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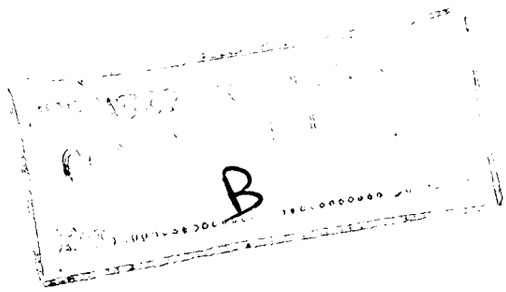
COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS



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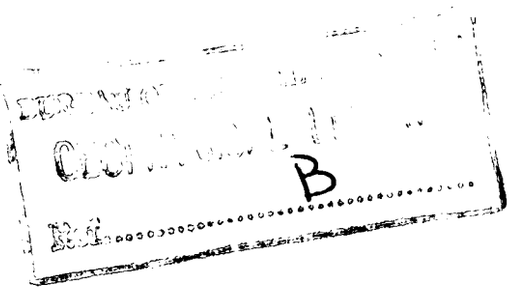
RECORD No.1962/100

LAKE JOHNSTON AREA AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, W.A. 1960

by

R. Wells

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.



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CONTENTS

ILLUSTRATIONS

SUMMARY

The magnetic and radiometric airborne survey of the Lake Johnston four-mile area made in 1960 is part of a programme of regional airborne reconnaissance surveys in Western Australia.

In general the magnetic profiles exhibit the characteristics associated with granite bodies at or near the surface. Intense anomalies mark jaspilite beds, and other anomalies mark a norite dyke.

Fifteen radiometric anomalies of only moderate intensity were recorded. They do not form a significant pattern or show any obvious relation to the geology. The region of the Johnston Lakes is marked by a relatively low level of radioactivity. Areas of higher general radioactivity appear to be associated with granite rocks in the northern and eastern parts of the area.

1. INTRODUCTION

The survey described in this Record is part of a programme of regional airborne reconnaissance surveys in Western Australia which was commenced by the Bureau of Mineral Resources in 1956. Between 1956 and 1959 the four-mile areas of Southern Cross, Kalgoorlie, Barlee, Jackson, Kurnalpi, Widgiemooltha, Boorabbin and Norseman were surveyed.

The 1960 survey covered the four-mile area of Lake Johnston (Plate 1). The selection of this area for inclusion in the Bureau's airborne programme was made in accordance with recommendations by the Mines Department of Western Australia.

Flying operations were made during November 1960 with the Bureau's DC. 3 aircraft VH-MIN. The field party was based at Norseman and comprised the following officers of the Geophysical Branch: R. Wells (Party Leader), G. Young, M.J.W. Duggin, P. Turner, D. Upton, J. Janulaitis, K. Mort, and D. Park; and the following officers of Trans-Australia Airlines: Capt. G. Close, First Officer G.C. Greene, and Engineer W. Briggs.

2. METHOD

The survey consisted of a systematic reconnaissance with airborne magnetometer and scintillograph.

The survey area was covered by flying parallel east-west traverses spaced one mile apart. The height of the aircraft was maintained at a nominal 500 ft above ground level, but the actual height varied as much as ± 50 ft under normal flying conditions.

Tie-lines were flown to enable corrections to be made for differences in magnetic data of individual flight-lines, for diurnal variation, and for instrument drift. The tie-lines were flown north-south at approximately 15 miles spacing; each tie-line was flown in one direction only and intersected all flight-lines.

The aircraft was navigated with aerial photographs upon which the predetermined flight paths had been drawn. A continuous photographic record of the flight path was taken for subsequent plotting of the flight path on photomosaics.

Correlation of the various instrument and photographic records was achieved by fiducial marks initiated by an accurate electronic timer.

3. EQUIPMENT

A saturable-core fluxgate magnetometer, type MFS-4, was used with its detector head installed at the end of a boom projecting from the tail of the aircraft. This equipment measured changes in the Earth's total magnetic field at a sensitivity of 50 gammas/in.

The output of the magnetometer was recorded on a 'Speedomax' chart recorder. Concurrently a digital record of the field was punched on 5-hole paper tape at one-second intervals so that the magnetometer data could be processed by a digital computer. Additional equipment produced a chart record of the magnetic profile at a reduced scale. Some of these profiles are reproduced on Plate 2.

The aircraft was fitted with two separate scintillograph systems. One system was mounted in the aircraft and consisted of two MEL scintillograph detector heads whose combined output was integrated by a BMR-type ratemeter and recorded on a single-channel Kelvin & Hughes chart recorder. The time constant of the ratemeter was approximately 2 sec. The second scintillograph system was housed in an aerodynamically stable fibreglass shell, and trailed 300 ft below the aircraft at the end of a cable controlled by a hydraulic winch. The shell contained a plastic phosphor detector head, a transistorised power unit, and a preamplifier; the output of the preamplifier was fed via the towing cable to a second ratemeter and Kelvin & Hughes recorder mounted within the aircraft. The time constant of the second ratemeter was approximately 1 sec.

The flight path of the aircraft was recorded by an 'Aeropath' continuous-strip 35-mm camera. This equipment was supplemented by an air position indicator which provided an air plot of the progress of the aircraft along each flight-line. The air position was resolved into two components at right angles and was recorded graphically on a 'Recti-riter' chart recorder. The components of position were also displayed on two mileage counters which were photographed at regular intervals.

An STR30B radio altimeter recorded the height of the aircraft above ground level; this height was continuously displayed on a Kelvin & Hughes recorder.

4. GEOLOGY

Regional geology of the surveyed area is shown on Plate 2 and is based on a sketch map accompanying a report of a survey of the Bremer Range country (Honman, 1913).

Aerial observation and airphoto interpretation indicate that the survey area is in general covered by sandy and lateritic deposits. Granite outcrops are wide-spread, indicating that this area forms part of the inland granite plateau.

A pocket of greenstones (Archaeozoic) extends from a point four miles north of Mount Round Top in a south-east direction to Lake Medcalf; a narrow tongue of greenstones south of Mount Gordon terminates at latitude 32° 45' and includes the Bremer Range. These greenstones are predominantly altered basic lavas and tuffs; the lavas are locally amygdaloidal and show pillow-structure (David, 1950). The central greenstone outcrop is flanked by two outcrops of gneiss in the vicinity of Maggie Haye Hill, and haematite-bearing quartzites (jaspilites) were mapped by Honman at various points along a line from Mount Round Top to the Bremer Range, and on an extension of this line to the south.

This Archaeozoic assemblage is related to similar outcrops in other parts of Western Australia where the greenstones are economically important. At Norseman, to the east, gold has been recovered from shear zones in the lavas; at Ravensthorpe, to the south, gold and copper have been recovered from similar zones.

Owing to the lack of geological survey work in the area, little tectonic information is available. Sofoulis (1958, p. 122) considers that there is evidence to suggest that a major continental nucleus embraces the Kalgoorlie/Yilgarn areas. The Johnston Lakes lie in the centre of the southern part of this nucleus, and it is interesting to note that if major lake lines reflect the fundamental negative or depression belts of the Archaeozoic geosynclines (Sofoulis, p. 43), the belt of greenstones which trends south-east across these Lakes may mark the line of coalescence between two minor subsidiary massifs in the nucleus.

5. RESULTS

Magnetic results

The magnetic pattern is represented by selected profiles recorded on the reduced-scale magnetic recorder (Plate 2). The vertical (amplitude) scale is approximately 1600 gammas per inch. In presenting the profiles, it has been necessary to adjust their lengths to agree with the base map and also to rectify the original curvilinear record. Consequently some distortion has been introduced and the profiles should be regarded as diagrammatic representations only. The position of the peak of each anomaly has been plotted within $\frac{1}{4}$ mile.

In general the magnetic profiles exhibit an erratically disturbed background, of the kind that is often characteristic of granite bodies at or near the surface. A slight contrast is apparent on some profiles between these disturbed patterns and less disturbed patterns which are probably associated with gneissic terrain. Delineation of granite boundaries may be possible when the magnetic contours are available.

Two exceptions to the general pattern are the line of steep anomalies, approaching 5000 gammas, which mark the jaspilite beds, and the east-west trending line of smaller anomalies associated with a norite dyke that enters the eastern margin of the area at latitude 32° 12'.

The jaspilites bear a marked susceptibility contrast to the greenstone lavas with which they are interbedded; consequently, the magnetic anomalies to which the jaspilites give rise stand out clearly. Generally the anomalies follow the direction of trend indicated by Honman, but there are discrepancies in position which are probably associated with the poor topographic control available when Honman's geological report was published. A marked gap in this trend occurs over a distance of about nine miles southwards from the identified jaspilite outcrop north-west of Maggie Haye Hill. Magnetic profile 24 shows no evidence of jaspilite occurring in this area. The disposition of the flanking gneiss outcrops and the narrowing of the greenstones in the area suggests that this break in the trend is structural in origin.

Due west of Mount Gordon the trend of the anomalies is less clearly defined and amplitudes are less than 1000 gammas. The trend continues southwards to a point five miles south-west of Wellstead Rock where magnetic profile 44 records an anomaly exceeding 3000 gammas. On the magnetic evidence this is the southernmost point of the jaspilite beds. The outcrop indicated by Honman farther south is not associated with any marked change in magnetic intensity.

Isolated anomalies occur about 10 miles west of the line of jaspilites. These may mark the remnants of a repetition of the greenstones.

East of Mount Round Top, magnetic profiles 12 and 13 show a series of magnetic anomalies, of intensities between 1000 and 2000 gammas, which are associated with a norite dyke. This dyke can be identified at some points on the aerial photographs, and Forsyth (1961) refers to it in the report of the Norseman survey. It is thought to be of late Precambrian age (O'Driscoll, 1953 p.140).

Radiometric results

Fifteen radiometric anomalies were recorded in the area. The position of these anomalies, together with changes in level of radioactive intensity are shown on Plate 2. The radiometric data have been plotted within $\frac{1}{4}$ mile.

None of the anomalies is of great amplitude. They are confined mainly to the northern part of the area and do not form a significant pattern nor, on the information available, can they be related to the geology. The areas with relatively high levels of radioactivity (shown on Plate 2) have a general north-south orientation and tend to enclose the region in which the Johnston Lakes lie. There is a marked absence of radioactively-high areas in the region of the Lakes. There is some evidence of a correlation of radioactivity with rock type. In the northern and eastern points of the surveyed area, the higher radioactivity appears to be associated with the granite enclosing the greenstones.

6. REFERENCES

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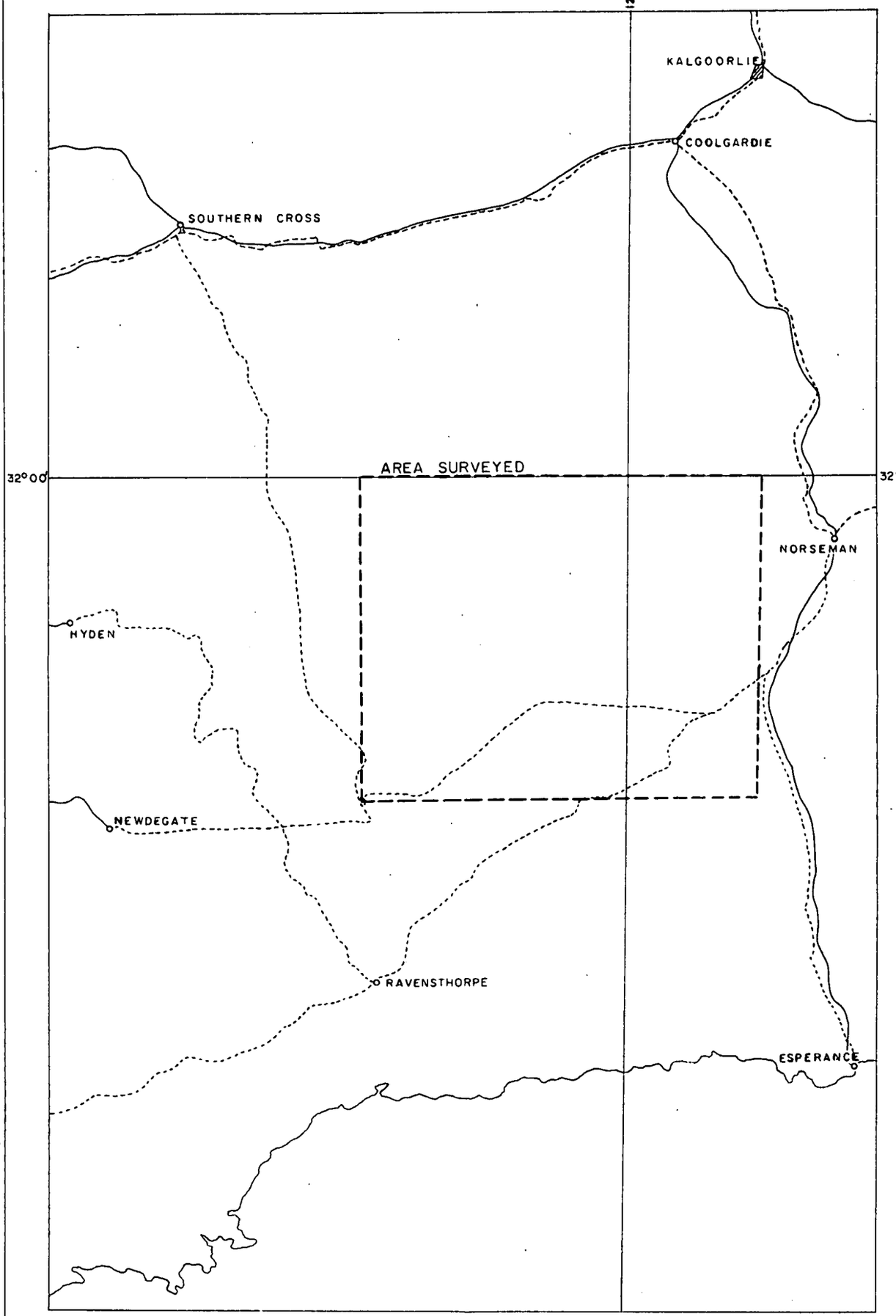
PLATE I



LAKE JOHNSTON W.A.

LOCALITY MAP FOR

AIRBORNE SURVEY 1960

SCALE 10 0 10 20 30 40 50 60 70 MILES

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GEOPHYSICAL BRANCH BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

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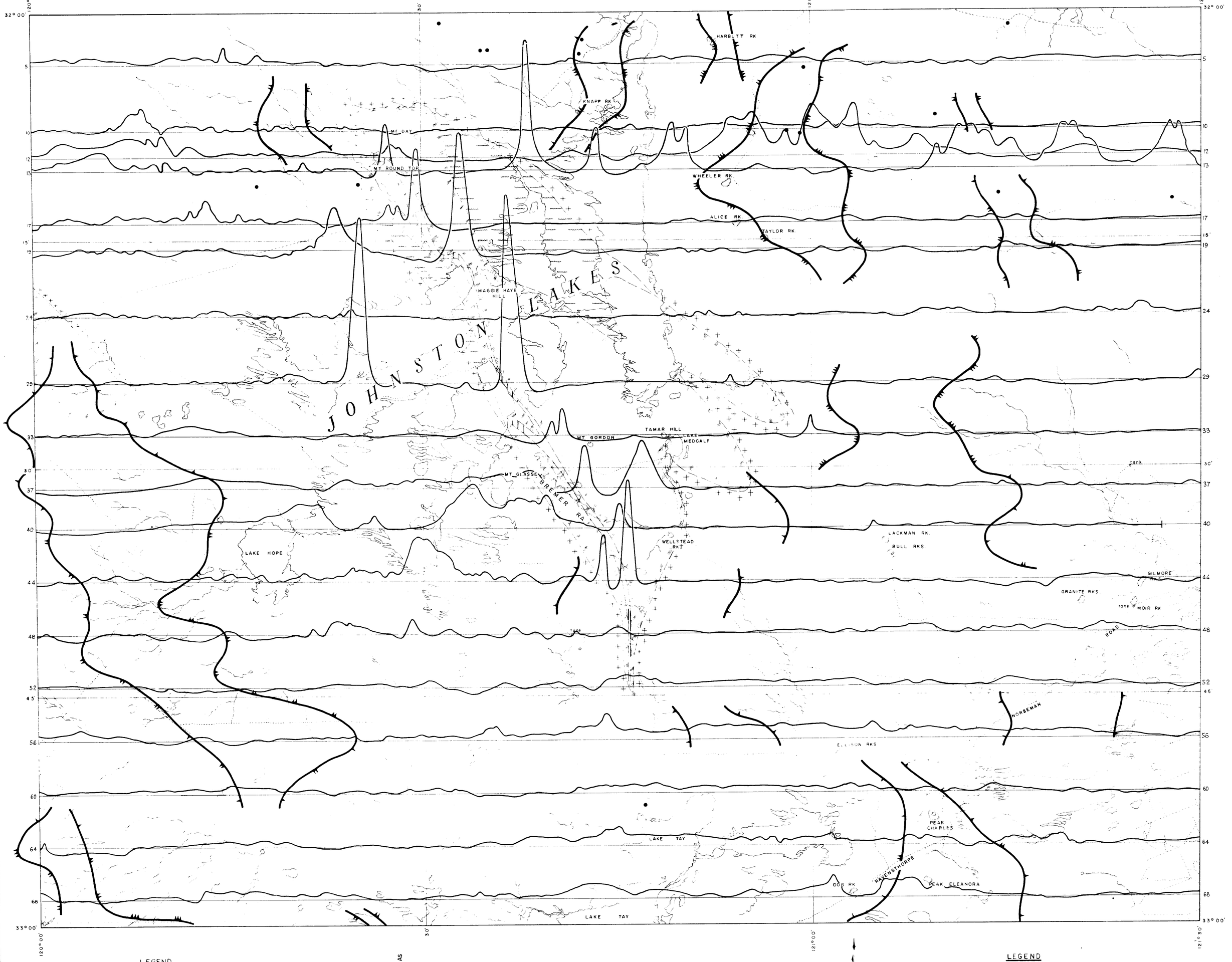
PLATE 2

LAKE JOHNSTON W.A.

MAGNETIC AND RADIOMETRIC RESULTS

AIRBORNE SURVEY 1960



LEGEND

ARCHAEOZOIC
- GREENSTONES
- GNEISS
- GRANITE (MASSIVE)
- HAEMATITE-BEARING QUARTZITES

VERTICAL SCALE IN GAMMAS (APPROX)
2400
1600
800
0

SCALE 2 0 2 4 6 8 10 12 14 16 MILES

LEGEND

- ROAD OR TRACK
- GEOLOGICAL BOUNDARY
- MAGNETIC PROFILE (DIAGRAMMATIC)

CHANGE IN LEVEL OF RADIOACTIVE INTENSITY

- BETWEEN $\frac{1}{2}$ AND 1 TIMES BACKGROUND
- BETWEEN 1 AND $1\frac{1}{2}$ TIMES BACKGROUND
- BETWEEN $1\frac{1}{2}$ AND 2 TIMES BACKGROUND

THE BARBED EDGE FACES THE AREA OF LOWER INTENSITY

- RADIOMETRIC ANOMALIES

MAP DETAIL COMPILED FROM WESTERN AUSTRALIAN LANDS DEPARTMENT 1 INCH TO 1 MILE PLANIMETRICS

NOTE GEOLOGICAL INFORMATION FROM GEOLOGICAL SKETCH MAP OF THE BREMER RANGE COUNTRY, DUNDAS G.F. BY C.S. HONMAN FIELD GEOLOGIST 21-11-1913

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