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DEPARTMENT OF
MINERALS AND ENERGY



BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

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RECORD 1975/10



MELBOURNE AREA GRAVITY SURVEY, 1975

PREVIEW REPORT

by

I. Zadoroznyj

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SUMMARY

The Bureau of Mineral Resources will carry out a detailed gravity survey of Melbourne and its surrounds between February and April 1975 in response to a request by the Geological Survey of Victoria. The purpose of the survey is to assist in defining the near-surface geological structure of the area and to provide assistance for groundwater investigations. About 1100 stations will be established along roads on an approximate 1.6 km grid, with stations more closely spaced over some features of special interest. Most stations will be located at benchmarks of accurately known elevation, so only a small amount of barometric levelling work will be required. Gravity control will be maintained by ties to four Isogal stations, and station positions will be marked on 1:63 360 topographic maps. Rock samples for density measurements will be collected and processed by the Geological Survey of Victoria.

1. INTRODUCTION

The Bureau of Mineral Resources, Geology & Geophysics (BMR) will carry out a gravity survey of Melbourne and its surrounds between February and April 1975 (Plate 1). The survey is being carried out at the request of the Geological Survey of Victoria to help define the near-surface geological structure of the area. It is also hoped that the results will provide assistance in groundwater studies of the area. An appreciation of the geology of the survey area can be obtained from the Melbourne and Queenscliff sheets of the Australian 1:250 000 Geological Series. The geology of the inner Melbourne area is discussed in a report by the Geological Survey of Victoria (Geological Survey of Victoria, 1967).

Several previous gravity surveys have been conducted within or near the proposed survey area. These are BMR's recent reconnaissance gravity survey (Zadoroznyj, in prep.), a BMR gravity survey of Port Phillip Bay and Mornington Peninsula (Gunson & Williams, 1965) which detected gravity expressions of old courses of the Yarra River, a detailed survey of the Westernport area conducted by Melbourne University in 1974 (Isles, 1974), and a subsidized survey carried out near Geelong in 1971 (Shell Development, 1971). Observations from these surveys will be considered in the interpretation of the present survey. Although the area has not been surveyed magnetically, several single aeromagnetic traverses have been recorded across it by BMR survey aircraft, and these will be included in the interpretation.

Transport of the meter and observer will be by car. Most stations will be read at benchmarks so that little levelling work will be required. About 90 km of optical levelling will be carried out by the Survey Branch of the Department of Services and Property to establish additional benchmarks in the Werribee area, and stations not at benchmarks will be levelled barometrically.

2. OBJECTIVES

The main objective of the survey is to help define the near-surface structure of the area and so provide assistance to groundwater and engineering geological studies. The results of the gravity survey in the adjacent Port Phillip Bay and Mornington Peninsula areas (Gunson & Williams, 1965) suggest that the gravity method will be useful in this area. Significant density contrasts are expected between the main rock types in the region. These are basalts (about 2.7 g/cm^3), Silurian sediments (about 2.5 g/cm^3), and the Quaternary and Tertiary sediments (about $1.8\text{--}2.2 \text{ g/cm}^3$). These density contrasts should enable good estimates to be made of the extent of the various rock types. The Geological Survey of Victoria will determine the density of the various formations in the area by measurements on representative samples. These values will be used in the interpretation of the gravity results. The Geological Survey considers that the data will also assist in solving specific problems in some areas. These are as follows (see Plates 1 and 2 for the locations and the geological features):

Dandenong-Frankston Area

The results may help outline bedrock topography and previous stream systems. Definition of the Selwyn Fault north of Frankston may also be possible.

Footscray-Williamstown Area

It is hoped that the positions of basalt-filled valleys and the structures of sub-basaltic sediments will be defined. The survey may detect a suspected fault between Footscray and Altona and provide data on the sediment thicknesses west of Newport.

Melbourne Suburban Area

The gravity results may help to delineate the Anonyma Flexure; to outline the western extension of the Melbourne Warp (which is associated

with a Silurian inlier at St Kilda); and to delineate any extension of the Studley Park Fault Zone. In addition the results may reveal faults obscured by Tertiary sediments.

Bacchus Marsh Area

Better definition of structure in this area will assist the Geological Survey of Victoria in its brown coal assessment program. Seams of brown coal appear to continue from Altona to Bacchus Marsh, and any structural features which cause these seams to be close to the surface will be important in assessing the economic significance of the deposits.

Geelong-Werribee-Bacchus Marsh Area

The survey will assist in defining the extent and thickness of Tertiary sediments in this area and will also help determine the subsurface shape of the You Yang Granite. According to the Geological Survey there are about 200 m of Tertiary sediments at Little River (southwest of Werribee).

3. DISCUSSION

Gravity measurements on a 1.6-km grid could not adequately define small near-surface structures such as basalt or sediment-filled erosional depressions, which generally have dimensions of only a few kilometres and depths of no more than one or two hundred metres; a grid spacing of perhaps 0.2 km would be required to do this. The survey results should be of value by defining regional structures which have influence on near-surface geology such as major faults and folds, by providing target areas for more detailed surveys, and by discriminating between near-surface and regional effects.

Detailed traverses (0.5-km spacing) will be carried out on two lines across the Quaternary basalts west of Melbourne (Plate 1) and over the Silurian inlier at St Kilda. These lines strike across the general

grain of the drainage pattern and will be surveyed to assess the effectiveness of gravity methods in delineating near-surface structures. Additional traverses with closer station spacing may also be read in areas where the results of the 1.6-km grid suggest that extra detail is necessary.

4. OPERATIONS

Traversing and traverse planning

The 'cell method' of traversing, modified to suit the operational requirements of this survey, will be used. This method is described by Hastie & Walker (1962) and has been used in most BMR reconnaissance helicopter gravity surveys. Stations will be on an approximate 1.6-km grid. Detailed traverses at a station spacing of 0.5 km or less will be made across some local geological features of interest where benchmark information is available.

Gravity control

Gravity control will be maintained by the occupation of Isogal stations (Barlow, 1970) at Footscray, Essendon, Tullamarine, and Moorabbin. Drift control will be maintained by repeat readings at the first station of each loop.

Vertical control

Benchmarks will provide vertical control in the area. About 90 percent of the stations will be at benchmarks and the remainder will be levelled barometrically.

Horizontal control

Station positions will be marked on the 1:63 360 topographic maps covering the area.

Reduction of data

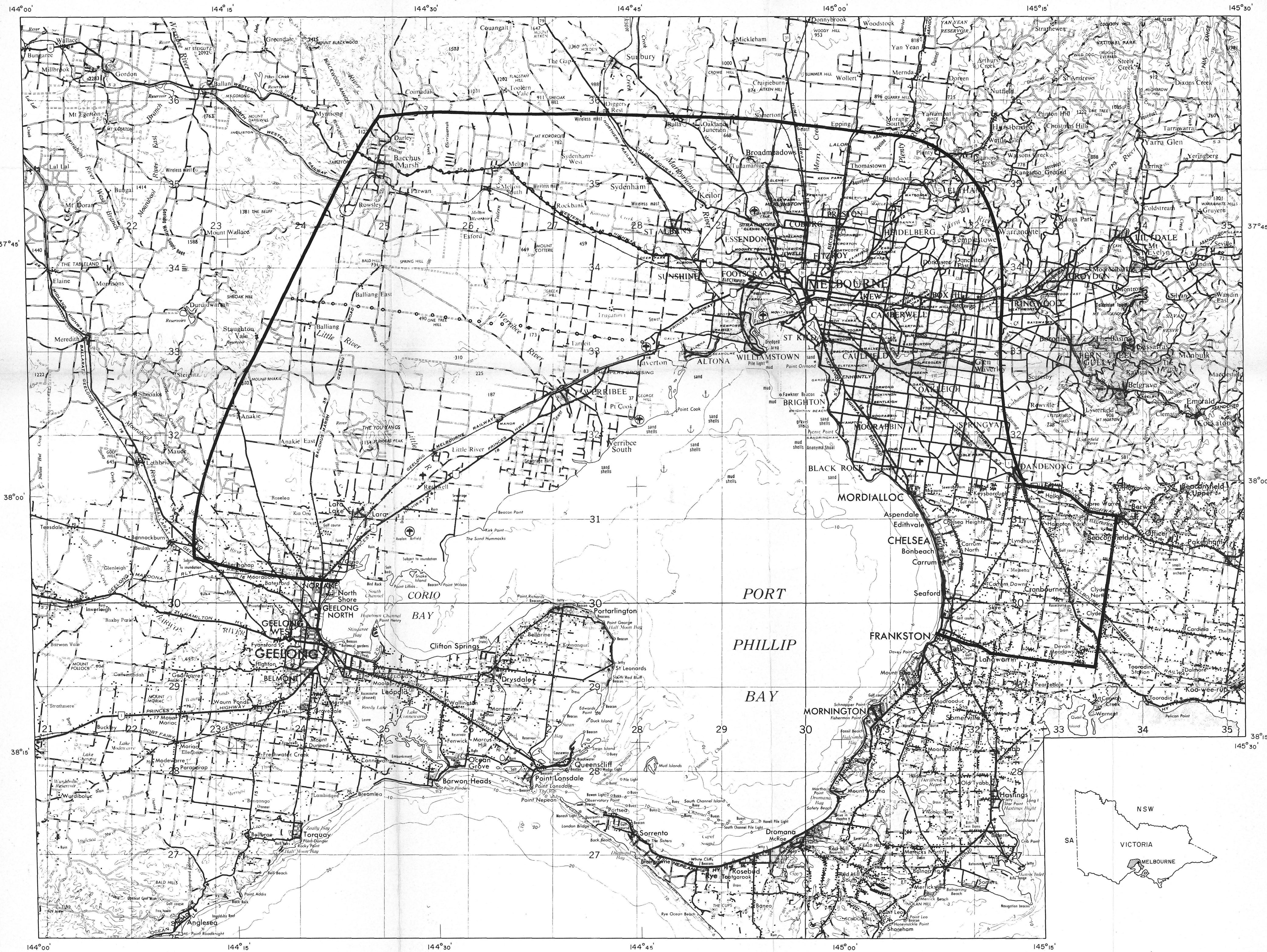
The data will be reduced by computer on completion of the field work. Preliminary computations will be made by hand as field work progresses, to keep a check on data accuracy and to reveal any unusual Bouguer anomaly features which may warrant further investigation.

Density measurements

Rock samples for density measurements will be collected and processed by the Geological Survey of Victoria. Samples may be collected by the gravity party as opportunity permits.

5. REFERENCES

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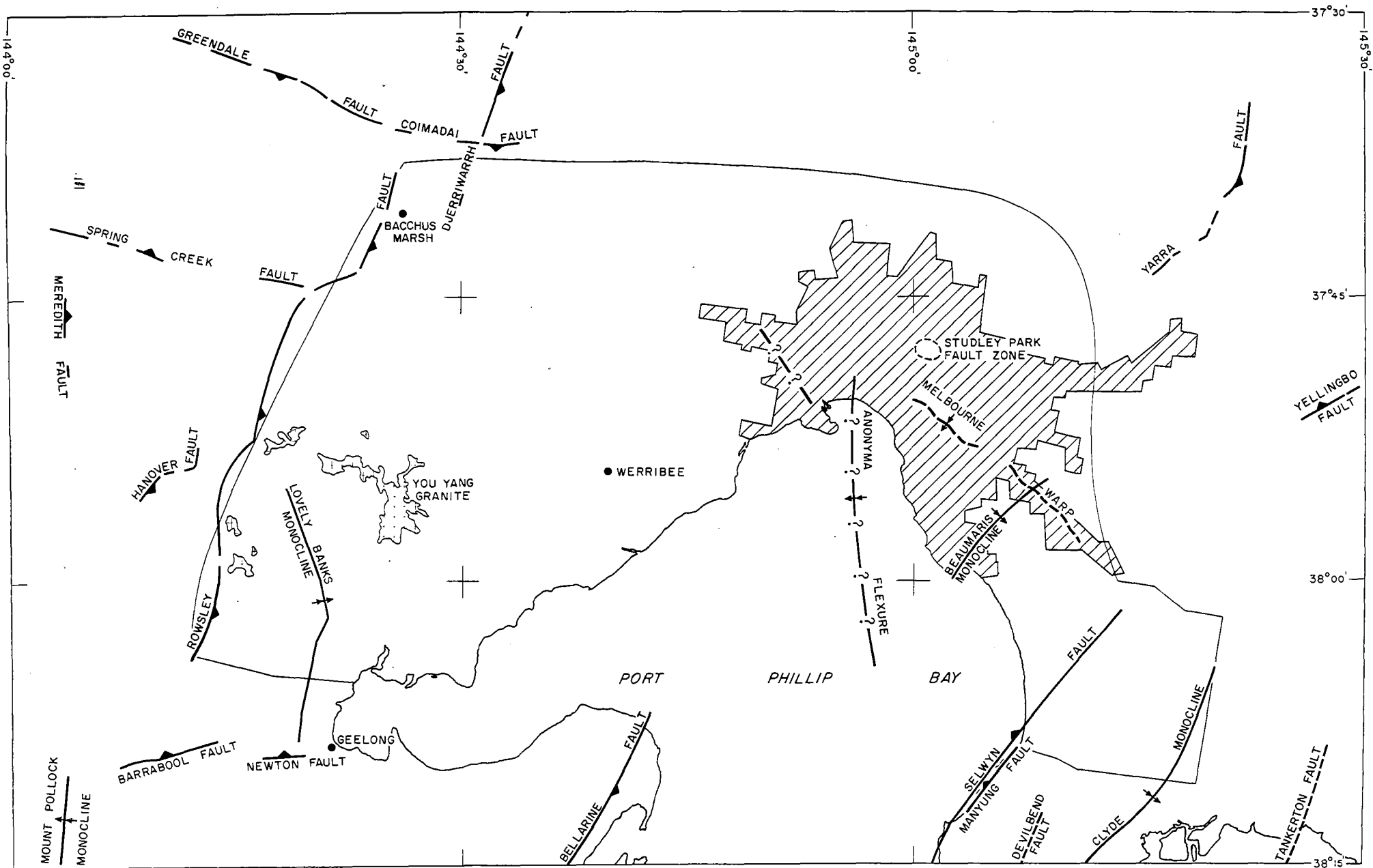


MELBOURNE AREA GRAVITY SURVEY 1975
LOCALITY MAP

5 0 5 10 15 20 25 KILOMETRES

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MAJOR STRUCTURAL FEATURES

5 0 5 10 15 20 25 KILOMETRES