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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS.

RECORDS

1958 No. 45

Preliminary Report

on

Airborne Magnetic and Radiometric Surveys

in

Kalgoorlie - Southern Cross Region

Western Australia

(1956/57)

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A.G. SPENCE

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CONTENTS

	<u>Page</u>
1. INTRODUCTION	1
2. THE AREA SURVEYED	1
3. SURVEY METHOD	2
4. EQUIPMENT	2
5. RESULTS	3
6. DISCUSSIONS OF MAGNETIC RESULTS	3

MAPS

1. Locality Map.
2. Southern Cross 4 mile to 1 inch.
3. Kalgoorlie 4 mile to 1 inch.
4. Jackson 4 mile to 1 inch.
5. Barlee 4 mile to 1 inch.

1. INTRODUCTION

The airborne magnetic and radiometric surveys in the Kalgoorlie-Southern Cross region, Western Australia, were carried out by the Bureau of Mineral Resources, Geology and Geophysics at the request of the West Australian Department of Mines.

The area surveyed is part of the great Pre-cambrian shield of Western Australia which in many places is mineralised. The area includes the Yilgarn Goldfield and portions of the Coolgardie, North Coolgardie, East Coolgardie and Broadarrow Goldfields in which gold occurs at numerous centres; the most notable being Kalgoorlie.

At some places the gold occurs in banded iron formation (jaspilite) which in its unweathered state is rich in magnetic iron minerals and can therefore be detected by magnetic methods. Basic and ultrabasic rocks (greenstone) occur in discrete areas and are by far the most common host rocks for gold deposition. Many of the deposits occur near the contact between greenstone and granitic rocks and generally the deposits can be related to geological structure in the greenstone.

Most of the area surveyed is deeply soil covered which makes precise geological mapping difficult. The greenstone contains magnetic minerals to a variable degree and it has been found that in some places the structure of the greenstone can be mapped by magnetic methods.

It is to be expected therefore that the airborne magnetometer results will be useful in delineating the greenstone areas, in determining precisely their contact with the granitic rocks and in mapping their regional structure. It is also likely that some of the magnetic anomalies are due to banded iron formations and that the interpretation of their structure from the magnetic results will indicate places where prospecting for gold is warranted.

Iron ore occurs at Koolyanobbing and other places in the Yilgarn Goldfield and the known deposits have given intense magnetic anomalies. Similar intense anomalies in other places may be due to similar iron ore deposits.

Although there are no known deposits of the radioactive minerals uranium and thorium in the area, it is possible that such deposits exist but have not been discovered by surface prospecting. Altered Pre-cambrian sediments and volcanics similar to those which occur in the area surveyed are in many parts of the world the host rocks in which important deposits of radioactive minerals occur. It has been found in many areas e.g. in the Darwin-Katherine region of the Northern Territory, that some granite intrusions are many times more radioactive than the surrounding rocks and that outcrops of such granite give rise to scintillograph anomalies. In view of the widespread occurrence of granite in the area surveyed it is to be expected that many of the radioactive anomalies detected will be found to be due to granite.

2. THE AREA SURVEYED

The area surveyed during September and October 1956 was the Southern Cross 4-mile military map area. This was surveyed with D.C.3 aircraft VH-MIN. The areas covered by the 4-mile

2.

military maps of Kalgoorlie, Barlee and Jackson, were surveyed during the period 16th April to 31st July, 1957 with D.C.3 aircraft VH-BUR.

The following personnel took part in the Southern Cross (1956) survey: J.K. Newman, W.A.L. Forsyth, A. Turpie, F.J. Merrick, G. Lamberts, L. Jackson, W. Irving and Miss C. Leary. T.A.A. personnel were Captain Duffield and B. Wales. The personnel taking part in the Kalgoorlie (1957) survey were: A. Spence, F. Jewell, M. Kirton, G. Lamberts, G. Woad, F.G. Walker, Mrs. W. Spence. The T.A.A. personnel were Captain Evans, D.E. Wright and B. Evans.

3. SURVEY METHOD

Survey flying was carried out at an altitude of 500 feet above ground level with flight lines in an east-west direction spaced one mile apart. In selected areas where large magnetic anomalies were recorded additional lines were flown to make the traverse spacing either one half or one quarter mile. The more important radioactive anomalies were surveyed at a height of approximately 200 feet above ground level to locate accurately those anomalies which appear to arise from restricted sources.

A system of north-south magnetic tie-lines was flown at an approximate separation of 25 miles to determine the instrumental and diurnal drift of the magnetic reference level between flight lines.

The aircraft were navigated visually from vertical aerial photographs (K-17) and a continuous photographic record of the aircraft's ground track was taken during each survey.

4. EQUIPMENT

The aircraft were fitted with magnetometers of the flux-gate type with a detector head mounted at the end of a 10 ft. boom extending from the tail of the aircraft. With this arrangement the detector was removed as far as practicable from the disturbing fields of the aircraft's magnetism. The effect of the aircraft's magnetism was reduced to small proportions by compensating devices. The output from the magnetometers was recorded on Speedomax recorders.

The radiometric equipment in each aircraft consisted of two Chalk River scintillation detection heads mounted in the aircraft feeding into an M.E.L. type radiation monitor, the output being recorded on an Esterline-Angus chart recorder. An overall time constant of 1 second was used and a continuous record of the gamma ray intensity was obtained along each flight line.

The aircraft were fitted with radio altimeters, an STR 30A in VH-MIN and an STR 30B in VH-BUR. The output from each radio altimeter was recorded continuously on an Esterline-Angus recorder.

In both surveys a 35 mm Vinten vertical camera was used for position of the aircraft's flight path. The camera was arranged to photograph the ground at regular intervals, the interval being arranged to give a small degree of overlap between adjacent photographs. The recorder charts and vertical photography

were correlated by relating photographic frame numbers to fiducial marks on each chart.

5. RESULTS

(i) Radiometric. About 200 radiometric anomalies were detected when flying at 500 feet and 70 of these were re-examined at 200 feet elevation. The final evaluation of these anomalies is incomplete and no radiometric anomalies are shown on the plans which accompany this report.

(ii) Magnetic. The accompanying preliminary maps show the peak values of magnetic anomalies above the mean field level in the vicinity of the anomaly. The anomalies are plotted at points where the maximum values occur. Only peak values of anomalies are indicated; in many places the field is anomalous to a considerable extent in the area surrounding the anomaly shown.

In the Southern Cross 4-mile area the position of the magnetic anomalies has been plotted from the 35 mm. vertical photography with an error of approximately \pm 50 yards.

In the 4-mile areas of Kalgoorlie, Jackson and Barlee, however, the precise plotting of the anomalies from the 35 mm. vertical photography has not been completed and on the maps presented herewith they are shown only in an approximate position; the accuracy of positioning being about \pm quarter mile.

Also shown on the magnetic anomaly maps are the three main geological units, viz, the greenstone and whitestone series and rocks which are mainly acid types. Their boundaries have been plotted from the Geological Sketch Map of Western Australia, 1950, compiled by the Geological Survey of Western Australia.

Work is proceeding on the accurate plotting and evaluation of all the results which will be issued later as maps showing magnetic contours and scintillograph anomalies in their correct position relative to topography.

6. DISCUSSIONS OF MAGNETIC RESULTS

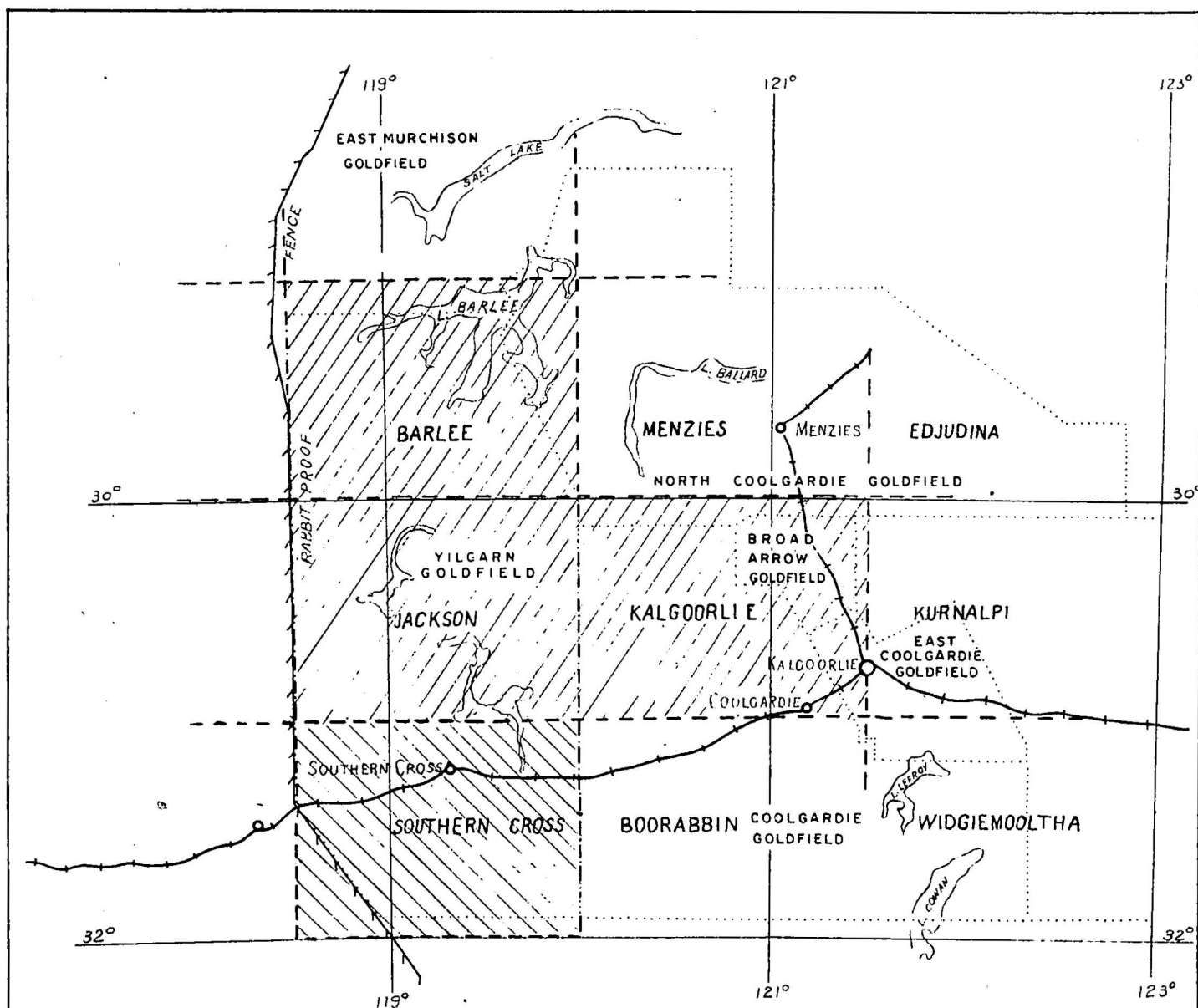
The magnetic anomalies fall in general along lines of considerable linear extent. The anomalies have a magnitude exceeding 10,000 gammas in some places, notably in the Koolyanobbing Range where iron ore deposits are known to occur and in the northern-central part of the Jackson 4-mile area.

In general the lines of magnetic anomalies fall within the areas mapped on the Geological Sketch Map of Western Australia, 1950, as greenstone but in many places the lines of anomalies extend beyond the areas so mapped.

It seems likely that the most intense anomalies are due to bodies containing relatively high proportions of the iron ore, magnetite, at or near the surface. Whether or not any or all of these are of economic importance can only be determined by surface prospecting.

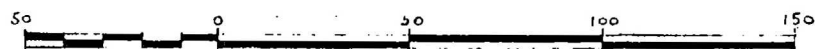
The pattern of the anomalies in the greenstone areas shows a good correlation with the known regional structure of the greenstone. It has been noted that there is a marked difference in the magnetic pattern between those areas occupied by

greenstone and those occupied by granitic rocks and it is believed that the results will be of considerable value in regional geological mapping. The final contour maps will show more clearly the relationship between magnetic pattern and rock types.






AIRBORNE SURVEY (MAGNETOMETER AND SCINTILLOGRAPH) OF
KALGOORLIE-SOUTHERN CROSS REGION, W.A.

LOCALITY MAP



SCALE IN MILES

-  AREA SURVEYED, APRIL-JULY, 1957
-  AREA SURVEYED, SEPT.-OCT, 1956
-  GOLDFIELD SUBDIVISIONS

BARLEE



AIRBORNE SURVEY OF KALGOORLIE-SOUTHERN CROSS REGION, W.A., 1956-57

PRELIMINARY MAP SHOWING POSITIONS OF MAGNETIC ANOMALIES

- Breckstone series
- White Line series
- Mainly acid rocks

LEGEND

- 500 < + Magnetic anomalies < 3000 gammas
- + Magnetic anomalies > 3000 gammas
- Magnetic anomalies > 2,000 gammas

Geological boundaries plotted from Geological sketch map of Western Australia, 1950, compiled by Geological Survey of Western Australia.

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JACKSON



AIRBORNE SURVEY OF KALGOORLIE-SOUTHERN CROSS REGION, W.A., 1956-57

PRELIMINARY MAP SHOWING POSITIONS OF MAGNETIC ANOMALIES

- Greenstone series
- White stone series
- Mainly acid rocks

LEGEND

- 500 ≤ + Magnetic anomalies < 3,000 gammas.
- + Magnetic anomalies ≥ 3,000 gammas.
- Magnetic anomalies > 2,000 gammas.

(Geological boundaries plotted from Geological sketch map of Western Australia 1950, compiled by Geological Survey of Western Australia.)

KALGOORLIE



Scale in Miles

AIRBORNE SURVEY OF KALGOORLIE-SOUTHERN CROSS REGION, W.A., 1956-57

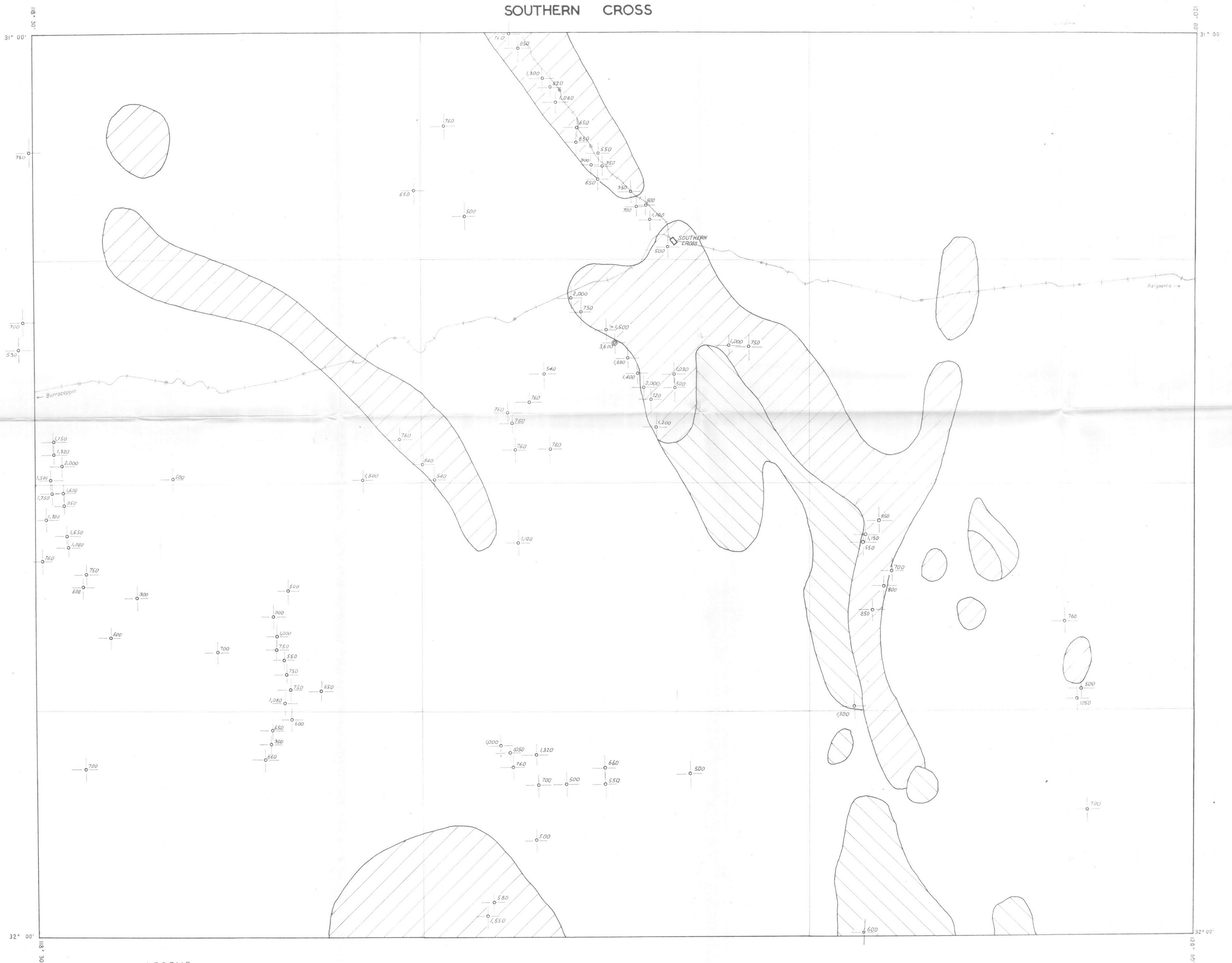
PRELIMINARY MAP SHOWING POSITIONS OF MAGNETIC ANOMALIES

(Geological boundaries plotted from Geological sketch map of Western Australia, 1950, compiled by Geological Survey of Western Australia).

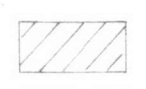
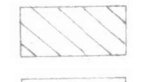

LEGEND

$500 \leq + \text{Magnetic anomalies} < 3000 \text{ gauss.}$
 $+ \text{Magnetic anomalies} > 3000 \text{ gauss.}$
 $- \text{Magnetic anomalies} > 2000 \text{ gauss.}$

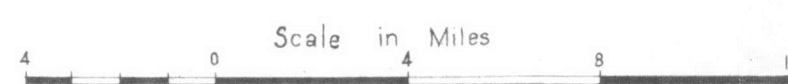
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LEGEND

-  Greenstone Series
-  Whitestone Series
-  Mainly Acid Rocks

AIRBORNE SURVEY OF KALGOORLIE-SOUTHERN CROSS REGION, W.A., 1956-57 **PRELIMINARY MAP SHOWING POSITIONS OF MAGNETIC ANOMALIES**



-  $500 \leq + \text{Magnetic anomalies} < 3,000 \text{ gammas}$
-  $+ \text{Magnetic anomalies} \geq 3,000 \text{ gammas}$

(Geological Boundaries plotted from Geological sketch map of Western Australia, 1950, compiled by Geological Survey of Western Australia).