66/94
(3)

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1966/94

REGIONAL GRAVITY TRAVERSES,

NORTH QUEENSLAND 1963

by

W.J. LANGRON

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1966/94

REGIONAL GRAVITY TRAVERSES,

NORTH QUEENSLAND 1963

by

W.J. LANGRON

CONTENTS

ILLUSTRATIONS

SUMMARY

This report discusses the results of two regional gravity traverses in North Queensland. The primary objective of the gravity measurements was to investigate certain problems arising in connection with the Tasman Geosyncline.

Along the northern traverse good correlation was obtained between the gravity results and the known geology but the traverse did not extend far enouth west to fully investigate the western boundary of the Tasman Geosyncline. A greater variation in gravity occurs along the southern traverse and here also there is good agreement between the gravity results and the geology.

Although the gravity results are of value in interpreting some of the structure within the geosyncline they have not indicated the western margin of the Palaeozoic sedimentation.

1. INTRODUCTION

This Record discusses the results of two regional gravity traverses in North Queensland (see Plate 1). The traverses concerned are :

(1) Traverse BM, from Mount Molloy to near Wrotham Park (Plate 2). A connection was made between Mount Molloy and the Bureau of Mineral Resources (BMR) pendulum station No. 52 at Cairns, during which several stations previously read by Dooley (1965) and J. van Son (Flavelle, 1966) were re-occupied.

(2) Traverse BN, from Einasleigh railway station to Ewan (Plate 3). A connection was made to BMR pendulum station No. 51 at Townsville, during which some stations previously read by J. van Son (Flavelle, 1966) were re-occupied.

The locations of the traverses are shown in Plates 2 and 3, which also show the Bouguer anomaly and surface elevation for each station.

The field work was carried out byF. Darby during October and November 1963, at the conclusion of ground control surveys for the 1963 helicopter contract gravity survey in Central Queensland. The logistics of the operation are shown in the Appendix.

The work was originally done at the request of the Geological Branch of the BMR, who were carrying out geological mapping in this region. The gravity results, in preliminary form, were discussed with the geologists concerned soon after field work was completed. Now that accurate base maps and station locations are available the data have been reduced to final values and adjusted to the 'May 1965 isogal' values of Barlow (in preparation).

The results of this work will not be discussed in detail here as they will be incorporated in the final maps of the 1966 contract helicopter gravity survey. It is felt that the real value of the work will only be realised when it is considered in conjunction with the gravity picture of the surrounding region. However, consideration is given here to an examination of the gravity data in relation to the Tasman Geosyncline, which was of particular interest to the geologists.

2. GEOLOGY

For a general description of the geology of the Cairns-Townsville hinterland, reference should be made to White (1961). To permit a more detailed interpretation of the gravity traverses, reference should be made to the geological maps and explanatory notes for the 1:250,000 map areas of Einasleigh (White, 1963a), Clarke River (White 1963b), and Mossman (de Keyser, 1961).

The Palaeozoic Tasman Geosynclinal Zone is discussed by Hill (1951) and Hill and Denmead (1960). It is the most prominent structural feature associated with the two regional gravity traverses discussed in this report. The extent of the geosyncline eastwards is not known. The western margin of the geosyncline (the Tasman Line) is taken to be the boundary between the marine Palaeozoic sediments of eastern Queensland and the Precambrian.

The sediments within the geosyncline have been folded and faulted and intruded by granites of at least two ages. There are a number of structural 'highs' of older rocks trending along the geosyncline and separating structural 'lows', most of which appear to be younger, separate basins of deposition (Hill, 1951). Within the region considered here, the structures include the Chillagoe Shelf, the most westerly region of deposition, and the adjoining Hodgkinson Basin. The Broken River Embayment, Clarke River Basin, and Star Basin are barely included by Traverse BN. The exposed rocks of the North Coast Structural High are predominantly metamorphics with granitic intrusions.

3. DISCUSSION OF GRAVITY RESULTS

The data have been reduced to Bouguer anomaly values using a density of 2.67 g/cm^3. The Bouguer anomaly value and surface elevation for each station are shown in Plates 2 and 3. Bouguer anomaly profiles have not been drawn and discussion of the gravity results will be based on the information shown in these plates.

Traverse BM

This traverse is located within the Hodgkinson Formation for almost its entire length.

The lowest gravity values (between BM-0 and BM-5) are associated with outcropping Mareeba Granite, which together with other undifferentiated granites and diorite could be fairly extensive at depth and would appear to be responsible for the low Bouguer anomaly values further west to about BM-14.

Between about BM-14 and BM-27, Bouguer anomaly values are generally slightly higher; this is especially so between BM-15 and BM-21 and in the vicinity of BM-26 and BM-27. There is no obvious explanation for this small gravity variation, but as faulting would appear to be prevalent in this region it is likely that the more positive gravity values are due to structural 'highs' within the Hodgkinson Formation.

The rise in gravity near station BM-0 (Mount Molloy) fits in very well with the gravity picture further to the east presented and discussed by Dooley (1965).

The low gravity values near the western end of the traverse are associated with the Almaden Granite and Nychum Volcanics. The gravity results give no clear indication of the western boundary of the Tasman Geosyncline in this region and it is obvious that the traverse should have been extended further westwards. However, it was not possible for the surveyors to do this.

Traverse BN

This traverse exhibits considerably more variation in gravity than does traverse BM, probably because of the more complex geological conditions in this region due to the presence of the Broken River Embayment.

The western portion of the traverse contains generally large negative Bouguer anomalies which can be correlated with Forsayth and McKinnons Creek Granites, which crop out between BN-1 and BN-6 and between BN-9 and BN-12. It is of interest to note that between these two granite bodies the Bouguer anomaly values rise to almost zero, thus lending support to the geologists' opinion that the two granite masses are in fact separate bodies. The gravity results suggest that any connection between the two bodies is at depth. Another feature about this portion of the traverse are the large negative Bouguer anomalies in the vicinity of Einasleigh. The stations here are located on Archean rocks which presumably lie at shallow depth beneath a Quaternary cover, and it is assumed that there is little density contrast between the granites and the Archean rocks. The only reasonable explanation for this trend in negative Bouguer anomaly values would seem to be that the gravity minimum, which is apparently beyond the end of this traverse, is associated with a granite mass that extends westward well beyond Einasleigh. Reference to the BMR 40-mile tectonic map of Australia indicates that the granites in this region do have such wide distribution.

Between stations BN-13 and BN-21 the Bouguer anomaly values reach almost +2 milligals owing to the presence of higher density basic rocks in this section. The western boundary of this gravity 'high' zone can be placed fairly reliably near station BN-13. The eastern boundary of this zone is not so well defined, being obscured by faulting in the region between BN-20 and BN-23. The traverse passes to the south of the tectonic zone that White (1961) describes as the McBride Basalt Province.

The Bouguer anomaly values decrease to the north, along traverse H, which was surveyed in greater detail to investigate the thickness of basalt in this province. The results of this work, which was carried out in 1960, are discussed by Langron (in preparation).

Gravity values along the eastern portion of the traverse became increasingly negative as the traverse crossed lighter rocks and sediments of the Clarke River Basin. As with traverse BM the Bouguer anomaly values gradually rise towards the eastern end of the traverse, and again this is in agreement with the results of Dooley (1965) further east.

4. REFERENCES

BARLOW, B. C. - The Australian isogal survey, 1964 Bur. Min. Resour. Aust. Rec. (in preparation).

DOOLEY, J. C. 1965 Gravity surveys of the Great Barrier Reef and adjacent coast, North Queensland 1954-1960. Bur. Min. Resour. Aust. Rep. 73.

de KEYSER, F. 1961 Geology and mineral deposits of the Mossman 1:250,000 sheet area, North Queensland. Bur. Min. Resour. Aust. Rec. 1961/110.

FLAVELLE, A. J. 1966 Gravity meter measurements between pendulum stations, eastern Australia, 1959-1960. Bur. Min. Resour. Aust. Rec. 1966/45.

HILL, D. 1951 "Geology". In HANDBOOK OF QUEENSLAND. Aust. N.Z. Ass. Adv. Sci. p. 13-24.

HILL, D., and DENMEAD, A. K. (ed.) 1960 THE GEOLOGY OF QUEENSLAND. Geol. Soc. Aust.

LANGRON, W. J. - Gravity investigation of the thickness of basalt cover in the Einasleigh sheet area, Qld 1960. Bur. Min. Resour. Aust. Rec. (in preparation).

WHITE, D. A. 1961 Geological history of the Cairns-Townsville hinterland, North Queensland. Bur. Min. Resour. Aust. Rep. 59.

1963a Einasleigh, Qld, 1:250,000 geological series, Sheet E/55-9. Bur. Min. Resour. Aust. Explan. Notes.

1963b Clarke River, Qld, 1:250,000 geological series, Sheet E/55-13. Bur. Min. Resour. Aust. Explan. Notes.

APPENDIX

Organisation of the survey

Logistical organisation

Staff : F. Darby (geophysicist)
K. Kirby (field assistant)

Vehicles : One International one-ton 4 x 4

Duration of Survey : 12th October 1963 to 2nd November 1963. Gravity ties and other stations were read elsewhere in the region during this period whilst waiting for spirit levelling to be completed on traverses BM and BN.

Scientific organisation

Instruments. World-wide gravity meter, Serial No. 35, with scale factor 0.11541 milligal/scale division, was used throughout the survey. The meter was calibrated on the Brisbane calibration range before and after the survey and on the Townsville calibration range during the survey. Meter drift was determined by using the looping method, i.e. reading stations in the order 1, 2, 3, 4, 3, 2, 1, 4, etc.

During the survey, the drift rate was usually rather steeply upwards in the morning and somewhat flatter downwards in the late afternoon. Evacuation of the meter on returning to Melbourne showed the pressure in the vacuum flask to be several millimetres too high.

Elevations. Elevations of the bench-marks were provided by the Department of the Interior and tied to Queensland State Datum.

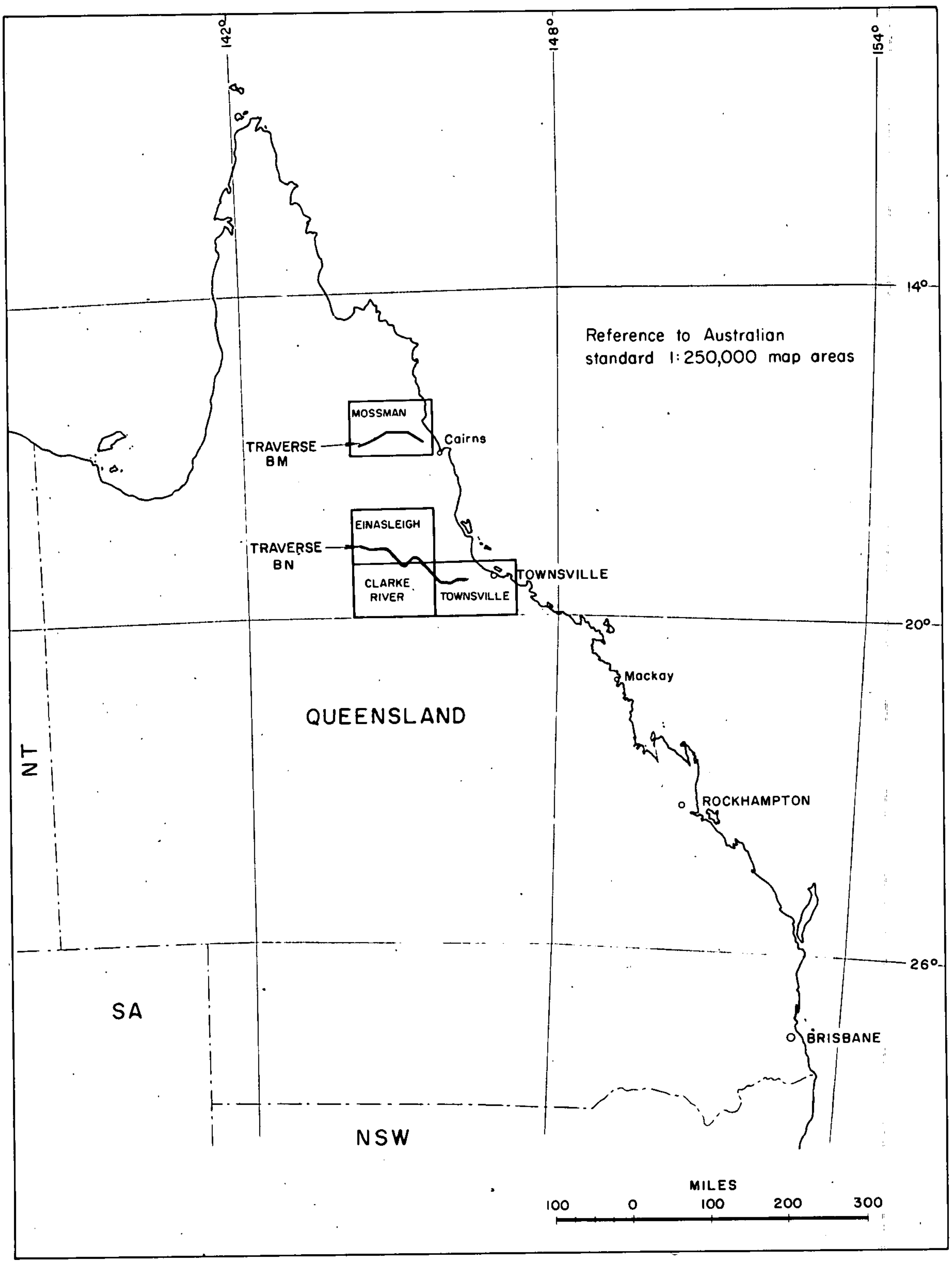
Plotting. The co-ordinates of the stations were obtained from Royal Australian Survey Corps planimetric compilation 1:250,000 maps of Mossman, Einasleigh, Clarke River, and Townsville.

Tie stations. Gravity traverse BM was tied to BMR pendulum station No. 52 at Cairns. Gravity traverse BN was tied to BMR pendulum station No. 51 at Townsville.

Bouguer anomalies. The Bouguer anomalies were calculated using a density of 2.67 g/cm^3 in the Bouguer correction.

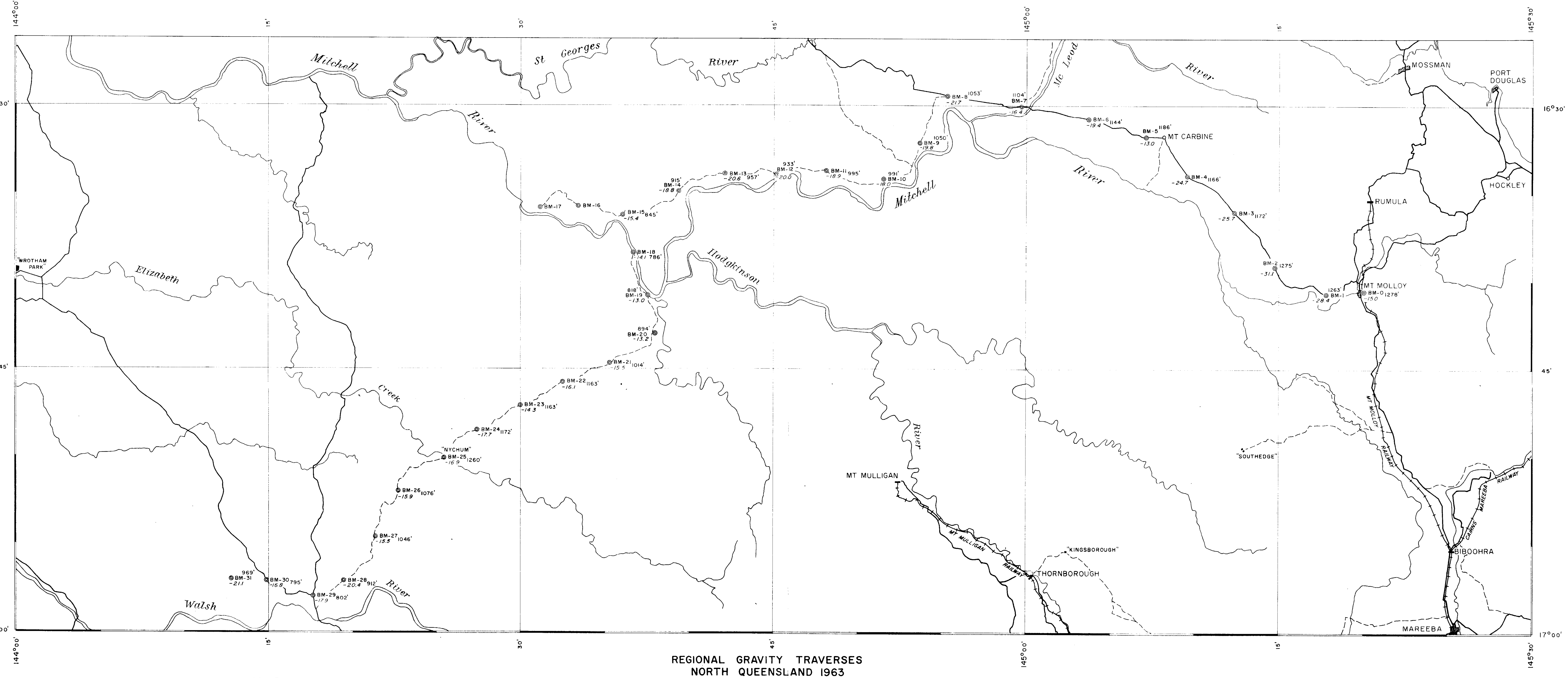
Gravity data files (stored in the BMR Gravity Section).

6306.1 : level data and intermediate tie station sketches.
6306.2 : gravity field sheets and drift plots.
6306.3 : gravity calculation sheets.



REGIONAL GRAVITY TRAVERSES
NORTH QUEENSLAND 1963

LOCALITY MAP



REGIONAL GRAVITY TRAVERSES
NORTH QUEENSLAND 1963

SCALE
5 0 5 10 15 MILES
5 0 5 10 15 20 KILOMETRES

TRAVERSE BM

TRAVERSE PLAN SHOWING STATION ELEVATIONS IN FEET ABOVE SEA LEVEL AND BOUGUER ANOMALY VALUES IN MILLIGALS

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS E55/B2-31

TO ACCOMPANY RECORD NO 1966/94

PLATE 3

REGIONAL GRAVITY TRAVERSES
NORTH QUEENSLAND 1963
TRAVERSES BN AND H

TRAVERSE PLAN SHOWING STATION ELEVATIONS IN FEET ABOVE SEA LEVEL AND BOUGUER ANOMALY VALUES IN MILLIGALS

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS H55/B2-32

TO ACCOMPANY RECORD NO. 1966/94