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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1962/191

CARNARVON BASIN AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, WA 1961

by

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ILLUSTRATIONS

SUMMARY

During the period May to August 1961, a BMR survey party completed the airborne magnetic and radiometric survey of the Carnarvon Basin, which commenced in 1956.

The magnetic data provide evidence of the eastern boundary of the Basin, and of the existence of some major structures within the Basin. Within the Precambrian region, restricted areas of intense magnetic disturbance were located. One of these areas corresponds with a known iron ore deposit.

One radiometric anomaly was detected.

1. INTRODUCTION

The airborne magnetic and radiometric survey described in this Record was done by the Bureau of Mineral Resources, Geology and Geophysics at the request of the Western Australian Mines Department. It formed part of a programme to survey the Carnarvon Basin which was commenced in 1956 (Parkinson, 1957), and was continued during 1957 (Forsyth, 1960) and 1959 (Spence, 1961). The object of the programme was to record magnetic data over the entire Basin in order to obtain information concerning its depth and principal structural features. Concurrently with the recording of the magnetic data the survey area was tested for radioactivity. The survey was extended east of the Basin for an average distance of about 50 miles over outcropping Precambrian rocks. The northern area of the 1961 survey was extended eastwards to complete the coverage of the Yarraloola 1:250,000 map area. The areas covered by the surveys are shown on the locality sketch (Plate 1). The programme for the Carnarvon Basin was completed by the survey described in this Record, which took place during the period May to August 1961.

The 1961 survey was made with the Bureau's DC.3 aircraft VH-MIN. Staff from the Bureau engaged on the survey were: A.G. Spence (party leader), A. Drage, F.E.M. Lilley, J. Janulaitis, C.J. Braybrook, K. Mort, D. Park, J.E. Lynne, and O. Scherl. Personnel from Trans-Australia Airlines who assisted in the operations were Captain G.G.B. Close, First Officer D. Baker, and Aircraft Maintenance Engineer W. Briggs.

2. METHOD

The survey consisted of a systematic measurement of the changes in total magnetic intensity and gamma radiation throughout the area along east-west flight-lines spaced one mile apart. The survey was extended some 50 to 70 miles beyond the eastern edge of the Basin into the outcropping Precambrian rocks.

A system of tie-lines spaced 15 miles apart was flown in a north-south direction to provide the information required to remove systematic error from the magnetic data and to reduce the profiles recorded along individual flight-lines to a common datum.

The aircraft was flown at an average height of 500 ($\pm$ 50) feet above ground level and was navigated by comparing ground feature with detail on mosaics of vertical aerial photographs.

Using a vertical strip-film camera, photographs were taken of the aircraft's track and used in conjunction with air-position data to plot the aircraft's ground position.

3. EQUIPMENT

An MFS-4 saturable core fluxgate magnetometer was used. The detector head was mounted in a boom projecting from the tail of the aircraft so as to remove it as far as possible from the disturbing fields of the aircraft's own magnetism. The output of the magnetometer was recorded on a 'Speedomax' chart recorder.

Two separate scintillographs were carried. One was mounted within the aircraft and consisted of two MEL detectors, whose outputs were fed into a BMR-type ratemeter and presented on a Kelvin & Hughes chart recorder. The other scintillograph measured the radiation level about 300 ft below the aircraft. The detector in this case was contained in a 'bird' which was towed by the aircraft on 500 ft of cable. The output of the detector was fed to a second BMR-type ratemeter and recorded on a Kelvin & Hughes chart recorder.

The altitude of the aircraft was continuously measured and recorded by an STR30B radio-altimeter. The altitude profile so recorded was used to correct the radiometric data where necessary.

The air-position indicator used was the Mk 1A version and its output was recorded as co-ordinates, referred to an arbitrary origin, which were displayed on digital counters and photographed every 10 seconds. In addition the output was fed to a chart recorder which provided a continuous plot of the aircraft's air position.

A magnetic-storm detector was operated to provide information on diurnal drift and the presence of magnetic storms.

An 'Aeropath' vertical strip camera was used for recording the aircraft's track.

A fiducial marker system provided the correlation between all the records.

4. NORTHERN AREA

Geology

Apart from the Cape Range area where the geology, both surface and subsurface, is known in some detail, the geological information on the area surveyed is limited. The geological boundaries on Plate 2 are taken from the Tectonic Map of Australia published by the Bureau of Mineral Resources in 1960.

Most of the geophysical surveys and drilling work have been confined to the Cape Range area. A gravity traverse has been made by West Australian Petroleum Pty Ltd on the mainland adjacent to Exmouth Gulf and a marine seismic survey has recently been made within the Gulf and surrounding waters. No mining of any importance has been done in the area, and none is being done at present.

Condon (1954) describes the mainland coastal area as largely covered by a generally thin veneer of Recent deposits. Sand in the form of ridges, dunes, and flat or hummocky plains covers the largest areas. Alluvial deposits are also widespread especially along the lower reaches of the main rivers. Marine mud and sand occupy most of the flats and marshes along the seaward margin. The southern portion of the coastal area is comprised mainly of gently folded Cretaceous sandstone, siltstone, shale, and minor limestone.

The main structural feature of the coastal region is the buried Ajana/Wandagee ridge of Precambrian basement. The Yanrey No. 1 well bottomed in this ridge at 1437 ft.

Most of the inland area consists of Proterozoic rocks. The metamorphosed Proterozoic rocks comprise schist, quartzite, siltstone, and gneiss. The structural trends observable are mainly north to north-west. A number of basic dykes, some of great length, intrude the schist and gneiss.

Archaean granite crops out about 30 miles south-east of Onslow and in the north-eastern part of the Yarraloola area.

Magnetic results

The main features of the magnetic results are shown on Plate 2. Over the Cape Range, Exmouth Gulf, and the adjacent mainland area the profiles are extremely flat and featureless, indicating a great thickness of sediments. It is known from drilling that there is a great thickness of sediments in the Cape Range area, Cape Range No. 2 well having continued to a depth of 15,170 ft without reaching basement.

Proceeding eastward the profiles become more disturbed as the basement approaches the surface. The line joining the points of change in the character of the profiles marks roughly the indicated north-eastern boundary of the Basin.

Two broad anomalies of low amplitude occur within the Basin. The western one of these is almost certainly due to the Ajana/Wandagee ridge of basement rocks which has been proved to exist as far as the Yanrey No. 1 well and which a gravity survey by West Australian Petroleum Pty Ltd has traced to the vicinity of Point Locker. The other anomaly is probably due to a similar subsurface ridge and was traced as far as Thevenard Island (See Plate 2). It appears to continue north in the direction of Barrow Island.

Over the inland area the magnetic profiles show the disturbed pattern typical of those recorded over the Precambrian Shield. A region of fairly intense magnetic activity occurs in the central and south-eastern sections of the Yarraloola area. The maximum intensity recorded was about 10,000 gammas. The central zone averages 15 miles in width about an axis which roughly approximates that of the western margin of the area of Proterozoic rocks. At its northern end the disturbed zone appears to continue beyond the coastline and its southern and eastern limits apparently lie beyond the limits of the present survey.

By comparison, the remainder of the Yarraloola area is fairly undisturbed. The profiles in the central-eastern portion of the area are remarkably flat.

Insufficient data are available on the structural features in the area to enable accurate correlation with magnetic data.

Radiometric results

The radiometric profiles over the coastal area show little of interest. Minor changes in level of radioactive intensity were observed along parts of the eastern margin of the Cape.

Over the inland area, numerous changes in the level of radioactive intensity were recorded, but the lack of accurate geological mapping in the area prevents any correlation with lithological boundaries being observed.

A localised area of fairly intense radioactivity was detected in the vicinity of Mount Salt, in the coastal marshes of the north-western corner of the Yarraloola area. The position of this radioactive anomaly is shown on Plate 2.

5. SOUTHERN AREA

Geology

The Darling Fault divides this area into two geologically distinct regions. West of the fault, and extending to the edge of the continental shelf, lie the sediments forming the northern part of the Perth Basin. East of the fault lie the Precambrian rocks of the Yilgarn Block. An extensive inlier of Precambrian rocks crops out within the region of the coastal sediments and is referred to as the Ajana Inlier or the Greenough Block.

The Hardabut Fault, which marks part of the boundary between the Perth and Carnarvon Basins, extends into the surveyed area in the north-western corner. The Urella Fault, trending nearly parallel to the Darling Fault, is concealed within this area, although it is exposed farther south.

The Precambrian rocks within this area have not been mapped in detail. The most recent reconnaissance was made by Johnson (1950) and included the Precambrian rocks north of the railway line between Mullewa and Yalgoo. In general the rocks are metamorphosed and highly folded and include granitic rock, schist, slate, sandstone, volcanic sediments, pegmatite, and basic dykes. A large part of the area is covered by alluvium. In some places the alluvial series is 80 ft thick and is an important aquifer. Other recent deposits include travertine and laterite.

The only structure mapped in the Precambrian rocks consists of trend-lines ranging in direction from north-north-east to north-north-west (Tectonic Map of Australia, BMR, 1960).

Magnetic results

The main features of the magnetic results are shown on Plate 3. An abrupt change in the character of the magnetic profiles corresponds closely with the Darling Fault, which marks the contact between the Precambrian Shield and the younger coastal sediments. West of the contact, a smooth broad magnetic 'high' of varying intensity lies within the region of the coastal sediments and trends north-north-west. This magnetic 'high' is almost certainly an expression of the concealed Urella Fault and indicates that the fault extends some distance beyond the northern limit shown on the Tectonic Map of Australia. Farther west a region of low magnetic relief can be correlated in part with the boundaries of the Greenough Block.

Two localised areas of intense magnetic disturbance lie within the Precambrian rocks. One of these is associated with the Tallering Range iron deposits which occur in jaspilite beds within highly metamorphosed sediments. The maximum intensity recorded here was about 3000 gammas. The second area of intense magnetic disturbance is near the eastern boundary of the surveyed area and probably continues beyond the boundaries of the area. Within the surveyed area it extends discontinuously for 40 miles along a line roughly south to south-west from Wolla Wolla. At five centres along this line the disturbance is very intense. Magnetic intensities of about 15,000 gammas were recorded.

The Tectonic Map of Australia does not indicate any outcrop that can be related to the magnetic anomalies recorded over the second area. Basic volcanics ('Greenstones') are shown north and west of the area. 'Banded iron formations' are often associated with the 'Greenstones' and the anomalies may be due to these formations. The extent and intensity of the magnetic anomalies suggest the area is worthy of prospecting for iron ore deposits.

Radiometric results

Changes in level of radioactive intensity show some correlation with the Precambrian contact and the boundaries of the Precambrian inlier.

No radiometric anomalies were recorded.

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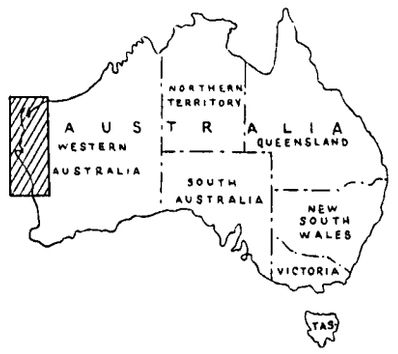
PLATE 1



112° 115° 118°

26°

32°

Onslow

Carnarvon

Shark Bay

GERALDTON

Watheroo

PERTH

BUNBURY

Busselton

LEGEND

AIRBORNE SURVEY 1956

" " 1957

" " 1959

" " 1961

AIRBORNE MAGNETIC AND RADIOMETRIC SURVEYS, CARNARVON BASIN, W A , 1956 - 61

LOCALITY MAP

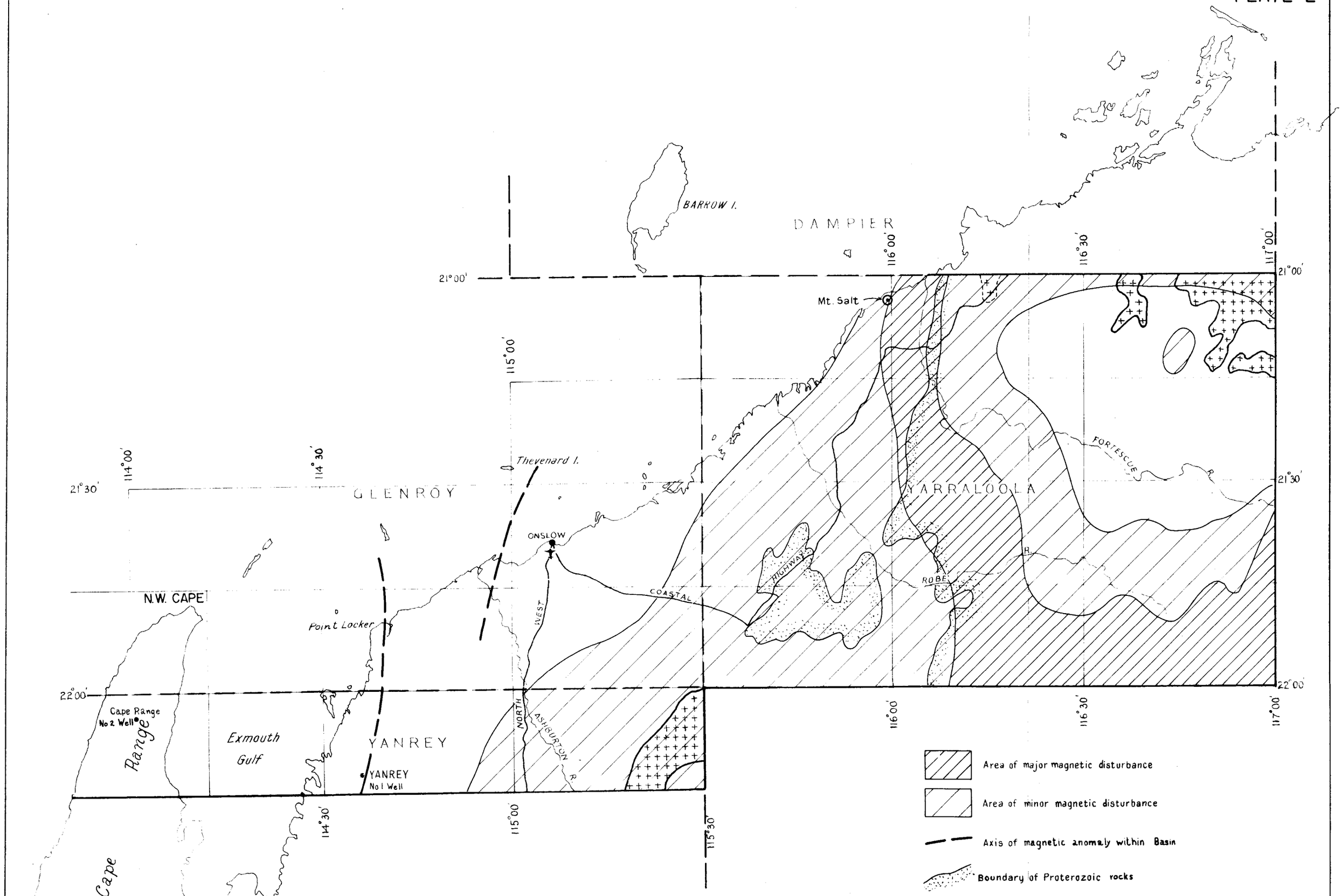
SCALE IN MILES

100 50 0 100 200

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 50/B1-2

To Accompany Record No 1962-191

PLATE 2



CARNARVON BASIN SURVEY 1961

NORTHERN AREA

SCALE 10 0 10 20 30 40 50 60 70 MILES

MAGNETOMETER AND SCINTILLOGRAPH

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics F 50/B1-2

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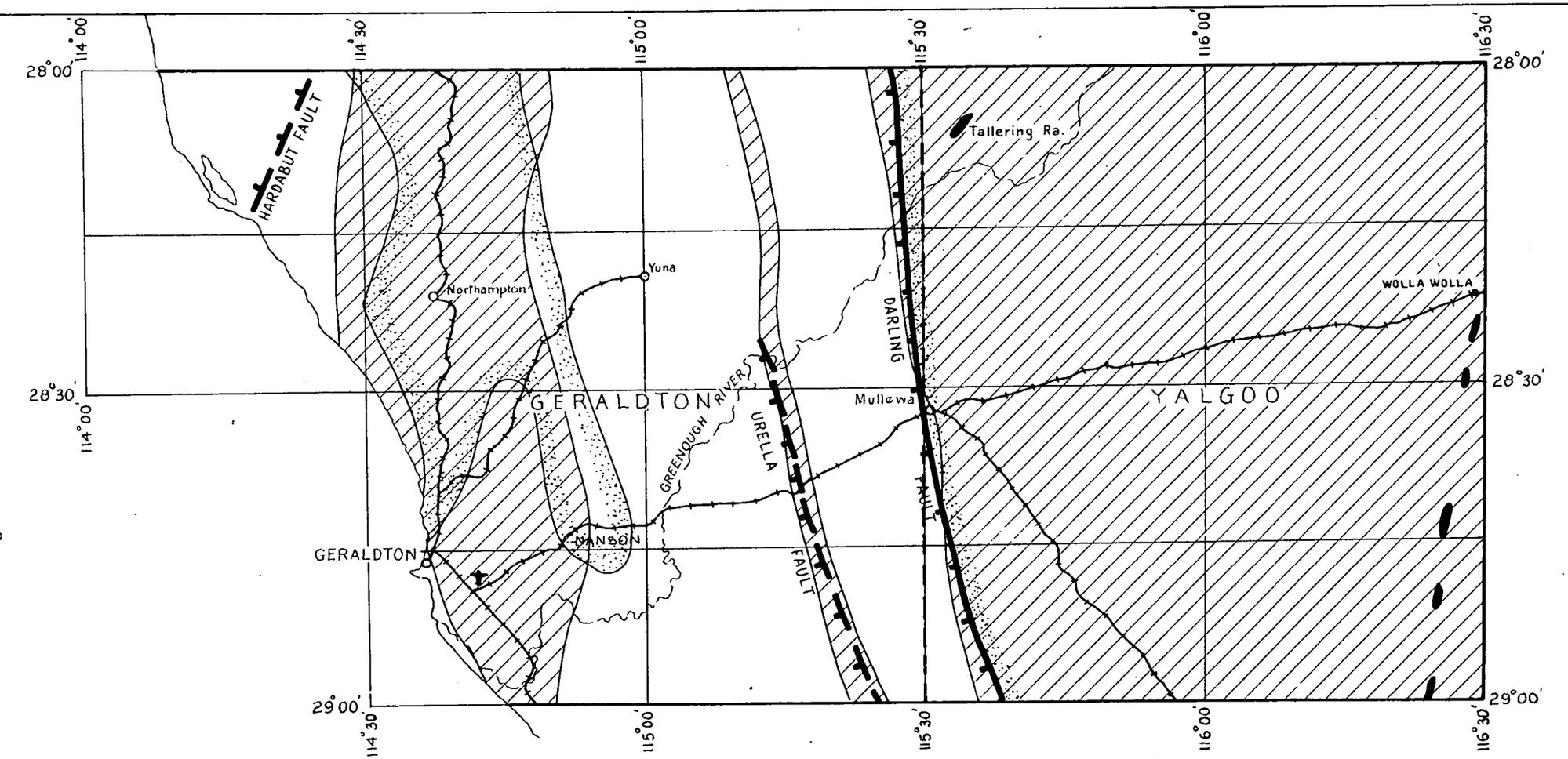

CARNARVON BASIN SURVEY 1961

SOUTHERN AREA

Boundary of Precambrian rocks

Fault

Fault (concealed)

Area of magnetic disturbance

Area of intense magnetic disturbance

SCALE 10 0 10 20 30 40 50 60 70 MILES

MAGNETOMETER AND SCINTILLOGRAPH

PLATE 3

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

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H50/B1-3