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GRAVITY SURVEY OF NORTH-EASTERN TASMANIA

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ABSTRACT

A gravity survey across north-eastern Tasmania has shown that the Blue Tier and Scottsdale 'plutons' are true batholiths while the granodiorite 'plutons' are thick irregular sheets. The granodiorite intrusions have been disrupted by granite diapirs forming the Blue Tier massif. Late stage tin-bearing intrusions have the form of pipes.

Tertiary sediments up to 600 m thick occupy restricted fault controlled basins.

INTRODUCTION

North-eastern Tasmania, is designated as that area north and east of 41°15'S, 147°30'E which includes the Boobyalla, Ringarooma, Blue Tier and Eddystone quadrangles.

The region is characterised by two topographic regimes; the rugged, elevated hinterland of the granite massif at Blue Tier and the broad coastal lowland which encircles it. In general the topography is slight and the relief low. Vehicular access within the area is variable and some parts are virtually inaccessible.

North-eastern Tasmania is the second of a series of areas to be covered by systematic gravity surveys at a scale of 1:250 000. Regional gravity surveys of this type are valuable in providing control for detailed surveys and aiding in structural interpretations of the geology, especially where outcrops are restricted and direct structural observation is limited. This area is of considerable interest since some Bass Strait structures impinge onto mainland Tasmania.

The map (fig. 1) is a compilation of surveys by Leaman and Jordan (1973) and the authors. Other than the gravity surveys incorporated in the map, negligible regional geophysical work had been undertaken although small areas have been extensively surveyed using shallow seismic and resistivity methods. However, probing by such methods and any drilling, has rarely exceeded 100 m.

Acknowledgement is given to W.R. Moore, Dr E. Williams and D.J. Jennings, for background information on the area.

GEOLOGY

Most of the region has been mapped but the geological detail has been variable. Groves (1974) has prepared a detailed sketch map at 1:126 720 while the Regional Section of the Geological Survey has produced a generalised map at 1:250 000 scale based on limited mapping at 1:63 360. Only the mapping of Groves (1974) is referred to below as this is adequate to outline all the principal features of the area that are reflected in the gravity field.

The Recent or Tertiary alluvial tin-bearing deposits in the area are of economic interest while the petrology and structure of the granitic masses is of more academic interest. Various types of granitic rocks dominate north-east Tasmania and intrude folded slate, greywacke, sandstone and quartzite of the Lower Palaeozoic Mathinna Beds. Upper Palaeozoic and Mesozoic rocks are rarely present and are most abundant at Waterhouse and around Cape Portland. Tertiary lead and lake deposits, sometimes overlain by basalt, cover much of the granite basement. This cover is quite thin, usually less than

50 m but thicker deposits have been found in the valleys of the Great Forester and Ringarooma Rivers. Much of the intrusion and fold detail is concealed by the Tertiary rocks and the more recent and widespread cover of Quaternary sand.

Figure 3 presents the geology of the region in a simplified form.

STRATIGRAPHY

Ordovician-Devonian

The Mathinna Beds, a series of sandstone and slate, possibly up to 15 km thick, range in age from Early Ordovician to Early Devonian. Two major belts of these rocks crop out in this region (fig. 3). Generally metamorphism is apparently slight except in the region between Mt Cameron and Ringarooma Bay.

Granitic rocks, of Late Devonian age, occupy most of the area. A complete classification of rock types has been given by Groves (1974) and the present authors have combined some rock types according to both family relationships and rock type densities (fig. 3). Gee and Groves (1971) have given a brief summary of each pluton and using their terminology the following amalgamations have been made. The Gardens and Pyengana plutons, a biotite-hornblende granodiorite; the Mt William mass, Mt Paris mass and the Lottah Sheets, a biotite-muscovite adamellite and granite; the Poimena, Mt Pierson and Ansons Bay plutons, a biotite granite and adamellite, usually porphyritic.

Permian

Fossiliferous sandstone and shale, occasionally unconformably, overlies all older rocks but outcrops can only be seen near Gladstone and at Tomahawk where it is intruded by dolerite.

Jurassic

Dolerite intruded into Permian rocks as thick sheets has been downfaulted to form coastal exposures at Waterhouse, and Ringarooma Tier.

Tertiary

The dominant materials are sand and clay which are occasionally carbonaceous. The sediments occupy the structural and often erosional depressions produced by Eocene(?) faulting and a lower erosional base. Basalts are commonly found interbedded with, or more usually, overlying the sediments. The sediments have been derived from the weathering products of granitic rocks.

Quaternary

Some alluvial deposits occur in the river valleys but the predominant Quaternary material is windblown sand which is seen over a large part of the area, especially between Bridport and Eddystone Point.

STRUCTURE

The region is dominated by the major intrusions of the Scottsdale and Blue Tier Batholiths (Gee and Groves, 1971). The Blue Tier Batholith is a composite body considered by Gee and Groves to represent a series of more alkali rich intrusions in an environment of regional tension. Probable dilation effects have been noted in the Blue Tier body. No simple description of the structure of the Mathinna Beds is possible. Relatively recent faulting, probably early Tertiary in age, has shattered the area. Much of the recent faulting displays an E-W trend while most of the older structural trends are N-S or NW-SE.

GRAVITY FIELD

SURVEY DETAILS AND ACCURACY

The gravity survey presented is a composite of three major surveys using two different gravity meters. Most of the area was covered with Worden meter no. 273, scale factor 1.008 $\mu m/s^2$/divn and the remainder with Worden meter no. 913, scale factor 0.94 $\mu m/s^2$/divn.

Two base stations have been used, the Bureau of Mineral Resources (BMR) reference station 6491.0171 at Launceston Airport and BMR reference station 6491.9136 at St Helens Airport. The value of the observed gravity at these stations is 9 802.756 4 and 9 803.023 5 m/s^2 respectively. The principal tie station within the area is at a Lands and Surveys Department bench mark in Gladstone where the observed gravity is 9 802.645 6 m/s^2. All stations have been corrected for instrumental drift and loop errors and loop corrections have been made using the methods of Gibson (1941) and Green (1961). The accuracy of the observations is about 0.3 $\mu m/s^2$. No specific corrections have been made for tides and such as may be necessary are considered to have been included within the drift correction.

Stations have been sited, where possible, on State Permanent Marks or Lands and Surveys Department survey spot heights. The elevation of many other stations has been determined using microbarometers. Using overlap control techniques and re-reading of intervals in association with tie elevations, an accuracy of 1.5-2 m is possible. However Symonds (1971) used a base recorder and claimed an accuracy of 3 m for such observations. The accuracy of the Bouguer anomaly thus ranged from 0.2 $\mu m/s^2$ for surveyed stations to 3 $\mu m/s^2$ for most stations and up to 6 $\mu m/s^2$ for some stations west of Winnaleah.

All stations have been located to a minimum accuracy of about 100 m, and some stations have been determined to 50 m using 1:31 680 and 1:15 000 maps. The error in the Bouguer anomaly is about 0.5 $\mu m/s^2$.

All stations have been terrain corrected to a radius of 19 km using the method of Hammer (1939). At this radius the effects of the earth's curvature become significant and the attraction in outer zones becomes constant for large blocks of stations. As a result no further calculation is worthwhile since any errors present are constant over the whole survey as the dimensions of the area covered became small compared with distances to significant features such as the continental shelf. The accuracy of the correction made is estimated at 5% or less, resulting in an error of 0.2-1.0 $\mu m/s^2$ at most stations

The R.M.S. accuracy of the observations at all stations is 3.3-4.0 $\mu m/s^2$ excepting those of Symonds (1971) where it is 5-6 $\mu m/s^2$. A contour interval of 10 $\mu m/s^2$ is thus justified over the greater part of the region but may not be reliable in the south-west portion of the region.

Stations have principally been installed on roads and tracks, as well as along the coastline, at an interval of approximately 1.5 km. Access is generally good in coastal, farming and forested areas but some places are almost inaccessible on foot with a gravity meter. The station distribution and survey origin is shown in Figure 1.

BOUGUER ANOMALIES

SPECIFICATION AND PRESENTATION

The results of the survey have been expressed in terms of the extended Bouguer anomaly, since this is the most direct and useful form of preliminary treatment leading to an interpretation of near-surface crustal features.

A density value of 2670 kg/m^3 has been used throughout the reduction. The density of pre-Permian rocks and continental crustal rocks in Tasmania, in general approximates this value. Deviations from this value in such rocks or in high level younger rocks can be accounted for during residual interpretation.

Contoured total Bouguer anomalies are presented in Figure 1, with a contour interval of 10 $\mu m/s^2$.

REGIONAL SEPARATION

The total Bouguer anomalies (fig. 1) show that the gravity field generally decreases to the south and west, due principally to crustal thickening. The term regional is here applied to that component of the field derived from the core, mantle and lower crust. An averaging procedure was adopted. Initial averaging was based on squares with sides of 5 km in length. Each square included an average of 6 stations. In those cases where no stations fell in a square a reasonable value was included based on the surrounding values. The averages obtained were then re-calculated using squares of 16 times the area. This is a crude but effective filter (for theory see St John, 1967). A uniform distribution of points is desirable for the most effective filtering. Two major problems with the method involve selection of the area-average factor and estimation of edge effects. In this case edge effects in the west of the area have been overcome by referring to data by Leaman, Symonds and Shirley (1973). The regional field obtained by this method is shown in Figure 2, and can be seen to contain significant variations in gradient and trend. West of the area the gradient is directly NW-SE (Leaman, Symonds and Shirley, 1973), whilst to the south the gradient is E-W (see Cameron, 1967; Johnson, 1972). Only part of these effects can be seen in the region covered here. An interpretation of this confused gradient is given on page 7.

DESCRIPTION OF RESIDUAL ANOMALIES

Figure 3 presents the residual Bouguer anomaly field as obtained from the total field (fig. 1) by removal of the regional contribution (fig. 2). Several features may be noted. A major depression is at Boobyalla (-100 $\mu m/s^2$) but most of the anomalies are moderate (-50 to +60 $\mu m/s^2$) and related to granitic bodies or the Mathinna Beds. Tertiary sediments cause some masking of anomalies that are due to other causes, especially west of Ansons Bay.

INTERPRETATION

ROCK DENSITIES

The results of density determinations upon rock formations occurring throughout the region are presented in Table 1. Most averages are based on more than 25 samples. Unless otherwise indicated determinations have been made on water saturated and, where possible, fresh samples of up to 5 kg.

GENERAL

Interpretation of the gravity field of this region is possible at two levels, one represented by the total Bouguer anomaly-regional Bouguer anomaly pattern and the other by the residual Bouguer anomaly.

Using the residual anomaly it is possible to estimate the effects of all near-surface structures but the contrasts can only be valid for a maximum depth of about 3 km. For example, the anomaly over much of the Blue Tier massif of porphyritic granite-adamellite is about -20 to -30 $\mu m/s^2$. Given the contrasts present this could imply a sheet of material about 2 or 3 km in thickness. However, when the regional field is examined it is found that strong gradients are present which could only be produced by features at depths of up to a maximum of 10-15 km. Further, the massive negative anomaly observed is consistent with a batholithic structure type larger than the outcrop pattern would suggest. For these reasons two types of interpretation are given; a broad crustal model incorporating all features in a simplified way and compared with the total Bouguer anomaly and a more detailed analysis of certain high level features clearly outlined in the residual Bouguer anomaly. The regional separation appears to be valid as the residual anomalies correlate well with geological features and the overall regional shape is compatible with the known geology. For example, the strong arched swing in contours from west to east is suggestive of termination of the lighter granite extrusion, a feature clearly seen between Bridport and Waterhouse where the granodiorite 'wraps around' the adamellite. As the adamellite is younger this is consistent with a northward termination.

For clarity of presentation and to enable the structure to be examined as a whole, the western part of profiles AB and CD has been taken from the earlier survey to the west (Leaman, Symonds and Shirley, 1973). The interpretation given earlier is unaltered although it is admitted that the mass of granodiorite implied near Lefroy may be very large. The regional pattern of that survey is dominated by the nearness of the batholith to the east (see also Longman and Leaman, 1971).

INTERPRETATION OF RESIDUAL ANOMALIES

A review of the residual Bouguer anomalies and simplified geology reveals the following correlations and observations.

(1) The 'Scottsdale Batholith' with variable Tertiary overlay has a maximum anomaly of -60 $\mu m/s^2$. This value could only imply a very few kilometres of granite, as discussed above. The eastern margin of the intrusion is clearly defined by a strong positive gradient.

(2) The 'Bridport granodiorite' with Tertiary cover is seen on the arc from the western edge of the map along the coast and around the Great Forester River as small positive anomalies of up to +20 $\mu m/s^2$.

Table 1. BULK WET DENSITIES

Rock unit	Density range kg/m^3	Average density kg/m^3
Tertiary		
clay, sandy clay	1820-2000	1920
sand	2000-2200	
basalt (solid)	2900-3100	
basalt (scoriaceous)	2500-2900	
Jurassic		
dolerite	2750-3200	2900
Permian		
mudstone, sandstone	2460-2520	2500
Devonian		
Bridport granodiorite	2690-2720	2700
Pyengana-Gardens granodiorite	2690-2720	2700
Scottsdale granite-adamellite	2590-2650	2620
Mt Paris granite-adamellite	2610-2630	2620
Poimena porphyritic granite-adamellite		2620
Ordovician-Devonian		
'Mathinna Beds'	2440-2830	
West of Scottsdale	2500-2710	2570
South of Ringarooma	2690-2820	2670-2710
quartzites (metamorphosed)	2650-2700	2810
pelites (metamorphosed)	2790-2820	

In each of the above cases, Tertiary lead systems make the anomaly pattern irregular and the values lower. The plateau of Tertiary sediments centred around 147°37'E, 41°7'S accounts for most of the -50 μm/s^2 observed due mainly to the reduction of positive anomalies over granodiorite. The direct effect of the 'Scottsdale batholith', in its higher levels, is only seen south of 41°13'S.

(3) The belts of Mathinna Beds extending from Waterhouse to Derby-Winnaleah, from Tomahawk to Mt William and near Ansons Bay each show positive anomalies, up to +80, +50, +30 μm/s^2 respectively. The bounds of these anomalies are clearly specified only in the first case since there is insufficient survey data elsewhere to examine the anomaly correlation in detail. The size of these anomalies shows that each block of rocks has a maximum thickness of about 4 km when contrasted against granite-adamellite and 5 km against granodiorite. Lighter belts of Mathinna Beds with a density less than 2620 kg/m^3 are not indicated but could be present. However if these blocks are large roof pendants then it is likely that metamorphism would increase the density to a minimum of 2660-2700 kg/m^3 and the above conclusion would apply. (Compare structures west of Bridport in Leaman, Symonds and Shirley, 1973).

(4) The Tertiary lead system south-west of Derby has no significant gravimetric effect, implying that little material is present.

(5) The Mt Paris intrusion has an anomaly comparable to the Blue Tier mass and there is no large positive reduction due to the Mathinna Beds in this region which clearly form a thin roof.

(6) The dolerite at Croppies Point and much of Cape Portland, has contributed little. With the possible exception of Ringarooma Tier only the basal part of a sheet can be present.

(7) The granite-adamellite mass extending from Blue Tier to Croppies Point, has in general, anomaly values of -20 to -30 $\mu m/s^2$. Exceptions are found south-east of Tomahawk, where a thick, narrow wedge of Mathinna rocks is present, and at Lottah. In the latter case there is an approximately circular anomaly of -60 $\mu m/s^2$. The area is marked by the presence of many sheets ('tin granites') and greisens, and it seems that these materials are more potassic, more acid and lighter than the surrounding adamellite. Further, such an anomaly must be related to a thick accumulation of sheets or a grouping of feeding pipes. The correlation between tin workings and anomaly is too precise for any other explanation. There is a similar, but smaller, negative anomaly at Mount Cameron where other potassic rocks comparable with the Lottah Sheets occur. Small positive anomalies near Pioneer and Winnaleah suggest the presence, at shallow depths, of sunken blocks of Mathinna Beds or granodiorite. The thickness of such fragments could not exceed one kilometre. Some other irregularities are presumably related to the Tertiary sediments and irregular basalt cover. The anomaly distribution is such that the possibility of major lead systems is excluded and the sediments at South Mount Cameron and Winnaleah-Herrick must be discrete basin deposits. This is suggested by the two separate slightly negative anomalies.

(8) The most obvious anomaly (-100 $\mu m/s^2$) in the area occurs between Boobyalla and Gladstone. It has been discussed elsewhere (Leaman, 1973*a*, 1973*b*; Moore and Leaman, 1974) and a thickness of 500-600 m of sediment is suggested on refraction and reflection evidence. It is flanked by positive anomalies which may be entirely due to Mathinna Beds. The positive anomaly on Ringarooma Tier may be due to a small dolerite feeder but this is probably unlikely in view of the anomaly pattern to the east and the overall outcrop pattern of granite and intruded rocks.

(9) Anomalies over the Ansons Bay and Great Musselroe intrusions are small and negative, typical of the large masses since the contrast with the density assumption is small.

(10) The Gardens Pluton of granodiorite provides one of the best correlations of geology and anomaly, especially around its northern and western edges. Variable coverings of Tertiary sediments confuse this simple view in places. The maximum relief of the Gardens Pluton in the main granite body is 4 km. The wedge of folded rocks at Ansons Bay is of comparable thickness.

The overall configuration of the structural slabs is shown in Figures 4-6, ENE-WSW sections which most nearly approach two-dimensionality for all components of the model. A very large number of variables is assessed in these models. The models include the Ansons Bay Pluton, part of the Pyengana Pluton, Mt Paris Mass, Ringarooma sedimentary block, Scottsdale Batholith and Bridport Pluton. Although the models presented were calculated using the total Bouguer anomaly profile, the relief of the various fragments can be checked using the residual Bouguer anomaly. A discrepancy of at least 10% can be expected in size estimations due to the use of two-dimensional methods. For example, while the Waterhouse-Ringarooma sedimentary block is an elongate feature, it is variable in width and in the scale of the anomaly. Indeed its thickness north-east of Derby must exceed 4 km, although only 2 km is implied in one section and even less in the other. However, as discussed previously most igneous blocks appear to have a consistent and fairly uniform thickness.

The primary sources of doubt in the interpretation are associated with the detailed shape of the batholith at depth, its depth extent and the form of the Mohorovičić discontinuity. The first two factors are inter-related and tied to the density assumptions made, especially with respect to the upper crust. A reasonable but possibly low value is used in the model and thus the maximum possible depth extent for the batholith is implied. Examination of the anomalies in the region of the 'Scottsdale Batholith' suggests that a depth of 12 km may be too great (see section AB). The western boundary of the batholith dips steeply westward although there is insufficient control on the contours in section CD to confirm this. The shape given for the Mohorovičić discontinuity is simply a fit for the regional lift in anomaly and varies slightly to the north where the dip is slightly less.

The positions of sections AB, CD and EF are shown in Figure 3.

Section AB

That portion of the section west of point A has been taken from the survey of the adjacent area (Leaman, Symonds and Shirley, 1973). To the east, the model included the continental shelf and ocean to 200 km, but this is not shown in Figure 4.

The densities used for high level rocks are based on the averages given in Table 1. A value of 2670 kg/m^3 was chosen for the upper crust since this is about the normal value for the rocks of the area and as far as known is typical for the Precambrian basement in Tasmania. The value of 2850 kg/m^3 quoted for the lower crust was arbitrarily selected and may be a little low. However since there is no independent seismic control in the region no other choice was possible. The value of 3300 kg/m^3 used for the upper mantle is a median of values quoted by mantle specialists. Although estimated, the crustal data is not very relevant since only the continental edge gradient is pertinent and this is a very broad feature upon which upper crustal anomalies are superposed.

The Tertiary sediments which cover the Bridport pluton in the region of the Great Forester River valley (near A, see Leaman and Jordan, 1973) have been assigned a density value of 2100 kg/m^3 due to their sometimes coarse but sandy nature. Not clearly shown in Figure 4 is the shape of the deposit at point A. In general the Tertiary cover is thin, less than 50-80 m, but in this area there is local thickening to 150-200 m.

A density of 2800 kg/m^3 has been used for the roof pendants of Mathinna rocks presuming that such xenoliths, when relatively small, will have been extensively metamorphosed. Since the metamorphism is not always complete in the larger blocks this value will be too high and the interpreted volume too small. Thus the interpretation shows the minimum size possible for the xenoliths. It must be noted however, that such blocks cannot be more than twice the size shown. The Waterhouse-Derby xenolith is very thin in this section since it happens that the section line crosses the narrowest part, which also possesses very little relative positive anomaly. This xenolith obviously varies greatly in shape and depth and is possibly partly intruded by the Bridport granodiorite. This section crosses the northern end of the 'Scottsdale batholith' and there is a sweep of granodiorite around the area to the north.

Between the Poimena and Ansons Bay-Great Musselroe Bay plutons is a further large xenolith. The above comments apply although it is discussed at greater length in section EF.

The anomaly shape, together with the known distribution of materials, especially the light Tertiary sediments, clearly requires that the western margin of the 'Scottsdale batholith' dips steeply to the west. The Tertiary cover makes significant local contributions in this part of the profile but the broad requirements lead to the above conclusion.

The Bridport pluton has a very irregular sheet-like form and the patchy Tertiary cover west of point A serves only to cause greater variation in the anomalies. Apart from the Jetsonville lead (Leaman and Jordan, 1971) most of this cover is less than 20-30 m thick.

The implication of the section is that the several granite-adamellite bodies effectively amalgamated, at least physically if not petrologically, into one large body which extends some 12 km into the crust. Since it is possible that a minimum contrast has been employed in the upper crust (2670-2620 kg/m^3) the depth quoted is a maximum. Since the contrast is unlikely to exceed about 80 kg/m^3 the thickness of granite must be at least 8-9 km.

Section CD (fig. 5)

In general similar comments apply as were stated for section AB. In this section the xenoliths are very much larger and have produced a more distinctive anomaly profile. The conclusions drawn are the same however, and they are not affected in this section by the problems of a significant Tertiary cover. Unfortunately the section of the profile covering the western margin of the 'Scottsdale batholith' is in the wedge of unmapped country between the two gravity surveys considered. The inferred gravity profile, drawn by extension of the linear contours in this region, suggests that the margin dips westward which is in agreement with section AB. The Mt Paris intrusion is gravimetrically indistinguishable from the remainder of the Poimena pluton.

Section EF (fig. 6)

Section EF is drawn through the two major anomalies in the area surveyed. It cuts across the slab of Mathinna Beds at Gladstone twice and the fragments shown join south of the section. As implied by the geology, the eastern portion is a relatively thin roof covering while the western part is a narrow prismatic wedge. The marginal structures of the intrusions between Gladstone and Tomahawk support the interpretation of such an upright wedge.

The Tertiary basin at Boobyalla has been discussed in detail elsewhere (Leaman, 1973*a*, 1973*b*; Moore and Leaman, 1974). The excess mass deficiency on the eastern side has not yet been resolved and this property was discussed in the more detailed original interpretation which, while overestimating the thickness of material, did provide a good indication of shape. A relatively high value for the density of the Tertiary material is now known to be required following a drilling assessment of the top 300 m.

CONCLUSIONS

There is a major granite-adamellite batholith in north-eastern Tasmania composed of several plutons forcibly intruded in a complex tensional environment. This conclusion is based on evidence by Gee and Groves (1971) and the relative mass distribution demanded by the gravity interpretation. The large volume and abrupt termination of all bodies appears to be such that total structural accommodation is unlikely (see also Bott and Smithson, 1967). The overall shape postulated in Figure 5 is very similar to that reduced for the Sierra Nevada batholith (Hamilton and Parkiser, 1965; Hamilton and Myers, 1967).

The Bridport, Gardens and Pyengana granodiorites appear to be parts of large irregular sheets which had a maximum thickness of 4 km. The screens of country rock suggest some spatial if not time separation in intrusion. The sheets thicken southward as do the xenoliths of folded Mathinna Beds.

The petrologically distinctive Mt Paris intrusion is structurally similar to the other plutons in the batholith although the same anomaly pattern would be produced if it were a high level sheet.

The late stage intrusions at Lottah and Mt Cameron, with which tin is related, appear to have emanated from distinct pipe-bearing zones and are not general features.

Tertiary sediments locally produce significant anomalies but the greatest thickness of material is at Boobyalla (550-600 m of sediments).

The 'regional' anomalies of north-eastern Tasmania are dominated by the intercrustal effects of the granite bodies. Thus the irregular contour forms presented by Longman and Leaman (1971) and Leaman, Symonds and Shirley (1973) can be explained. The inversions present are produced by superimposition of middle crust and base crust effects.

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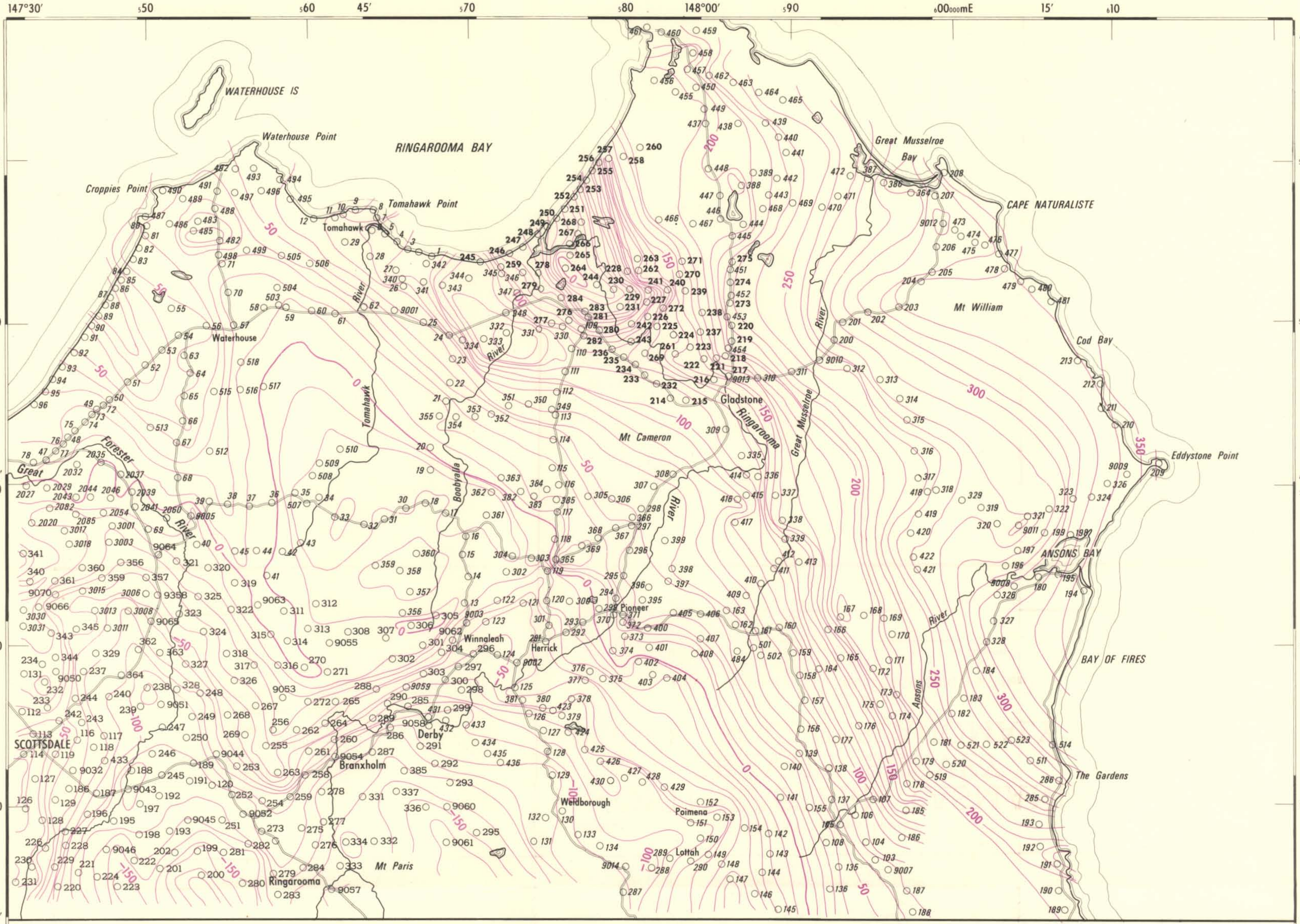
APPENDIX 1

GRAVITY DATA: SELECTED TIE STATIONS

Station	Location	Observed gravity *(m/s²)*	Altitude *(m)*
BLUE TIER 7151.9014	Foot signpost, Goulds Country, high point on Tasman Highway.	9 801.604 2	598.93
FORESTER RIVER 7151.9004	Fireplace, bridge on Bridport-Waterhouse Road.	9 802.726 3	3.04
GLADSTONE 7151.9000	BM, Main Street intersection.	9 802.645 6	67.66
HERRICK 7151.9002	Island, Road junction Highway 3, Gladstone Road.	9 802.435 8	149.96
ST HELENS	BMR mark, airport entrance.	9 803.023 5	
TOMAHAWK 7151.9001	Centre road junction Bridport-Gladstone and Tomahawk turn off.	9 802.611 6	30.48
WINNALEAH 7151.9003	Road junction. Banca 6, Pioneer 8.	9 802.305 2	216.71
ANSONS BAY 7151.9011	Road junction N. Anson Road, St Helens Road.	9 802.840 1	77.41



DEPARTMENT OF MINES – TASMANIA

NORTH-EASTERN TASMANIA GRAVITY SURVEY TOTAL BOUGUER ANOMALY

GEOPHYSICS BY

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DENSITY 2670 kg/m^3
CONTOUR INTERVAL 10 μm/s^2
TERRAIN CORRECTION, R = 19km

ORIGIN OF STATIONS

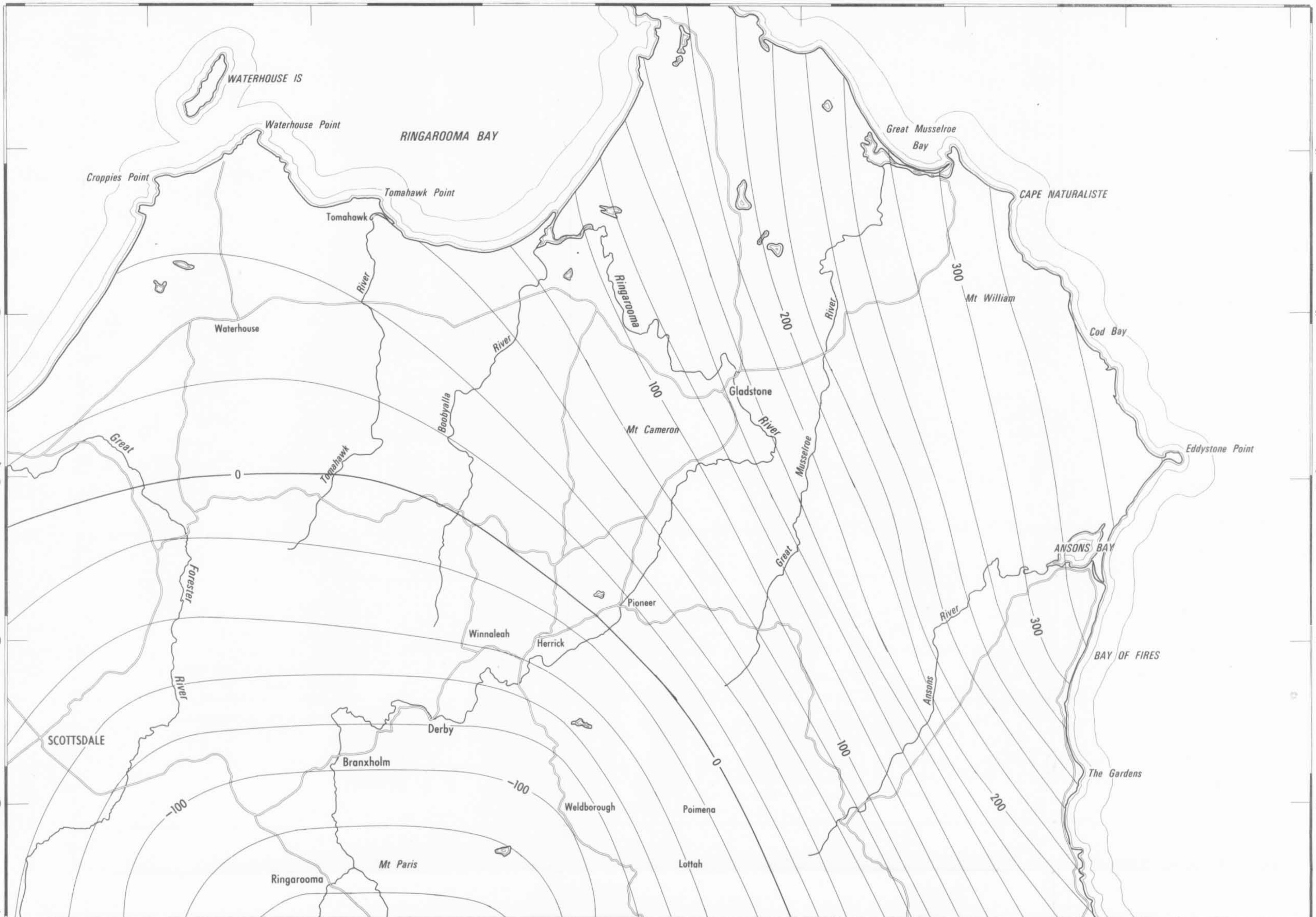
- ○ 320 D.E.Leaman (1972)
- ○ **214** M.J.Longman and D.E.Leaman (1971)
- ○ 292 P.A.Symonds (1970)

Kilometres 5 4 3 2 1 0 5 10 Kilometres

5 cm

Cartography by T.R.Bellis
Published 1974

Figure 1



DEPARTMENT OF MINES - TASMANIA

NORTH-EASTERN TASMANIA GRAVITY SURVEY
REGIONAL BOUGUER ANOMALY

GEOPHYSICS BY

D.E.LEAMAN B.Sc. (Hons.) Ph.D. AND P A SYMONDS B.Sc. (Hons.)

CONTOUR INTERVAL 20 $\mu m/s^2$
Contours derived by double average process of Total Bouguer Anomaly
Unit area from first average – 25 km^2
Unit area from second average – 400 km^2

5 cm

Kilometres 5 4 3 2 1 0 5 10 Kilometres

Cartography by T.R.Bellis
Published 1974

147°30′ 50 60 45′ 70 80 148°00′ 90 600000mE 15′ 610 620

Figure 2

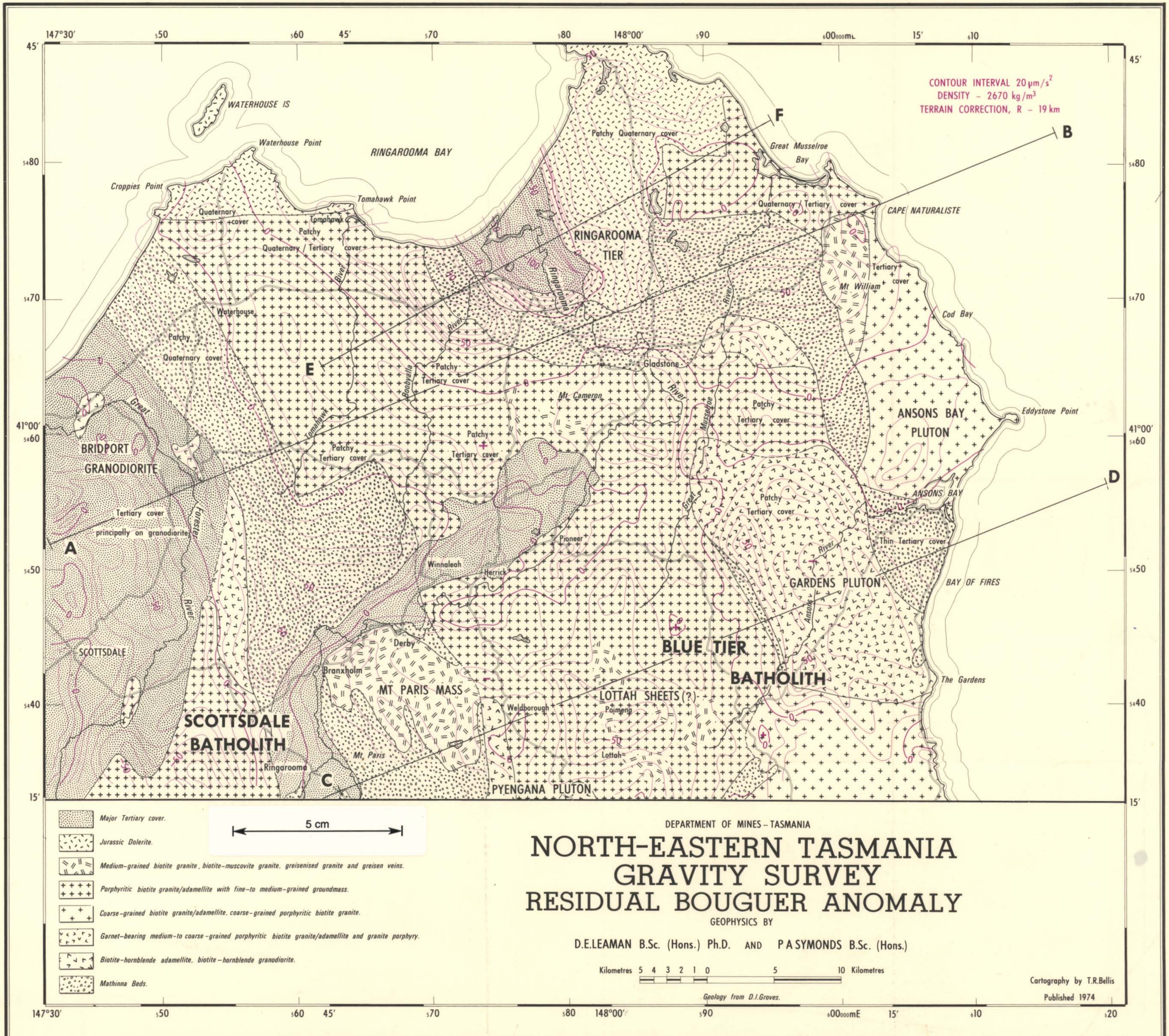

CONTOUR INTERVAL 20 µm/s²
DENSITY - 2670 kg/m³
TERRAIN CORRECTION, R - 19 km
WATERHOUSE IS
Waterhouse Point
RINGAROOMA BAY
Croppies Point
Tomahawk Point
Great Musselroe Bay
CAPE NATURALISTE
RINGAROOMA TIER
Mt William
Cod Bay
Gladstone
Mt Cameron
ANSONS BAY PLUTON
Eddystone Point
BRIDPORT GRANODIORITE
Tertiary cover principally on granodiorite
ANSONS BAY
Pioneer
Winnaleah
Herrick
Thin Tertiary cover
GARDENS PLUTON
BAY OF FIRES
SCOTTSDALE
Derby
Branxholm
BLUE TIER BATHOLITH
MT PARIS MASS
LOTTAH SHEETS (?)
The Gardens
Weldborough
Poimena
SCOTTSDALE BATHOLITH
Mt Paris
Lottah
Ringarooma
PYENGANA PLUTON
Major Tertiary cover.
Jurassic Dolerite.
Medium-grained biotite granite, biotite-muscovite granite, greisenised granite and greisen veins.
Porphyritic biotite granite/adamellite with fine-to medium-grained groundmass.
Coarse-grained biotite granite/adamellite, coarse-grained porphyritic biotite granite.
Garnet-bearing medium-to coarse-grained porphyritic biotite granite/adamellite and granite porphyry.
Biotite-hornblende adamellite, biotite-hornblende granodiorite.
Mathinna Beds.
5 cm
DEPARTMENT OF MINES - TASMANIA
NORTH-EASTERN TASMANIA GRAVITY SURVEY
RESIDUAL BOUGUER ANOMALY
GEOPHYSICS BY
D.E.LEAMAN B.Sc. (Hons.) Ph.D. AND P A SYMONDS B.Sc. (Hons.)
Kilometres 5 4 3 2 1 0 5 10 Kilometres
Geology from D.J.Groves.
Cartography by T.R.Bellis
Published 1974

Figure 3

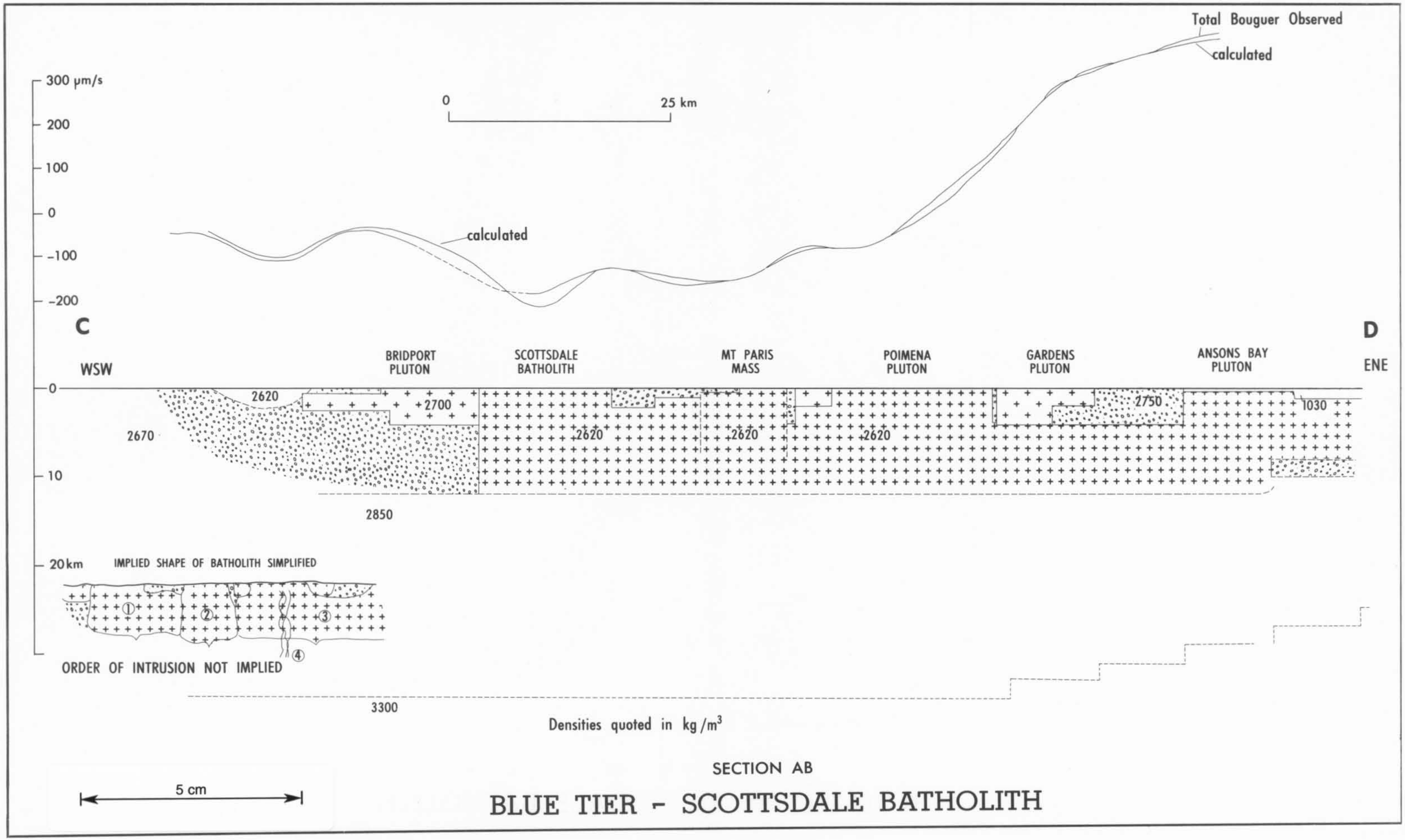
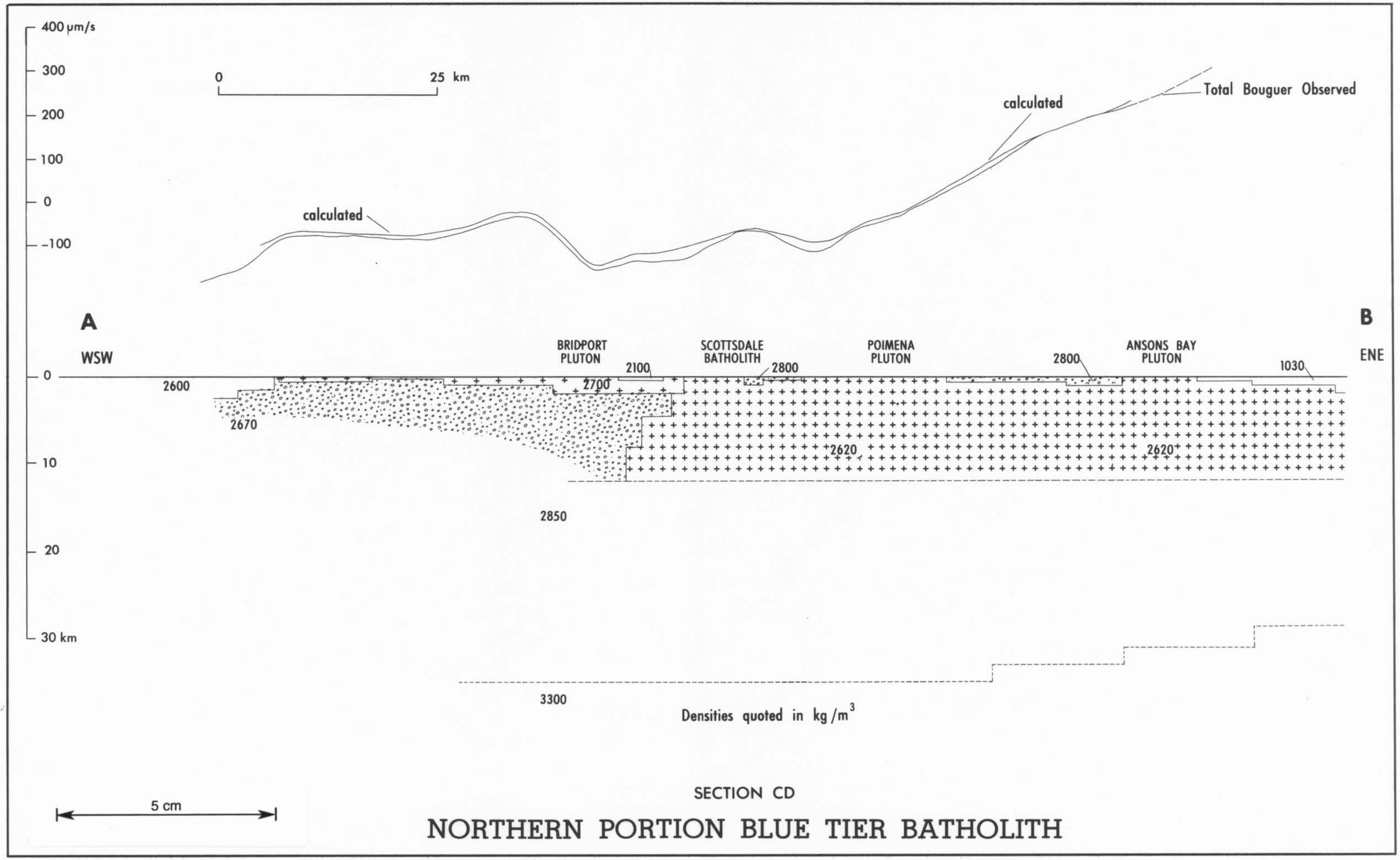
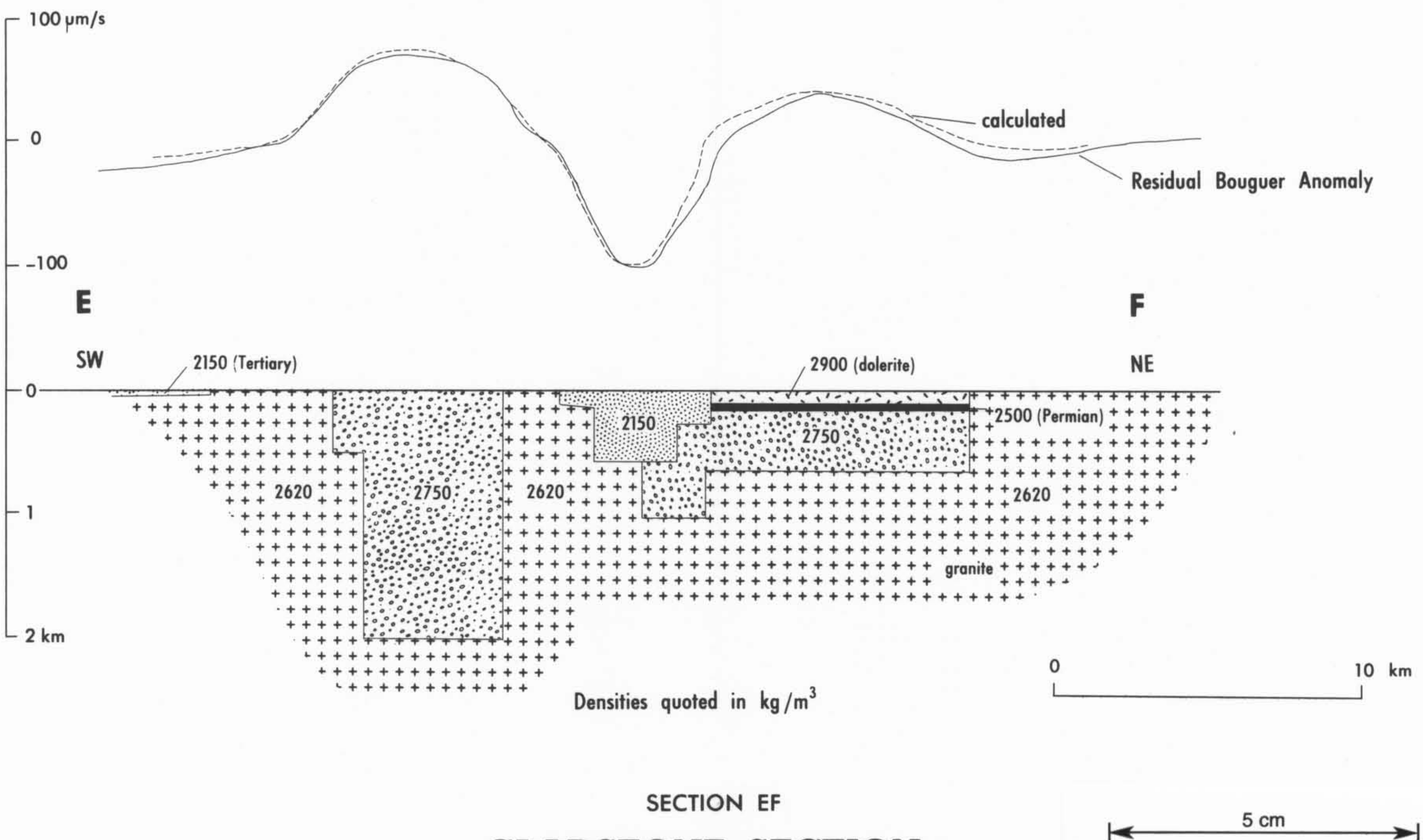

Total Bouguer Observed
calculated
300 μm/s
200
100
0
−100
−200
0
25 km
calculated
C
D
WSW
ENE
BRIDPORT PLUTON
SCOTTSDALE BATHOLITH
MT PARIS MASS
POIMENA PLUTON
GARDENS PLUTON
ANSONS BAY PLUTON
0
10
20km
2620
2700
2670
2620
2620
2620
2750
1030
2850
IMPLIED SHAPE OF BATHOLITH SIMPLIFIED
ORDER OF INTRUSION NOT IMPLIED
3300
Densities quoted in kg/m³
SECTION AB
5 cm
BLUE TIER - SCOTTSDALE BATHOLITH

Figure 4



400 μm/s
300
200
100
0
-100
0
25 km
calculated
calculated
Total Bouguer Observed
A
B
WSW
ENE
BRIDPORT PLUTON
SCOTTSDALE BATHOLITH
POIMENA PLUTON
ANSONS BAY PLUTON
0
10
20
30 km
2600
2100
2700
2800
2800
1030
2670
2620
2620
2850
3300
Densities quoted in kg/m³
5 cm
SECTION CD
NORTHERN PORTION BLUE TIER BATHOLITH

Figure 5



GLADSTONE SECTION

Figure 6