COMMONWEALTH OF AUSTRALIA

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS

1957, No. 83

GEOPHYSICAL INVESTIGATIONS IN THE CRANBOURNE AREA, VICTORIA

by

R.F. THYER

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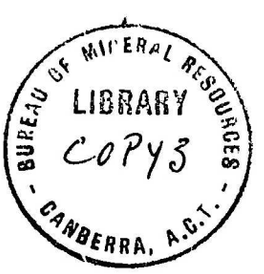

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R.F. THYER.

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ABSTRACT

Two seismic traverses were surveyed in the Cranbourne area near Frankston, Victoria, to assist in selecteding bore sites to test a supposed basalt flow - subsequent drilling showed that bedrock was not basalt but sandstone. Later an aerial magnetometer survey was made over the area.

Some isolated magnetic highs were detected and there is a reasonable probability that they are due to buried basalt. Sites are recommended for testing two of these "highs" by drilling.

1. INTRODUCTION

In October, 1955, Bayview Quarries Pty. Ltd., Victoria, was investigating the possibility of opening up a basalt quarry in the Carrum Downs area, near Frankston, to serve the needs of Frankston and other bay-side suburbs, and the Mornington Peninsula in general. It was supposed, on existing evidence, that a buried basalt flow exists in this area, and the company was seeking assistance in selecting bore sites to test the supposed flow. The problem was discussed with officers of the Bureau of Mineral Resources, and it was agreed that geophysical methods might be applicable. The Department of Mines, Victoria, supported a request from the company for the Bureau to provide geophysical assistance, and subsequently a limited amount of seismic work was done. Later, an aerial magnetometer survey was carried out over the area, the location of which is shown on Plate 1.

2. GEOLOGY

The area surveyed by the aeromagnetic method is covered mainly by Tertiary or Recent sands, clays, etc. Silurian sediments - shale and sandstone - crop out over an area of a few square miles to the east of Frankston and near Berwick, where granitic rocks in contact with the Silurian are also exposed.

Tertiary basalt crops out immediately to the north of Berwick where it is quarried extensively by Bayview Quarries Pty. Ltd., and for 3 to 4 miles to the south of Berwick. Basalt also crops out to the south of Cranbourne where it is exposed in a railway cutting.

The Tertiary and Recent sands, clays, etc. are known to be relatively thin and probably do not exceed 200 feet in thickness. It is likely that they overlie a bedrock of Silurian sediments, but there is no direct evidence of this. Basalt may occur beneath the sands, clays, etc. as its presence has been reported in old bores sunk for water a few miles inland from Seaford and Carrum.

3. THE PROBLEM AND GEOPHYSICAL METHODS USED.

Investigation of old boring records by an officer of Bayview Quarries Pty. Ltd. indicated the presence of a basalt flow at a depth of less than 100 ft. under a cover of unconsolidated Recent and/or Tertiary sediments in the Carrum Downs area. Nothing was known of the quality of the basalt, but it was proposed that this should be tested by drilling, with the object of determining whether it would be suitable for quarrying. Also, if a quarry is to be developed in this area it is essential from an economic aspect to develop it where the thickness of the overlying sediments is a minimum. It was

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desirable, therefore, in the first place to determine the thickness of the sediments and to concentrate test drilling in those places where it is a minimum.

This appeared to be a suitable problem for the application of seismic methods of survey because it was expected that a substantial difference would exist between the seismic velocity in the sediments and that in the underlying basalt. The velocity in unconsolidated sediments usually ranges from 1,000 to 6,000 ft/sec., whilst that in basalt ranges from 8,000 to 15,000 ft/sec., depending on the degree of weathering, jointing, etc.

The velocity in massive and unweathered basalt may even exceed 15,000 ft/sec. It was expected, therefore, that not only would the seismic method determine the thickness of the sediments, but would also give some indication of the degree of weathering in the basalt - a factor of some importance in assessing the possibility of successful quarry development.

Sites about 1 to 2 miles south-east of Carrum Downs were selected for the seismic tests, and these were made on 10th November, 1955.

In selecting these sites it was assumed that the early bore records were reliable and that basalt did, in fact, exist beneath the sediments. Subsequent drilling, however, proved that this was not so. Two holes drilled to 90 ft. and 107 ft. respectively, failed to locate any solid basalt, although one intersected 5 ft. of basalt pebbles interbedded with sediments. It appeared, therefore, that the evidence of the earlier water bores was not reliable and some other means was needed to determine if and where basalt flows exist beneath the sediments.

Basalt usually contains relatively large amounts of magnetic minerals, and magnetic methods of prospecting have been used successfully elsewhere to locate basalt flows. It was decided, therefore, as the next stage in the geophysical investigation, to make an airborne magnetometer survey at low altitude (500 ft.) over the area to locate magnetic anomalies.

An aerial magnetometer survey was made on 21st May, 1956, over an area of approximately 150 sq. miles bounded on the north by a line between Mordialloc and Berwick and on the south by a line passing due east through Frankston (see Plate 1). The western boundary of the area surveyed is the coast of Port Phillip Bay and the eastern boundary is a line due south from Berwick. Flight lines were spaced at approximately half-mile intervals in an east-west direction. The area was contained entirely within the Cranbourne one-mile military map area, the township of Cranbourne being roughly in the central part of the area.

4. RESULTS OF THE SURVEY

(a) Seismic

Seismic tests were made along two east-west traverses, about one and two miles respectively south-east

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of Carrum Downs. These were called traverses A and B (see Plate 2). The refraction method was used.

On traverse A, the results indicated a layer with a velocity of about 9,000 ft/sec. at depths ranging from 72 to 83 ft. In view of the evidence of the water bores mentioned previously, it was thought that this layer was basalt.

On part of traverse B, a layer with a velocity of 8,000 ft/sec. was indicated at depths ranging between 62 and 118 ft. and over the rest of the traverse a layer with a velocity of 11,000 ft/sec. was indicated at depths ranging between 85 and 130 ft. The 8,000 and 11,000 ft/sec. layers were tentatively interpreted as weathered and partly weathered basalt respectively. Near the eastern end of traverse B, a deeper layer was indicated. The depth to, and velocity in, this layer are uncertain, but the depth is of the order of 500 to 600 feet and the velocity about 20,000± ft/sec.

These results were conveyed orally to an officer of Bayview Quarries Ltd. The company subsequently advised the Bureau that two drill holes had been put down at 100 and 250 yards south of the central part of traverse B, near where the velocity changes from 8,000 ft/sec. to 11,000 ft/sec. According to detailed bore logs provided by the company the northern of the two holes showed sand and clay down to 85 ft. and sandstone from 85 to 90 ft. The other showed basalt pebbles between 24 and 29 ft, but otherwise only clay and sand down to 97 ft. and sandstone from 97 to 107 ft.

It is apparent that the layer with a velocity of 8,000 to 9,000 ft/sec. is either sandstone or a similar sedimentary rock. The depths (85 feet and 97 feet respectively) at which this was intersected agree, at least in order of magnitude, with those predicted from the seismic test. As the holes were not drilled on the seismic traverse no direct correlation is possible between the depths predicted from the seismic results and those obtained by drilling.

It is unlikely that the identity of the layer with a velocity of 11,000 ft/sec. was established by the drilling. However, as it occurs at approximately the same depth as the sandstone, and adjacent to it, it seems reasonable to suppose that it is a sedimentary rock of similar age to the sandstone and that the sandstone and other sedimentary rock are consolidated rocks forming the "bedrock" on which the unconsolidated sediments rest in this area.

(b) Aerial Magnetometer

The results of the aerial magnetometer survey are shown on the accompanying map of the Cranbourne area (Plate 2). This shows contours of total magnetic intensity; the contour interval is 25 gammas.

In general, it can be assumed that the magnetic intensity will be higher than normal over large masses of rocks which have a magnetic susceptibility greater than that of the surrounding and adjacent rocks. These masses of magnetic rocks might be contained within the bedrock which underlies the unconsolidated sediments or might be basalt flows overlying the bedrock.

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In this area, the surface is covered entirely by unconsolidated sediments of unknown thickness and little, if anything, is known about the underlying rocks. The two drill holes which were drilled to test the seismic results bottomed in sandstone at a depth of approximately 100 ft. The age of this sandstone is not known, but is possibly Silurian. If similar rocks underlie the whole of the area surveyed, it is unlikely that the bedrock would contain rocks of unusually high magnetic susceptibility. It is probable, therefore, that basalt flows alone would produce substantial increases in magnetic intensity.

The principal features in the magnetic map are three regions of high magnetic intensity indicated by closed contours. The first is centred about four miles due east of Edithvale, the second is parallel to the coast between Seaford and Frankston, at distances ranging from 1½ to 2 miles from the coast, and the third is centred about 2½ miles to the north of Cranbourne.

It is probable that some or all of these magnetic highs are due to basalt flows, but they may, of course, be due to magnetic rocks in the basement. As a matter of interest it will be noted that magnetic readings are generally low near the sites of the earlier seismic test, where no solid basalt exists.

The basalt pebbles intersected by one of the bores may have been derived from a basalt flow corresponding to the second region of high magnetic intensity mentioned above. The geological map of Victoria shows an outcrop of basalt extending to the south of Cranbourne and the magnetic high to the north of Cranbourne is possibly associated with the continuation of this basalt under cover of unconsolidated sediments.

5. CONCLUSIONS AND RECOMMENDATIONS

The seismic survey showed "bedrock" at depths ranging from 62 to 130 feet and from geological information then available it was possible that this could be basalt. Subsequent drilling of two holes by the company proved that the bedrock was not basalt but sandstone.

There is a reasonable probability that the magnetic highs found in the Cranbourne area by the aeromagnetic survey are due to buried basalt. This possibility could be tested by drilling in the centre of the "highs", for example, at points 1½ miles east-north-east of Seaford and 4 miles due east of Edithvale.

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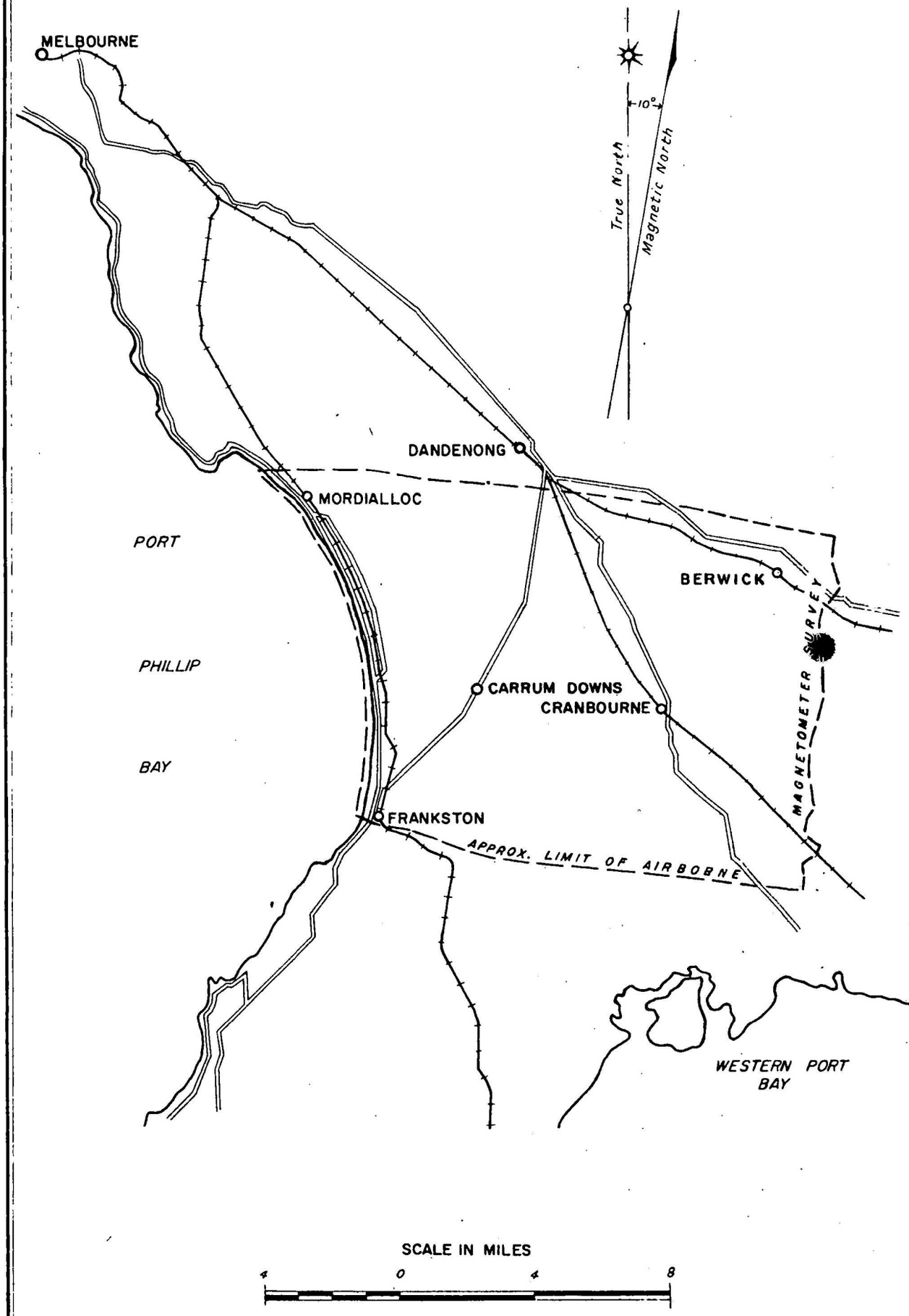
PLATE I



LOCALITY MAP

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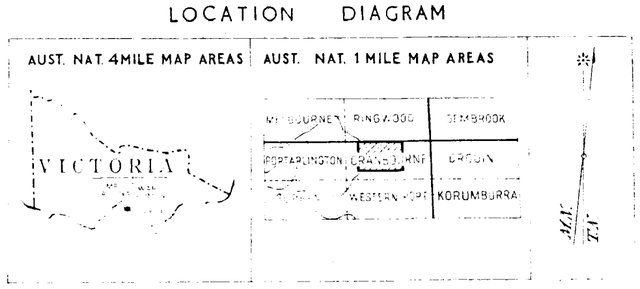
VICTORIA

CRANBOURNE AREA

PLATE 2

LOCATION DIAGRAM



LEGEND

- MAGNETIC CONTOURS (250 / 25)
- MAGNETIC LOW
- FLIGHT LINE
- RAILWAY
- ROAD
- TRACK
- CREEK
- SEISMIC TRAVERSE

SCALE IN MILES

1 0 1 2 3 4 5

CONTOUR INTERVAL **25** GAMMAS

AEROMAGNETIC MAP OF TOTAL INTENSITY CRANBOURNE AREA

EXPLANATION

- [illegible] MAGNETIC
- OLDER BASALT
- SILURIAN

[illegible] Geological Map of Central Victoria (May 1957)

This map was compiled [illegible] results of an aeromagnetic survey of a selected area in the Cranbourne area, Victoria, conducted by the Bureau of Mineral Resources in May 1956. The object of the survey was to delineate magnetic anomalies which might show the extent and distribution of basalt.

The data remain uncorrected for the regional gradient in total magnetic intensity of [illegible] per mile in a direction of S 10° W.

The total magnetic intensity was continuously recorded by an airborne magnetometer. The survey was made at an altitude of 500 feet above ground level along lines spaced one half-mile apart.

The Cranbourne one mile military map was used as a visual aid to navigation. The actual flight path of the aircraft was plotted from 35 mm. continuous strip photography of the ground taken during flight.

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