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PRELIMINARY REPORT ON

GRAVITY SURVEY OF PORT PHILLIP BAY AND ADJACENT AREAS

By

S.Gunson, L.W.Williams & J. C. Dooley

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ABSTRACT.

The first underwater gravity survey to be conducted in Australia was carried out in Port Phillip Bay over the period 18th. June to 16th. December, 1957.

The report briefly describes this survey; and its results, combined with previous gravity surveys made over the land areas fringing the Bay, are presented in the form of a Bouguer Anomaly map.

The results indicate that the Port Phillip Sunkland is not a simple structural unit but that complicated structure probably occurs within the Sunkland itself. Sediments, several thousand feet in thickness, are indicated in the southern portion of the Bay.

1. INTRODUCTION.

The gravity surveys described in this report were carried out by the Bureau of Mineral Resources as regional surveys. The field work was divided into two parts - an underwater gravity survey of Port Phillip Bay and a survey of Mornington Peninsula. In addition to the results of these surveys, information gathered during previous surveys of adjoining areas has been used in the compilation of the gravity anomaly contour map.

The underwater survey commenced on 18th. June, 1957, and was completed on 16th. December, 1957. A remote controlled "North American" gravity meter was used from a boat (Auxiliary Ketch "Commissioner") chartered for the duration of the survey.

The crew of the boat consisted of one or two geophysicists and a field assistant to operate the gravity meter equipment, and a master, engineer, and one seaman to handle the boat.

The survey of the Mornington Peninsula was carried out by one geophysicist, between 19th. February and 17th. March, 1958, using a "Worden" gravity meter and a "Western" vehicle-mounted elevation meter.

2. GEOLOGY AND PHYSIOGRAPHY.

Port Phillip Bay is an almost completely land-locked body of water, with its only opening to the sea at Port Phillip Heads which are approximately two miles apart. Water depths range generally from five to thirteen fathoms, but there are large areas of mud and sand banks in the southern part of the Bay.

The shoreline is mostly low-lying with the exception of parts of Mornington and Bellarine Peninsulas.

The majority of the area surrounding the Bay is covered by Recent, Pleistocene and Tertiary sediments, and large areas of Newer and Older Basalts. Granite is known in the You Yangs, at Arthur's Seat, and north-east from Dandenong. Outcrops of Silurian and Ordovician sediments occur on the Mornington Peninsula.

Hills (1946, p.160) described the Bay as part of the "Port Phillip Sunkland", bounded on the west by a line running approximately northerly from Geelong. The Mornington Peninsula is regarded as a horst, separated from the Sunkland by the Selwyn Fault, which runs along the western coast of the Peninsula from Frankston to Rosebud.

3. OPERATIONS.

A considerable amount of time was lost during the marine survey because of instrumental breakdowns and unfavourable

weather. The cause of the instrumental trouble was eventually found to be vibrations from an engine on the deck of the boat, and the trouble was then eliminated.

For the marine gravity work, base stations were established at six jetties around Port Phillip Bay, and these were used as starting and finishing points for each day's work.

The location of the vessel was determined by means of a horizontal sextant, by which the angles between three prominent landmarks were read, and a station pointer, which was used to plot the resulting position on the map.

The land survey was carried out by standard methods, with repeated stations for drift control. Elevations were available for railway stations, and the elevation meter was used to determine elevations at other points in the area, using railway stations as tie points.

The observed gravity values were tied to the national gravity base at Footscray, using 979, 979.0 mgal. as datum. The free-air and Bouguer anomalies were calculated for all stations. A density of 2.67 gm/cm^3 was used in the Bouguer reductions. The marine observations were corrected for tidal effects, and for normal variation of gravity with latitude. A correction to mean sea-level was made by subtracting .0678.d mgal. (where d is depth of water in feet), and the resulting anomaly is regarded as the free-air anomaly. A simple Bouguer correction was then applied by adding .0209 d, corresponding to the difference in density between sea-water (1.03) and rock (assumed 2.67).

No attempt has been made to correct for topography in either the land or marine observations.

4. RESULTS AND INTERPRETATION.

The Bouguer anomalies have been plotted on the accompanying map (Plate 1).

A prominent feature is the low gravity area in the southern part of the bay, bounded by steep gradients on the west, east, and north. The eastern gradient corresponds well with the Selwyn fault (Hills 1946, p.60), and the western gradient corresponds approximately with the Bellarine fault. The gradient at the northern boundary, which strikes approximately N.W. - S.E., is presumably associated with a fault intersecting the other two.

The Mornington peninsula is an area of high gravity. There is little sign of the Tyabb fault along the western coast of the peninsula, and this implies a comparatively small throw for this fault.

Other high gravity features occur in the western part of Port Phillip Bay between Portarlington and Altona, and in the Bellarine peninsula between Ocean Grove and Point Lonsdale. These high features may be associated with masses of older basalt.

In the western part of Corio Bay (between Geelong and Portarlington), the gravity gradient suggests a fault striking approximately W.N.W. - E.S.E., and downthrown to the south.

Lake Connewarre is in a low gravity zone, and this area may have been sinking for some time, and filled with light recent sediments.

Two low gravity "trough" features, extending northerly and north-easterly from the low gravity area in the southern part of the bay, are presumably sunken channels of the Yarra River and Dandenong Creek respectively.

5. CONCLUSION.

The underwater gravity survey was the first of its kind undertaken in Australia, and the survey was partly planned for development of suitable operational procedures. However the survey has also revealed much of interest in relation to the geology of Port Phillip Bay and surrounding areas. It seems clear that the Port Phillip Sunkland is not a simple structural unit, such as a graben filled with sediments, but that complicated structure occurs within the Sunkland. The thickest accumulation of sediments is presumably in the southern part of the bay north of Portsea and Sorrento, where several thousand feet of sediments may occur.

6. REFERENCE.

HILLS, E.S., 1946 - Physiography of Victoria. Whitcombe and Tombs. 2nd. Edition.

AUSTRALIA 1:126,720

PORT PHILLIP BAY (SPECIAL)

VICTORIA

PLATE I

J 55/5,9, ZONE 7

LOCATION

REFERENCE TO AUSTRALIAN NATIONAL 1 MILE MAP SERIES

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES

CONTROL: AUSTRALIAN 1 63,360 MILITARY MAPS AND B.M.R. SHORAN MEASUREMENTS

DETAIL: BASE GRID, GRATICULE AND POSITION CONTROL STATIONS IN PT. PHILLIP BAY AREA COMPUTED AND COMPILED BY THE GEOPHYSICAL DRAWING OFFICE, B.M.R. PLANIMETRY FROM 1 63,360 MILITARY MAPS GEOPHYSICAL DATA FROM B.M.R. UNDERWATER AND SURFACE GRAVITY SURVEYS

RELIABILITY: PLANIMETRIC - ACCURATE
GEOPHYSICAL - REGIONAL TO SEMI-DETAILED GRAVITY

REGIONAL GRAVITY SURVEY (1957)

PORT PHILLIP BAY - MORNINGTON PENINSULA, VIC.

BOUGUER ANOMALIES

SCALE IN MILES

2 0 2 4 6 8

CONTOUR INTERVAL 1 MILLIGAL

LEGEND

TOPOGRAPHY

- ROAD
- RAILWAY
- WATERCOURSE
- TOWN

GRAVITY

- STATION
- FD 5 STATION NUMBER
- +11·6 RELATIVE BOUGUER ANOMALY
- 2078' ALTITUDE IN FEET
- ANOMALY ISOGAMS IN MILLIGALS
- HIGH ANOMALY
- LOW "

EXPLANATION

RELATIVE BOUGUER ANOMALIES ARE BASED ON THE OBSERVED GRAVITY VALUE OF 979,979·0 MILLIGALS AT B.M.R. No. 1 GRAVITY PENDULUM STATION, FOOTSCRAY, VIC.

FOR THE CALCULATION OF BOUGUER ANOMALIES 1·03 GR/CCM. HAS BEEN TAKEN AS THE SEA WATER DENSITY AND 2·67 GR/CCM AS THE AVERAGE ROCK DENSITY.

ELEVATION DATUM: M.S.L. (L.W.M. WILLIAMSTOWN + 1·938' = M.S.L.)

PLANIMETRIC DETAIL SHOWN ONLY FOR LOCATION OF GEOPHYSICAL DATA.

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G 320-1

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