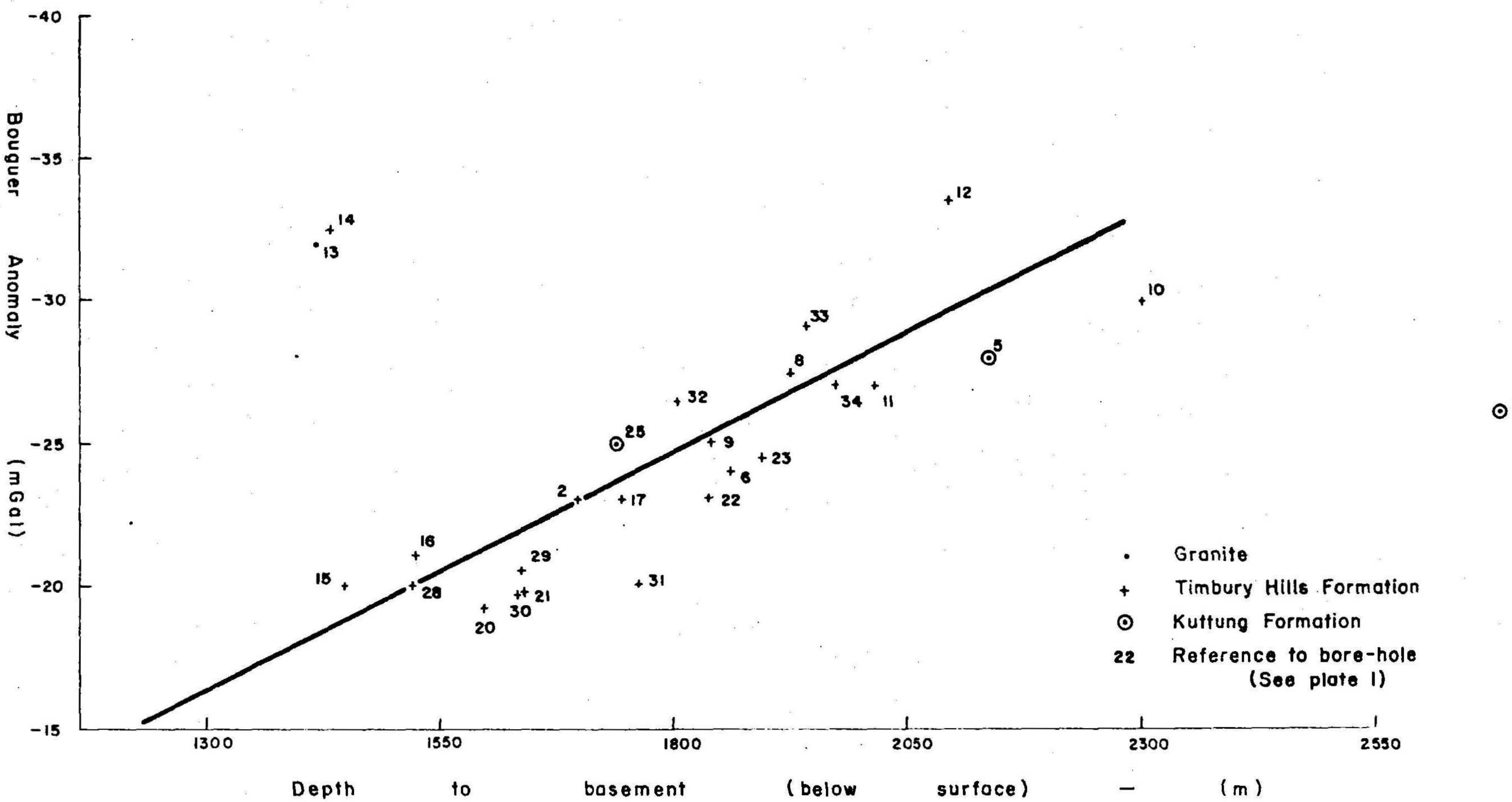


Fig. 6 CORRELATION BETWEEN 30 MINUTE MEAN BOUGUER ANOMALY AND DEPTH TO BASEMENT ON THE SOUTHERN ROMA SHELF

Record No. 1975/87

G 65-230A

16

sediments and basement of 0.40 tm^{-3} is assumed, then the theoretical decrease in Bouguer anomaly values with increased depth to basement is represented by the solid line in Figures 5 and 6. Therefore over the Southern Roma Shelf there is a correlation on a broad regional scale between Bouguer anomaly values and thickness of sediments.

The differences between the solid line and the individual points on Figure 5 represent 'residual' Bouguer anomalies. These 'residual' anomalies range in magnitude from -20 mGal to +10 mGal.

The most strongly residuals are shown at Colgoon No. 1 well ('13' on Plate 1) and Kincora No. 1 well (14) and correspond to the Yalebone Gravity Low (Feature 2A, Fig. 4a). Both of these wells are located in the north of the area, and on the southern extremity of a Bouguer anomaly low that is fully developed on ROMA. Colgoon No. 1 well bottomed in granitic basement and Kincora No. 1 well in the Timbury Hills Formation. Numerous wells on ROMA bottomed in granite and the outline of the granite can be defined by the Bouguer anomaly low. It is therefore postulated that Kincora No. 1 well was situated at the edge of this granite, or that the Timbury Hills Formation is only a thin veneer over the granite at this locality.

The most strongly positive residual features are shown at Wanganui (21), Thomby (22), Weribone (10), and Flinton (1) wells. The first two are located on the Wanganui Gravity High (Feature 1A) and the third on the Weribone Gravity High (2B). (Glinton No. 1 is located in the Mimosa Syncline and is not typical of the Southern Roma Shelf area). It is postulated that the Wanganui and Weribone Gravity Highs which form a northeast-trending belt of Bouguer anomaly highs, are related to a high-density mass within the Timbury Hills Formation. This mass could in fact be a more highly metamorphosed part of the Timbury Hills Formation, and as such could indicate a zone of increased tectonic activity. This zone is on the direct northeast extension of the Darling River which in turn is paralleled by major Bouguer anomaly lineaments (Darby, 1969). Therefore these high residual features on SURAT could represent a northeast continuation of major tectonic lineaments parallel to the Darling River.

Mimosa Syncline

The Mimosa Syncline contains up to 4500 m of sediments of Permian to Cretaceous age, belonging to the superimposed Bowen and Surat Basins, which contain 2400 m and 2100 m of sediments respectively.

The axis of this syncline can be correlated, on eastern SURAT, with the Meandarra Gravity Ridge (Feature 3). There are three possible explanations for the inverse relationship, as discussed by Darby (1969). These are:

(1) That the Bowen Basin sediments are denser than both the overlying Surat Basin sediments and the underlying basement.

Density determinations presented previously do not support this hypothesis. However the samples were not obtained from the deepest part of the basin and it is probable that the density increases with depth (see Figure 3 for the density determinations of the Rewan Formation). As discussed elsewhere (Darby, 1969), the Meandarra Gravity Ridge continues to the south into areas where the thickness of the Bowen Basin sediments is such that it is suspected they could not be the cause of the Bouger anomaly feature.

(2) That the Meandarra Gravity Ridge is related to density changes below the Bowen Basin sequence and in particular could be related to a thick accumulation of dense volcanics (Kuttung Formation or 'Lower Bowen Volcanics').

(3) That there is a crustal upwarp beneath the axis of the Bowen-Surat Basin.

Possibilities 2 and 3 are discussed in more detail later, under 'Quantative interpretation along profiles'.

The eastern margin of the Mimosa Syncline on DALBY is defined by the Goondiwindi-Moonie Fault zone, but no well-defined Bouguer anomaly corresponds with this fault zone (also discussed below).

Dalby Shelf

The Dalby Shelf occupies the eastern part of DALBY and comprises a westerly-thickening sequence of Mesozoic sediments bounded on the west by the Goondiwindi-Moonie Fault Zone. It is bounded on the southern part of DALBY by granitic and metamorphic rocks of the Texas Structural High.

The depth to basement, as determined from borehole information, has been plotted against observed Bouguer anomaly values and 30-minute average Bouguer anomaly values in Figures 7 and 8. The relationship is not so clear as on the Southern Roma Shelf but nevertheless there appears to be a correlation. A density contrast of 0.55 tm^{-3} between sediments and basement is necessary for this correlation. This is higher than that required on the Southern Roma Shelf and possibly indicates a denser basement, which is not unrealistic as basement here could be more highly metamorphosed owing to its proximity to the Carboniferous-Permian axis of the Tasman Geosyncline. An alternative explanation for this increased density contrast is the possibility that some of the increase in Bouguer anomaly value to the east is caused by a regional trend related to the rise of a possible intrabasement horizon towards the east.

It is postulated that the Kogan Gravity High (Feature 5A), the Willis Gravity High (5C), the Zig Zag Gravity Low (5D), and the Millmerran Gravity High (5E) are related to density changes within the basement. The Zig Zag Gravity Low in particular appears to be related to a shallow granite of the Texas Structural High. The Cecil Plains Gravity Low (5B) could have a sedimentary source, and is discussed separately below.

Cecil Plains Gravity Low (5B)

A north-south section across the Cecil Plains Gravity Low, from Yarrala No. 1 well (76) to Millmerran No. 1 well (80), is shown in Figure 9. On this section the gravity contributions of the rocks down to the base of the Precipice Sandstone have been plotted. It can be seen that the sediments do not account for the whole of the Bouguer anomaly. A negative feature of approximately 6 mGal amplitude remains to be accounted for. There are two possible explanations for this negative feature:

(1.) That it represents Triassic sediments. There are at least 360 m of Triassic sediments at Cecil Plains No. 1 well, and in Tipton No. 1 well about 30 m of Triassic sediments were encountered above metamorphic basement. If a density contrast of 0.20 tm^{-3} is assumed, then the Triassic sediments would be about 730 m thick.

(2.) That it represents a low-density rocks within the basement.

If the first alternative is accepted, then to explain the lack of appreciable Triassic sediments in Tipton No. 1 well it would be necessary to postulate that the structural high upon which this well was drilled was present in

Triassic times, and only a small thickness of Triassic sediments was deposited, or it was formed in pre-Precipice Sandstone times, the Triassic sediments were eroded, and subsequent sediments were draped over the structure. Gravity station spacing is not adequate to outline any small Bouguer anomaly high that would inevitably be present at Tipton No. 1 well if this hypothesis is correct. Cecil Plains West No. 1 well encountered only a thin sequence of Triassic sediments overlying basement, but this is to be expected as it is at the margin of the Bouguer gravity low and therefore possibly at the limit of the area of Triassic sediments.

QUANTITATIVE INTERPRETATION ALONG PROFILES

Four east-west gravity and geological cross-section profiles (Figs. 10 to 13) have been constructed across SURAT and DALBY. The locations of these profiles are shown in Plate 1. The subsurface geology has been obtained mainly from borehole evidence, but in some places, particularly in the centre of the basin, seismic information has been used for correlation between boreholes. Minor geological structures have been ignored; this will not grossly affect the results as most gravity data were obtained on a seven-mile grid and are therefore too sparse to be influenced unduly by minor structural features. Also, the profiles are not straight, although this will not radically affect the interpretation as only large-scale geological and Bouguer anomaly features are being considered.

On each profile the gravity effects of sediments in the Bowen and Surat Basins have been computed and compared with the observed Bouguer anomaly values. The two computed profiles represent:

(1.) A normal density distribution, i.e. basement the densest material (densities used are average densities as defined in the section 'Rock Densities').

(2.) A density distribution in which the Bowen Basin sequence is assumed to be denser than the Surat Basin sediments and the basement rocks.

'Residual' Bouguer anomaly features, which represent the difference between observed and computed Bouguer anomaly values, are plotted on Figure 14 and will be discussed separately.

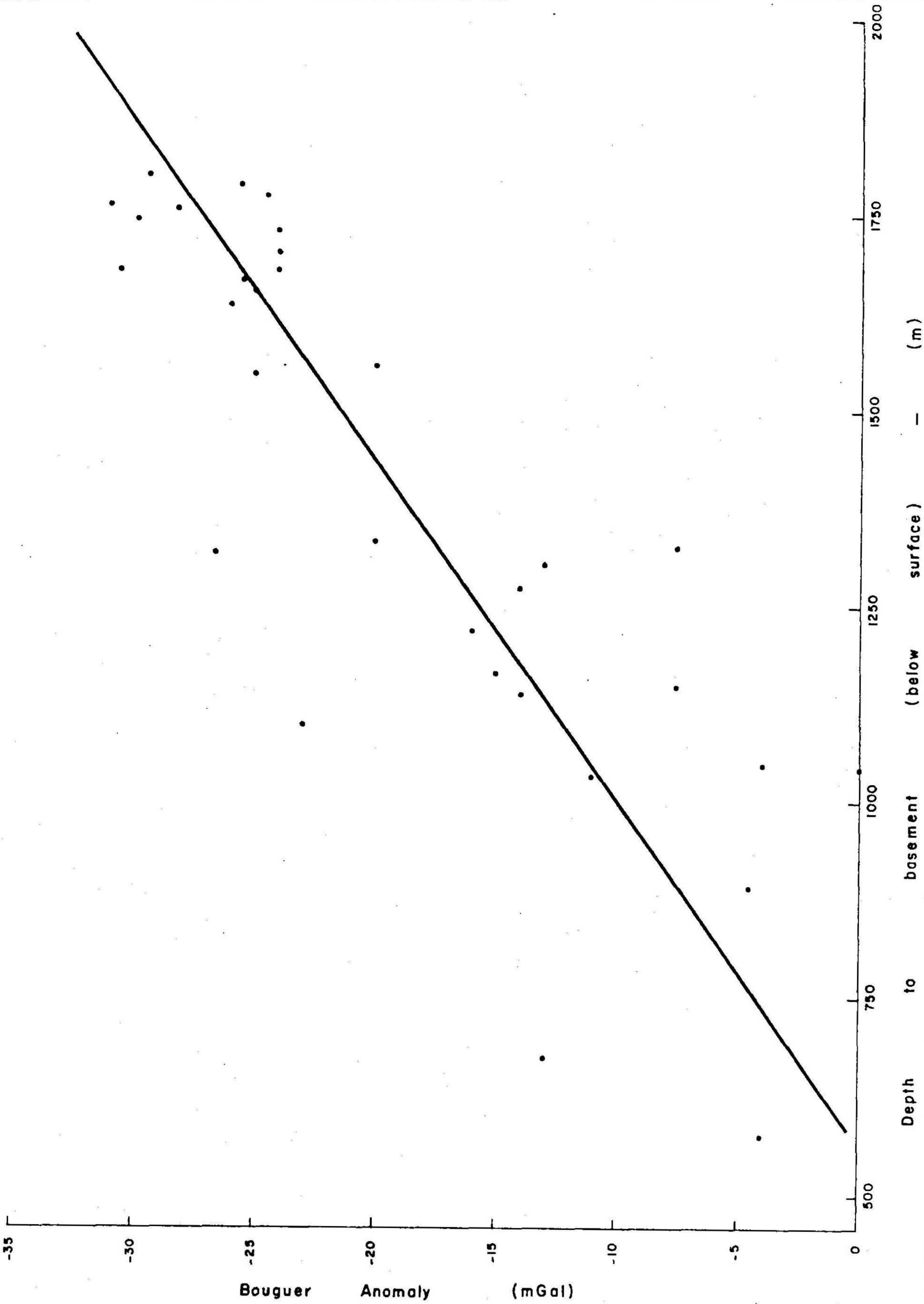


Fig. 7 CORRELATION BETWEEN BOUGUER ANOMALY AND DEPTH TO BASEMENT ON THE DALBY SHELF

Record No. 1975/87 G65-231A

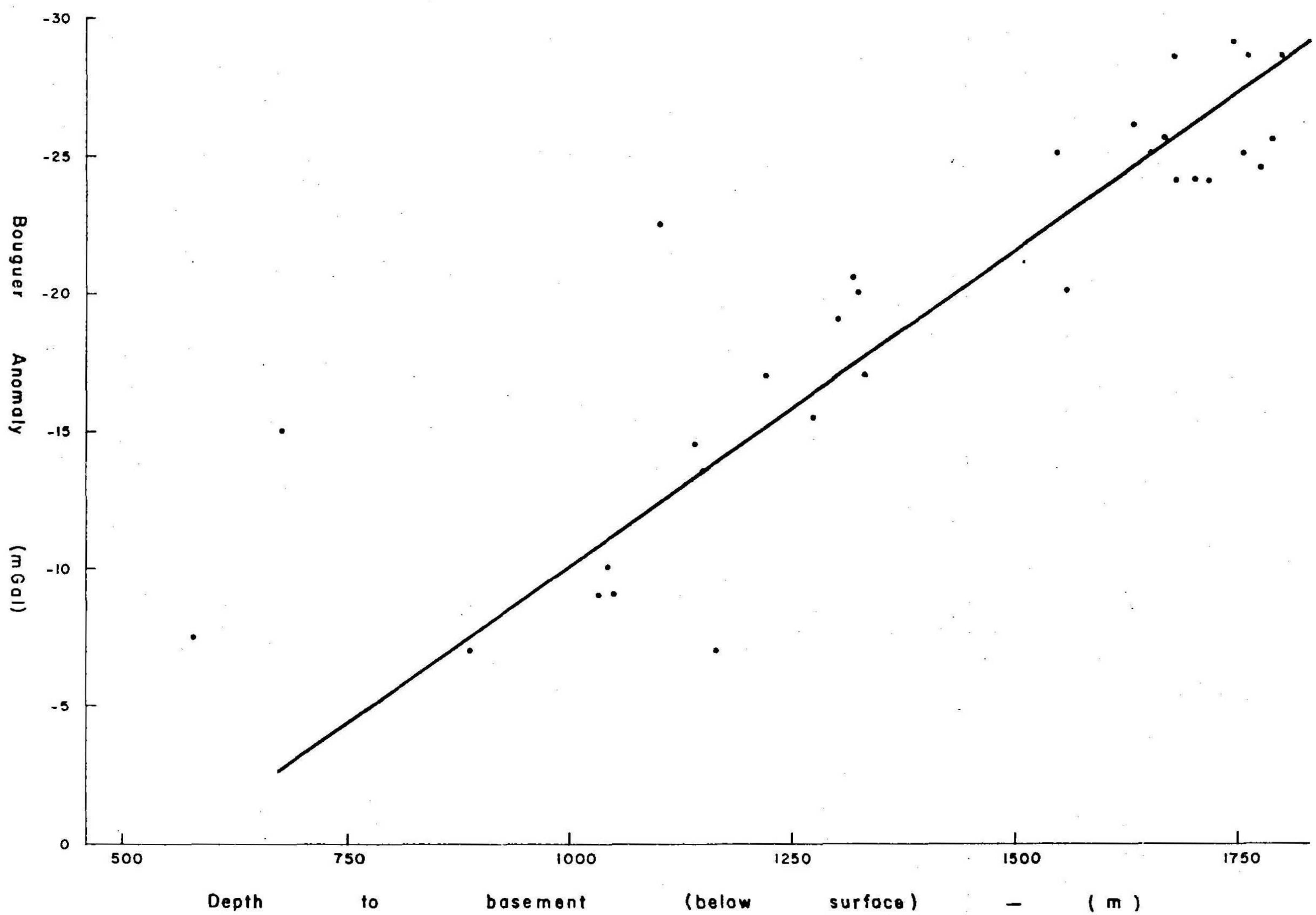


Fig. 8 CORRELATION BETWEEN 30 MINUTE MEAN BOUGUER ANOMALY AND DEPTH TO BASEMENT ON THE DALBY SHELF

Record No. 1975/87

G65-232A

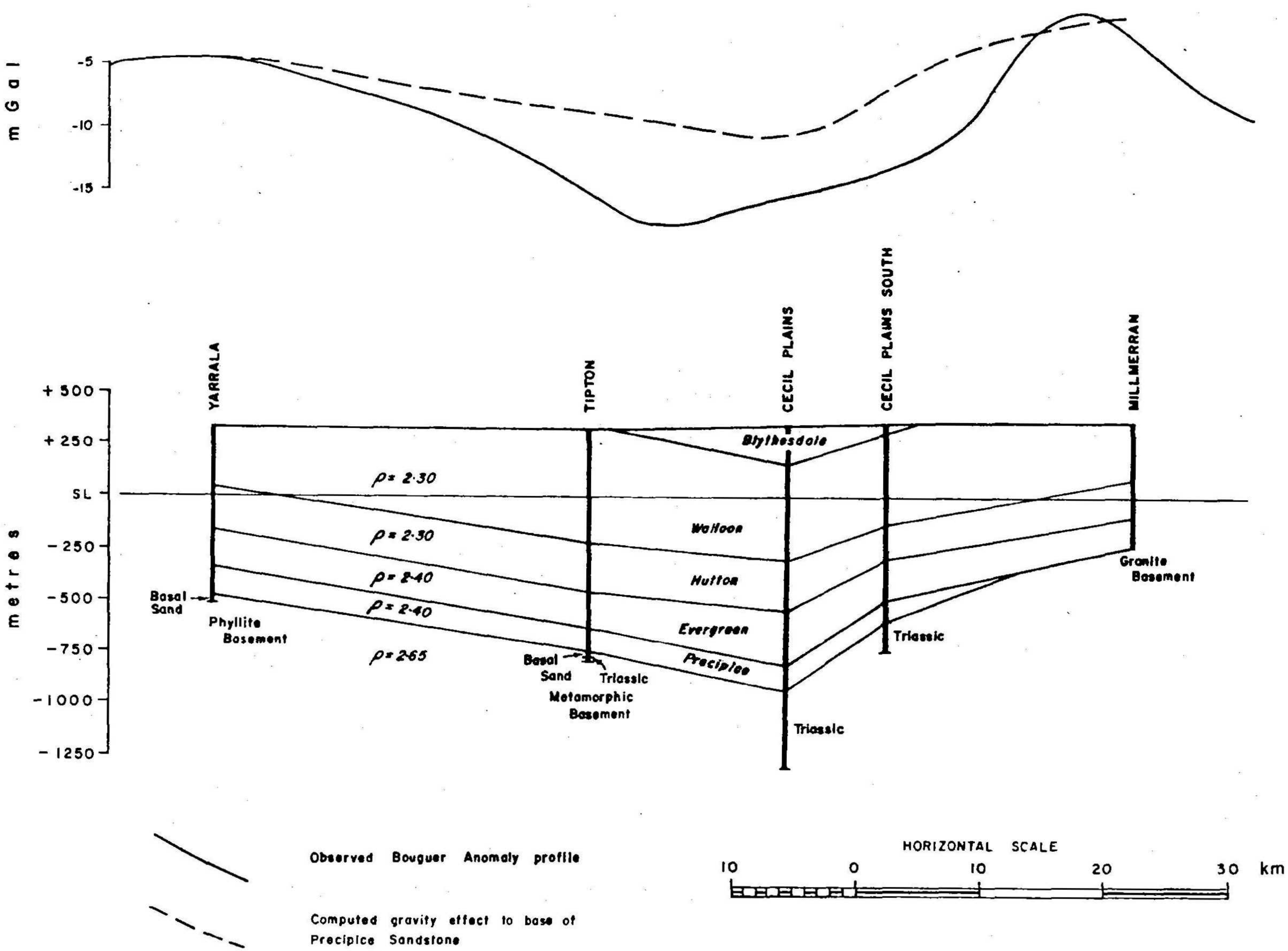


Fig. 9 CORRELATION OF BOUGUER ANOMALIES AND SUBSURFACE GEOLOGY ACROSS THE CECIL PLAINS GRAVITY LOW

Record No. 1975/87

G55/B2-52A

23

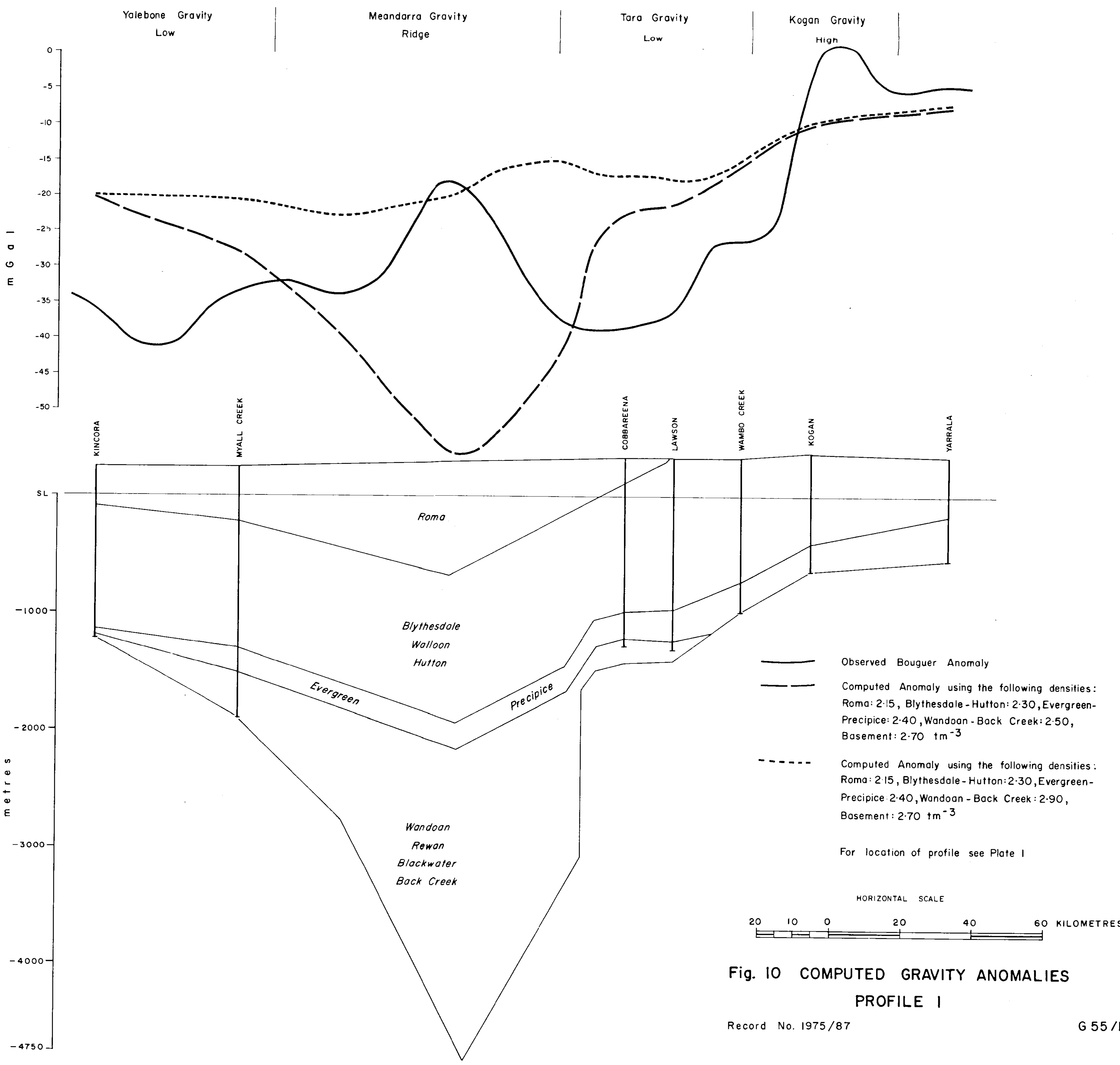


Fig. 10 COMPUTED GRAVITY ANOMALIES
PROFILE I

Record No. 1975/87

G55/B2-54

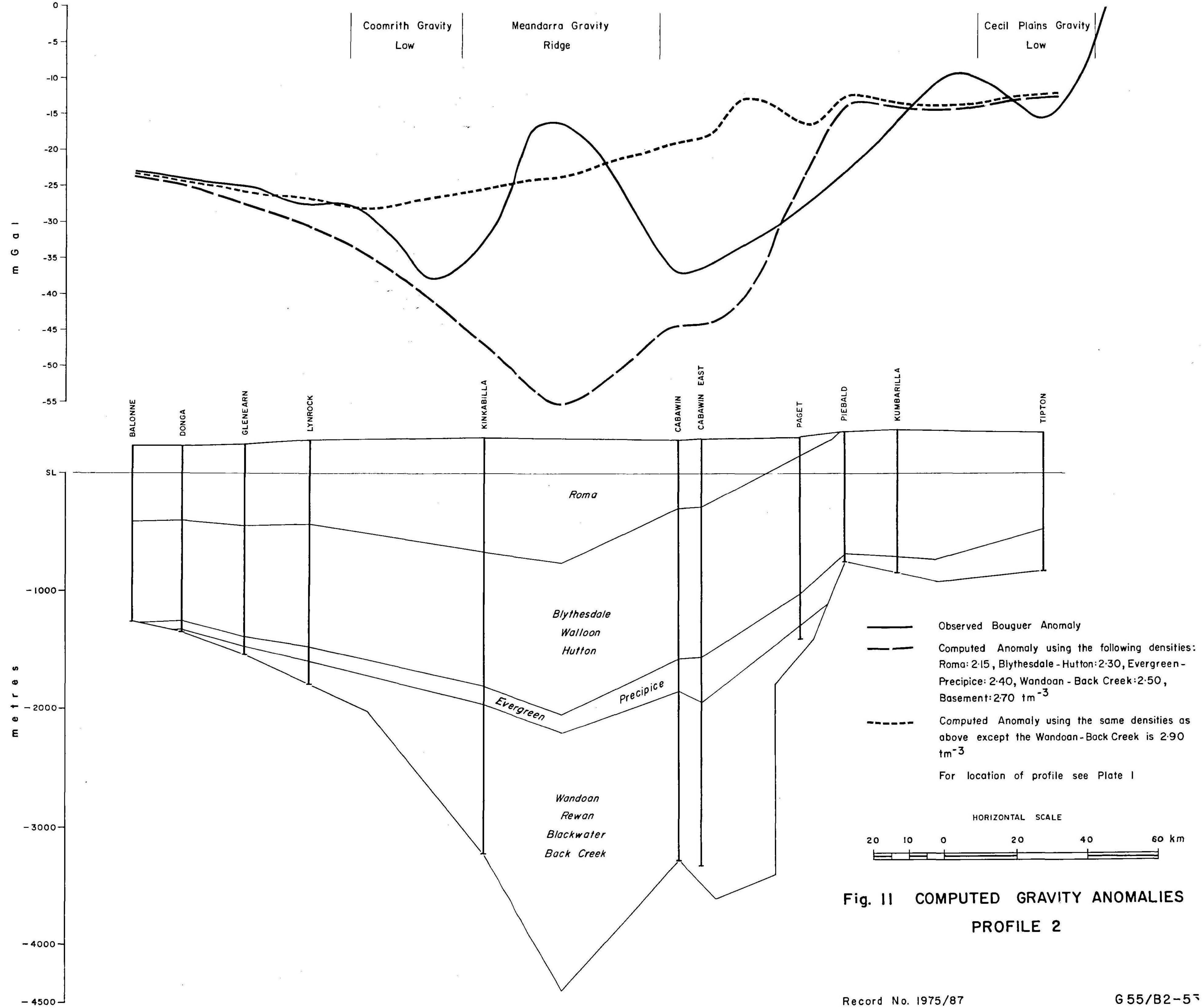


Fig. 11 COMPUTED GRAVITY ANOMALIES PROFILE 2

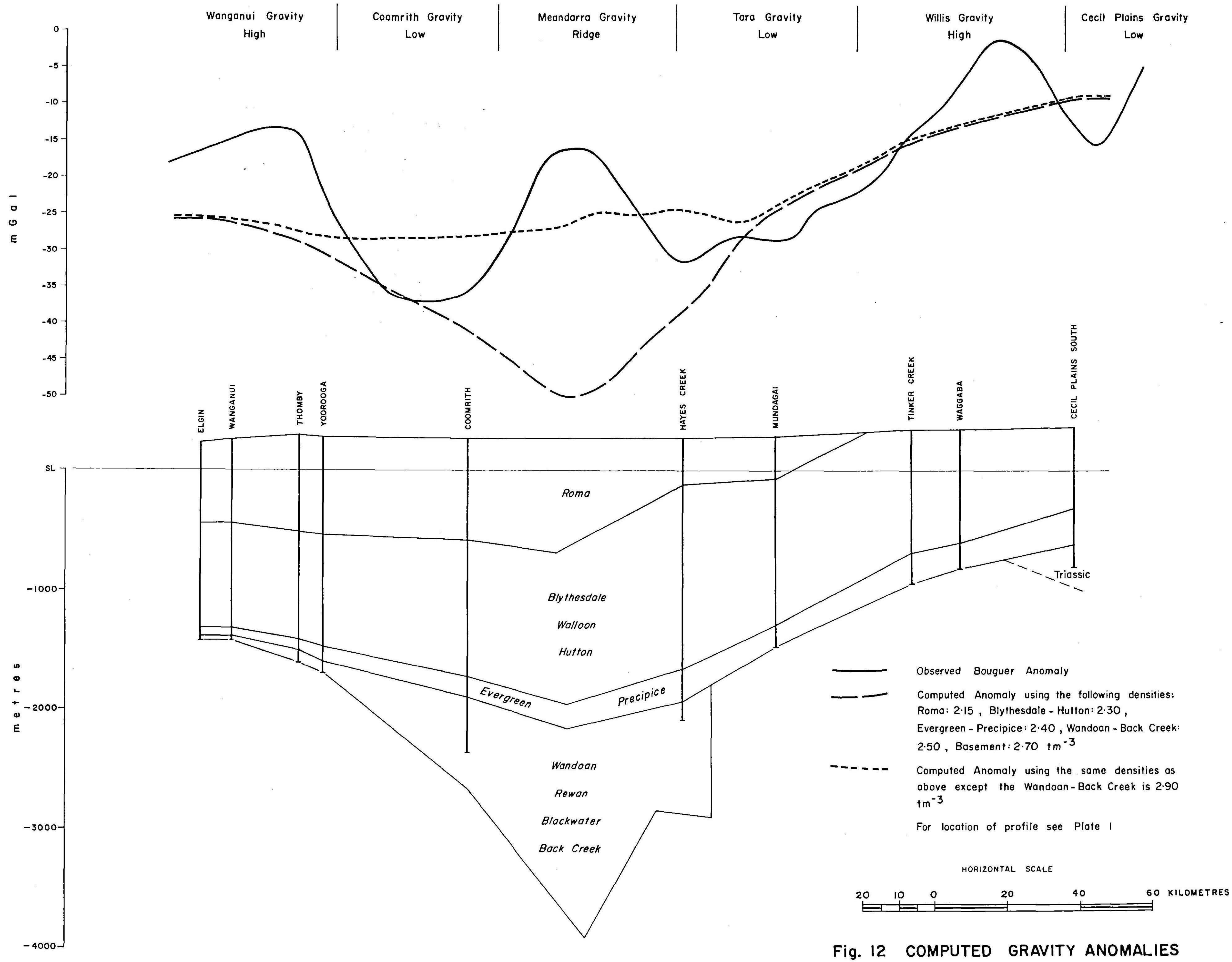


Fig. 12 COMPUTED GRAVITY ANOMALIES PROFILE 3

Record No. 1975/87 G 55/B2-56

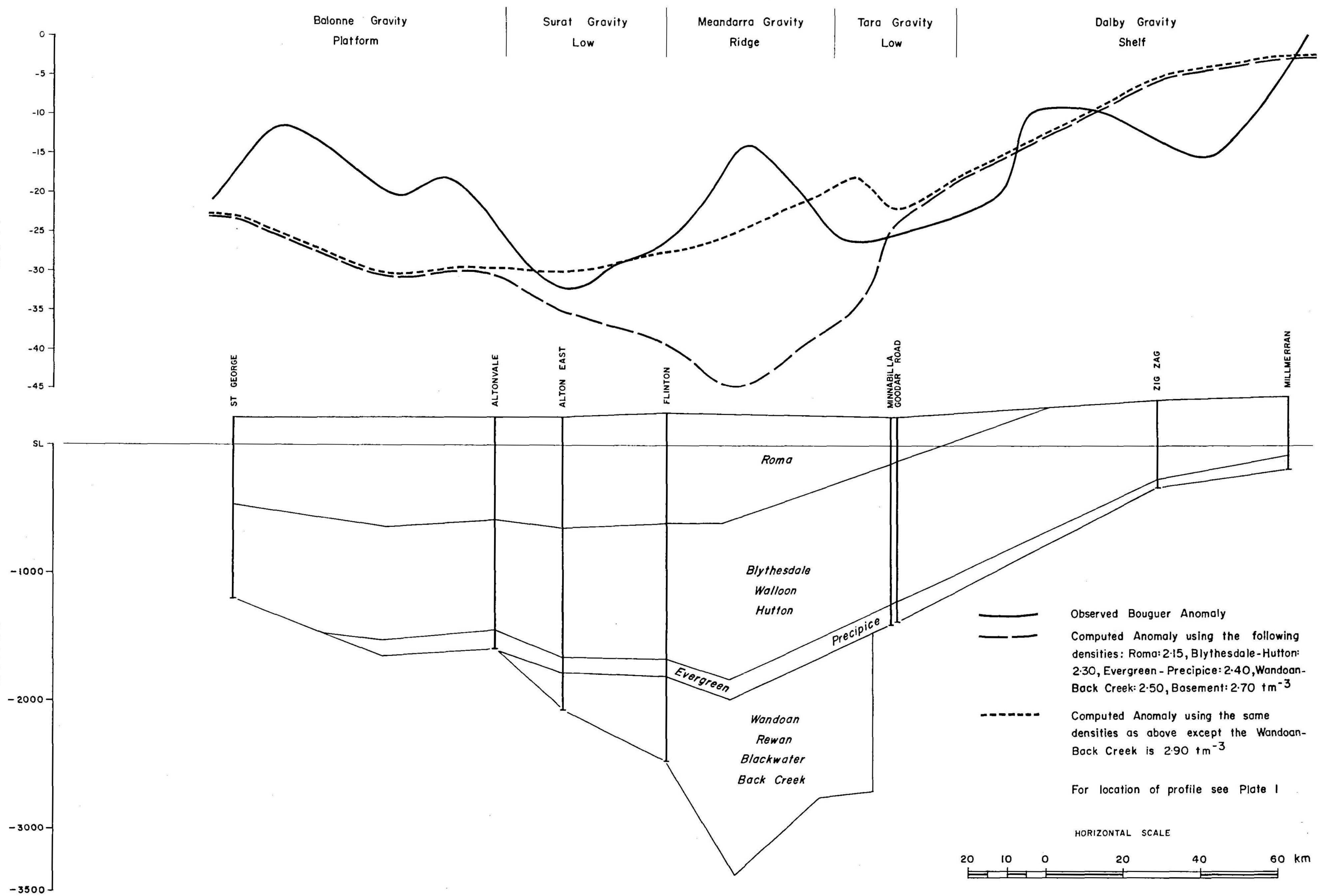


Fig. 13 COMPUTED GRAVITY ANOMALIES PROFILE 4

In Figures 10 to 13, there is little correlation between the observed Bouguer anomaly pattern and that computed for the actual basin structure. Even in the case of Bowen Basin sediments being denser than basement the correlation is not improved. The best correlation is on the Southern Roma Shelf and the Dalby Shelf, where the residuals have been explained as being caused by granites and high-grade metamorphics. From inspection of Figure 14 it is obvious that the most persistent residual is the Meandarra Gravity Ridge. It is so persistent in amplitude and width over the four profiles that a mean residual can be constructed (Fig. 15) and assumed to be representative of the whole area.

This mean residual is symmetrical and is suitable for the application of the method of Skells (1963) for determining the maximum depth to the source of this feature. If it is assumed that the source is a two-dimensional rectangular prism with a density contrast of 0.20 tm^{-3}, which is possibly a minimum density contrast with the basement, then the maximum depth to the top of the prism is 7560 m, the maximum depth to the bottom is 14 200 m, and the maximum width is 28 500 m. A diagrammatic representation of the prism is shown in Figure 15. These limits on the depth of the body suggest that the source of the Meandarra Gravity Ridge is within the crust and is not caused by an upwarp in the mantle, unless the mantle here is at an uncommonly shallow depth.

The Meandarra Gravity Ridge is probably due to a dense mass within the basement. One possible interpretation is that the mass is a thick pile of Lower Bowen Volcanics (Kuttung Formation) underlying the Permian Back Creek Formation. It is pertinent to note that Malone et al (1966) have recorded that at least 3660 m of Lower Bowen Volcanics are present on south BOWEN to the north of the area under consideration in this report. A large positive Bouguer anomaly feature is associated with these volcanics. A suggested shape and depth of burial for the causative body of the Meandarra Gravity Ridge is shown in Figure 16. This body has been superimposed upon the basin structure for Profile 3. A simple body shape has been assumed because the observed gravity data, and the assumptions made to obtain the residual Bouguer anomaly profile, do not justify more complexity. A reasonably good fit has been obtained, using a density contrast of + 0.30 tm^{-3}, between the postulated volcanics and basement. This contrast may be rather high, and if so the thickness of the causative body would have to be increased.

Beloussov (1962, p. 647) states 'extensive lava flows several kilometres thick and scores or hundreds of square kilometres in area are known.....Nearly every geosyncline affirms the general rule that the intensive volcanic activity during the early stages of the geosyncline is related to its subsidence. The chemical composition of the magma....gradually changes: it begins with the eruption of basic or intermediate lavas and ends with acidic magmas....' Therefore the concept of a large thickness of volcanics beneath the axis of the Bowen-Surat Basin on DALBY is supported by observations worldwide.

There is also a large Bouguer anomaly high on BOWEN (Darby, 1966). This can be traced, although discontinuous in parts, south to central CHINCHILLA (Lonsdale, 1965). The whole of this band of Bouguer anomaly highs may be correlated with exposed or buried basic volcanic rocks, and if so may well mark a former axis of subsidence within the Tasman Geosyncline.

The northern end of the volcanic pile postulated to explain the Meandarra Gravity Ridge is offset about 150 km to the southwest from the southern end of the other proposed volcanic pile extending discontinuously from BOWEN to CHINCHILLA. This indicates either two separate epochs or areas of extensive volcanism, or a once-continuous volcanic zone that was split by a large transcurrent fault before deposition of the Bowen Basin sediments. The direction of relative movement would have been to the northeast for the northern block; the trend of this possible fault is parallel to the dominant northeast Bouguer anomaly trends on BOURKE and ENNGONIA (Darby, 1969) and on northeast CHINCHILLA (Lonsdale, 1965).

It can be seen from Profiles 1 to 4 (Figs. 10 to 13) that there is no Bouguer anomaly feature that can be correlated with the Goondiwindi-Moonie Fault Zone on DALBY. In general terms there should be some gravity expression of this Fault Zone, unless the density of the Bowen Basin sediments is the same as that of basement. In such a case the computed gravity profiles in Figures 10 to 13 would be the mean of the two computed profiles shown. However, whichever density distribution is assumed there is no observed gravity expression of the Fault Zone. Bouguer anomaly features in this zone are therefore attributed to density changes within the basement which mask the expected Bouguer anomaly expression of the Fault Zone.

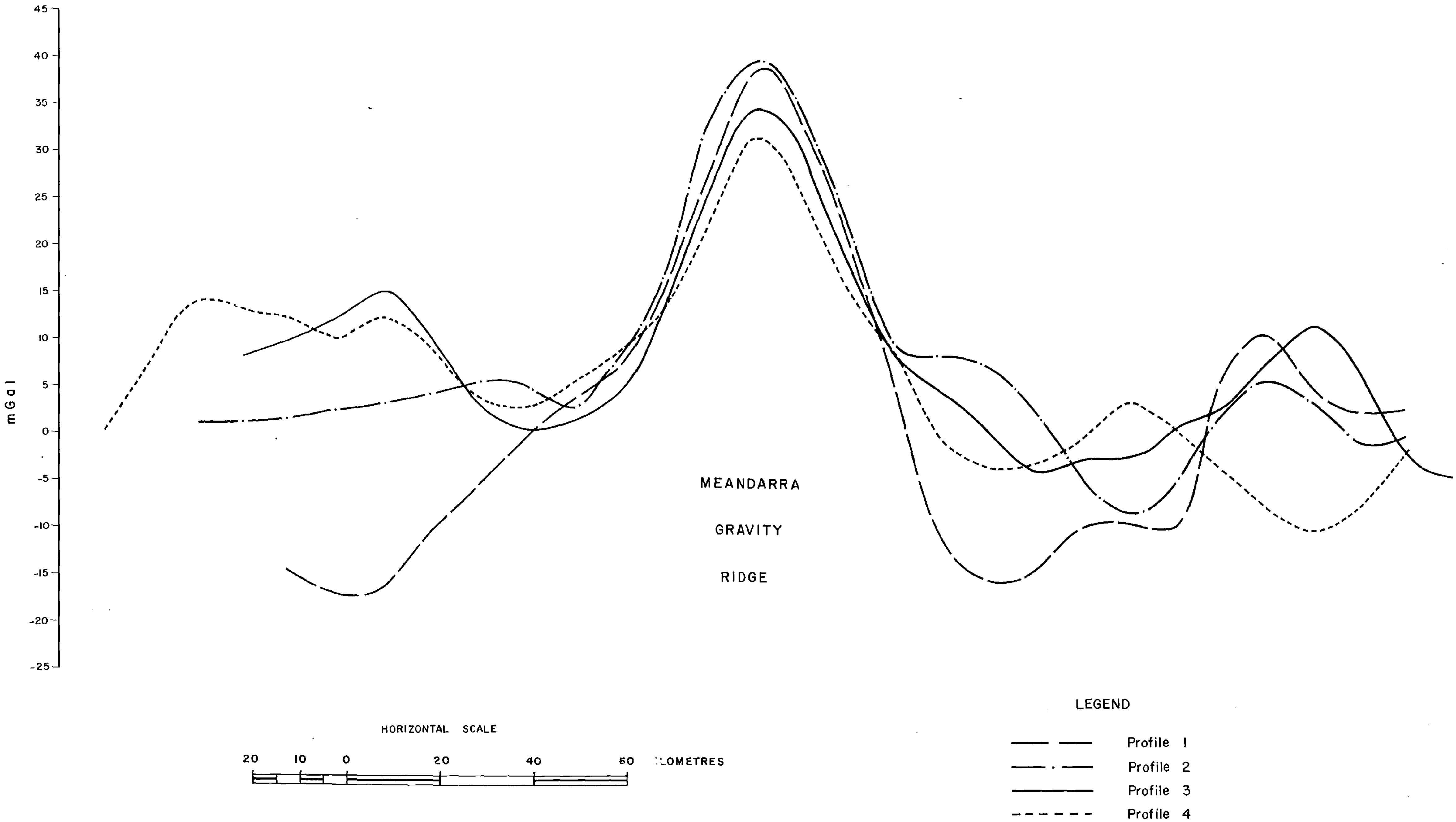
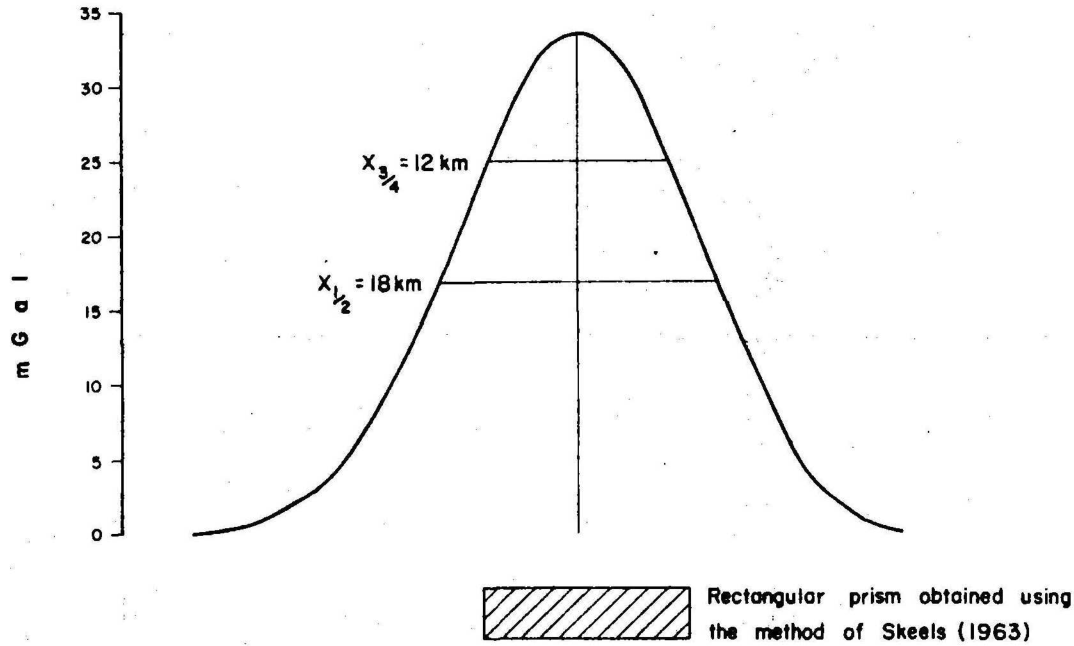


Fig. 14 'RESIDUAL' BOUGUER ANOMALIES



Δg_{max} = 33·5 milligals

$F = X_{3/4} / X_{1/2}$ = 0·67

$M = \Delta g_{max} / X_{1/2}\ \Delta\rho$ = 9·3 (assume $\Delta\rho$ = 0·2)

N = 0·42

D_1 = 7·56 kilometres (7560 m)

D_2 = 14·26 kilometres (14 200 m)

W = 28·52 kilometres (28 500 m)

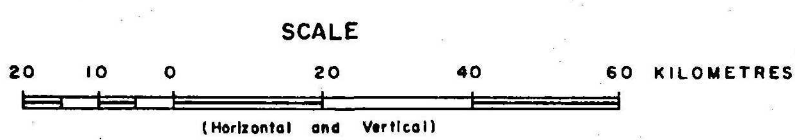


Fig. 15 MEAN 'RESIDUAL' BOUGUER ANOMALY PROFILE OF THE MEANDARRA GRAVITY RIDGE

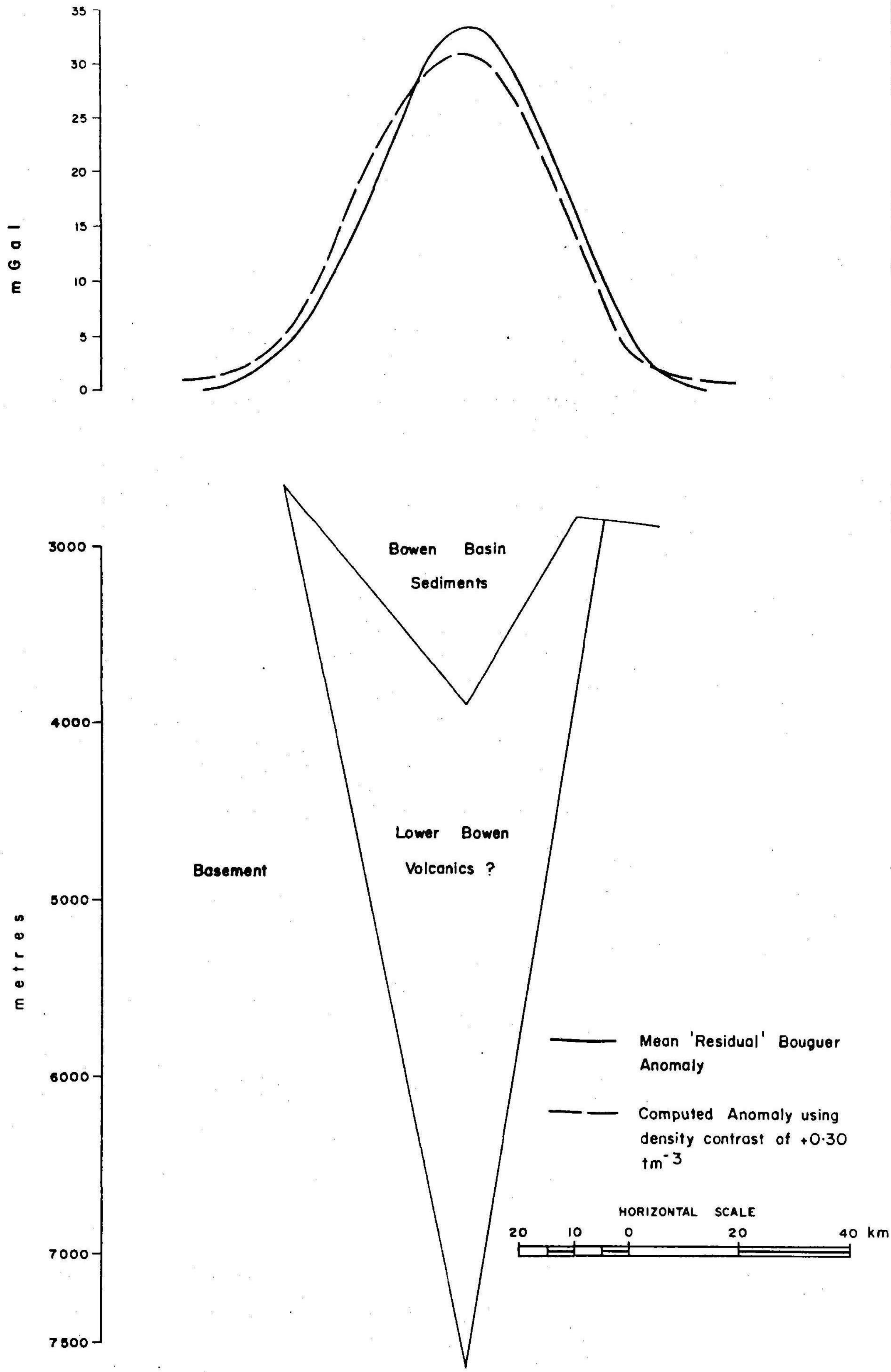


Fig. 16 INTERPRETATION OF THE 'RESIDUAL' BOUGUER ANOMALY PROFILE ACROSS THE MEANDARRA GRAVITY RIDGE

Record No. 1975/86 G55/B2-60A

CONCLUSIONS

The Bouguer anomaly features on SURAT and DALBY have been interpreted in terms of both known and inferred geological structures in and beneath the Bowen-Surat Basin.

All available density measurements on the rocks in the Bowen-Surat Basin have been analysed, and a normal density distribution indicating an increase in density with age and with depth of burial is suggested.

The major conclusions are:

1. There is good correlation between depth to basement and Bouguer anomaly values on the Southern Roma Shelf and the Dalby Shelf. When the depth to basement is compared with 30-minute mean Bouguer anomaly values this correlation is enhanced, indicating that Bouguer anomaly 'residuals' from the correlation curve are related to density changes within the basement. This is confirmed in some places, e.g. on northwest SURAT, where the Yalebone Gravity Low is correlated with granitic basement.

2. The Meandarra Gravity Ridge cannot reasonably be explained by postulating that the Bowen Basin sediments are denser than the basement. Maximum depth estimates also eliminate the possibility that the Bouguer anomaly feature may be caused by an upwarp in the mantle. The Bouguer anomaly feature is most satisfactorily explained as being due to a thick sequence of at least 3660 m of volcanics (Lower Bowen Volcanics or equivalent) that were deposited during the initial subsidence of the Bowen Basin within the Tasman Geosyncline.

It is tentatively suggested that the Meandarra Gravity Ridge and a Bouguer anomaly high feature extending from BOWEN to CHINCHILLA are genetically related. Both features are probably caused by thick volcanic sequences which formed during initial subsidence within the Tasman Geosyncline. It is not known, however, whether the two features have always occupied their present relative positions or were originally a single feature that was subsequently cut by a major transcurrent fault.

REFERENCES

BELOUSSOV, V.V., 1962 - Basic problems in Geotectonics. McGraw-Hill.

BOTT, M.H.P., & SMITHSON, S.B., 1967 - Gravity investigations of subsurface mass distributions of granite batholiths. Geol. Soc. Amer. Bull., 78, 859-78.

DARBY, F., 1966 - North Bowen Basin reconnaissance gravity survey, Queensland, 1963. Bur. Miner. Resour. Aust. Rec. 1966/209 (unpubl.).

DARBY, F., 1969 - Reconnaissance helicopter gravity surveys, northern New South Wales and southern Queensland, 1968. Bur. Miner. Resour. Aust. Rec. 1969/109 (unpubl.).

EXON, N.F., 1974 - The geological evolution of the southern Taroom Trough and the overlying Surat Basin. APEA J. 14(1), 50-58.

EXON, N.F., in press - The geology of the Surat Basin in Queensland. Bur. Miner. Resour. Aust. Bull. 166.

FRASER, A.R., DARBY, F., & VALE, K.R., in prep. - A qualitative analysis of the results of the reconnaissance gravity survey of Australia. Bur. Miner. Resour. Aust. Rep.

GIBB, R.A., 1968 - The densities of Precambrian rocks from northern Manitoba. Can. J. Earth Sci. 5(3), 433-38.

LONSDALE, G.F., 1965 - Southern Queensland contract reconnaissance gravity survey using helicopters, 1964. Bur. Miner. Resour. Aust. Rec. 1965/251 (unpubl.).

MALAHOFF, A., & MOBERLY, R., Jnr., 1968 - Effects of structure on the gravity field of Wyoming. Geophysics, 33(5), 781-804.

MALONE, E.J., JENSEN, A.R., GREGORY, C.M., & FORBES, V.R., 1966 - Geology of the southern half of the BOWEN 1:250 000 Sheet area, Queensland. Bur. Miner. Resour. Aust. Rep. 100.

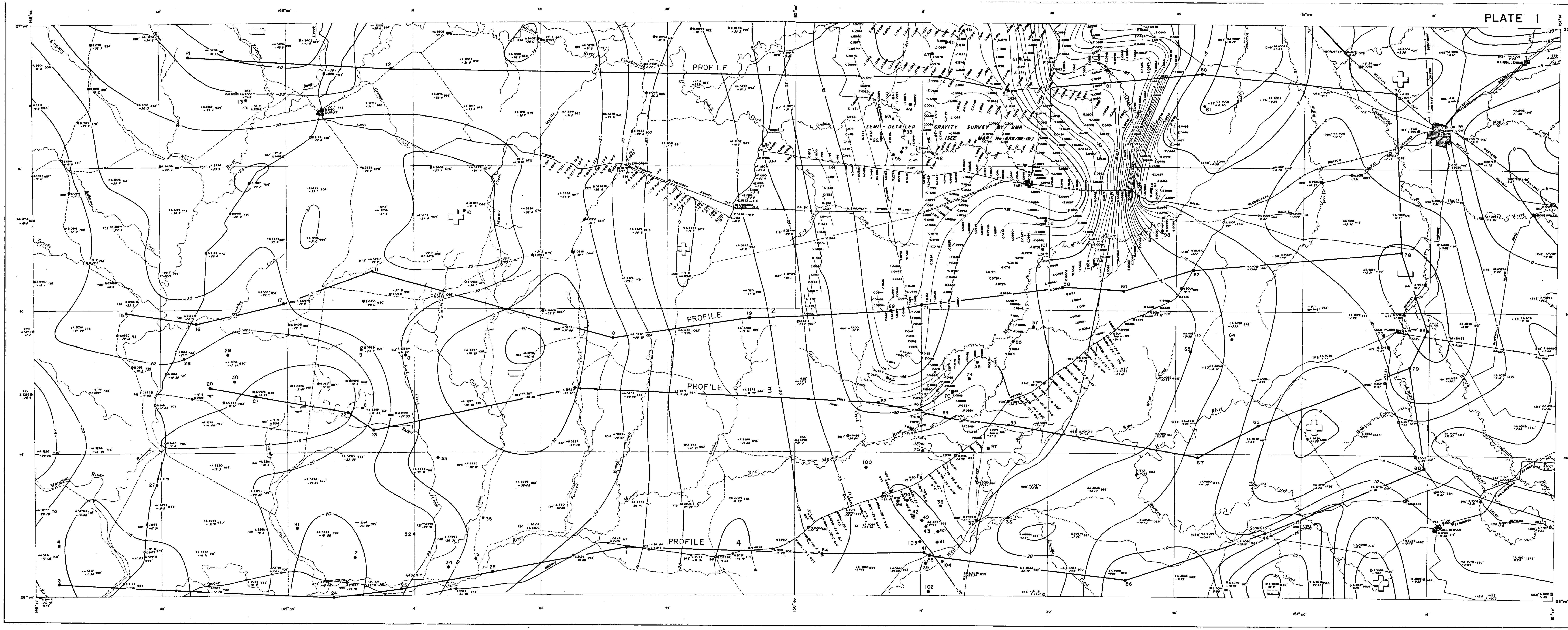
MOND, A., 1973 - Dalby, Qld - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SG/56-13.

REISER, R.F., 1971 - Surat, Qld - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan Notes SG/55-16.

SKEELS, D.C., 1963 - An approximate solution of the problem of maximum depth in gravity interpretation. Geophysics, 28(5), 724.

THOMAS, B.M., & REISER, R.F., 1968 - The geology of the SURAT 1:250 000 Sheet area, Queensland. Bur. Miner. Resour. Aust. Rec. 1968/56 (unpubl.).

PLATE 1



BORE HOLES

1. FLINTON
2. MOOMBAH
3. ST. GEORGE
4. MARONOA
5. ALTON No.1
6. WUNGER
7. COOMRITH
8. BIDGEL
9. BOGGO CREEK
10. WERIBONE
11. LYNROCK
12. MYALL CREEK
13. COLGOON
14. KINCORA
15. BALONNE
16. DONGA
17. GLENEARN
18. KINKABILLA
19. MIRRI MIRRI
20. ELGIN
21. WANGANUI
22. THOMBY
23. YOOROOGA
24. MT DRIVEN
25. ALTONVALE
26. ALTON EAST
27. KATOOTA
28. WARROO
29. MOULLIT
30. MAJOR No.1
31. GOULAMAIN
32. TRALEE
33. DALKEITH
34. ALTON WEST
35. KOOROON No.1
36. WEIR
37. BOOROONDOO
38. DOCKERILL
39. WARRIGABIE
40. IMINBAH
41. MINNABILLA
42. CROWDER N.
43. CROWDER
44. ZIG ZAG
45. CONDAMINE
46. MILES CREEK
47. COOLOOMALA
48. UNDULLA
49. TEY
50. LAWSON
51. WIEAMBILLA
52. TARA
53. SOUTHWOOD
54. TARTHA
55. TOOMBILLA
56. LIDDELL
57. TOOMBILLA E.
58. PAGET
59. MUNDAGAI
60. PIEBALD
61. KOGAN S.
62. KUMBARILLA
63. CECIL PLAINS
64. DURABILLA
65. DURABILLA W.
66. WAGGABA
67. TINKER CREEK
68. KOGAN
69. CABAWIN
70. MIDDLE CREEK
71. CABAWIN E.
72. COBBAREENA
73. MARMADUA
74. BRIGALOW CREEK
75. MOONIE
76. YARRALA
77. CECIL PLAINS W.
78. TIPTON
79. CECIL PLAINS S.
80. MILLMERRAN
81. WAMBO CREEK
82. HAYES CREEK
83. MOONIE NORTH
84. CURRAJONG
85. GOODAR ROAD
86. URANILLA
87. BENNETT
88. BENNETT NORTH
89. BRAEMAR
90. CROWDER E.
91. CROWDER S.
92. DAVIDSON
93. HUMBUG CREEK
94. KILLALOE
95. LEICHHARDT
96. PRING
97. RETREAT
98. ROCK CREEK
99. ROGERS
100. SUSSEX DOWNS
101. TARA SOUTH
102. WIDGEWA
103. WILLOWBE
104. WYBAR

LOCATION DIAGRAM

REFERENCE TO AUSTRALIA STANDARD MAP SERIES

MITCHELL	ROMA	CHINCHILLA	GYMPIE
HOMEBOIN	SURAT	DALBY	IPSWICH
DIRRANBANDI	ST GEORGE	GOONDIWINDI	WARWICK

Projection: Transverse Mercator, Australia Series
Planimetry: After the Queensland State Department of Public Lands 2-mile cadastral maps
Elevation datum: Queensland State
Station Bouguer Anomaly reliability Standard Deviation ≃ 1 milligal

BOUGUER ANOMALIES

1:500 000

5 0 5 10 15 20 MILES
5 0 5 10 15 20 25 30 KILOMETRES

Contour interval 5 milligals

KEY TO GRAVITY STATION NUMBERING ON SURAT
A=6403, B=6402, C=6003, E=6316, G=6005, N=6308

KEY TO GRAVITY STATION NUMBERING ON DALBY
A=6403, C=6313, D=6003, E=6312, F=6311, G=6005, H=6310, N=6308

TOPOGRAPHY

- Built-up area
- Homestead
- Railway
- Drainage
- Principal road
- Minor road
- Track

GRAVITY

- Gravity station
- Permanently marked gravity station
- 12.3 Bouguer anomaly (milligals)
- 825' Elevation (feet)
- -5- Isogals
- 'High' anomaly
- 'Low' anomaly

Bouguer anomalies are based on the 1962 observed gravity values at pendulum gravity base stations in and near the area. Reference: BMR Report 72

For the calculation of Bouguer anomalies 2·2 t m^{-3} has been adopted as an average rock density

Geophysical field data from BMR gravity and microbarometer surveys 1960 to 1964

Elevation control by Department of Interior levelling

Record No. 1975/87

G55/B2-53