COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1965/7

MOUNT BUNDEY DETAILED AEROMAGNETIC SURVEY, NT 1964

by

J.S. Milsom and W.A. Finney

RESTRICTED

This Record contains preliminary information only and is subject to amendment before final issue. It is intended for the private use of tenement holders or authorities who can make immediate use of the data and is not to be made available to anyone other than the original recipients without the Director's approval. The data after further review may be issued as an unrestricted Record.

CONTENTS

PLATES

SUMMARY

In October and early November, 1964 a detailed aeromagnetic survey was carried out around Mt. Bundey, 60 miles south-west of Darwin. The object of the survey was to locate any extensions of the known martite-magnetite iron ore body, (Pritchard's Lode) or any similar bodies in the district. An area of about eighty square miles was selected on the basis of the Darwin - Pine Creek reconnaissance aeromagnetic survey and this area was flown at a nominal line spacing of one tenth of a mile. In addition, a small area including the known ore body was flown at a nominal one-fifteenth mile spacing. Most of the magnetic anomalies are attributed to metamorphosed country rock on the margins of an intrusive igneous complex. Large amplitude anomalies were found to be associated with the known iron ore, but similar anomalies were not detected elsewhere. However further investigation of two of the secondary anomalies is recommended. It also seems probable that there is more iron ore in the north-western part of Pritchard's Lode than has been previously estimated.

1. INTRODUCTION

Between the thirteenth of October and the thirteenth of November, 1964 a detailed aeromagnetic survey was carried out by the Bureau of Mineral Resources in the far north of the Northern Territory. An area of about eighty square miles around Mt. Bundey, approximately sixty miles from Darwin in a direction S 60° E, was flown (Plate 1). Pritchard's Lode, a small martite-magnetite iron ore deposit, crops out about two miles north of Mt. Bundey and it was hoped that the detailed survey would detect similar non-outcropping bodies.

In 1962 a ground magnetic survey was carried out by a field party from the Darwin Uranium Group of the Bureau of Mineral Resources (Ashley, 1962). The results of this survey indicated that iron ore deposits of the Mt. Bundey type would be detected by an airborne magnetometer, and the Mt. Bundey 1:63,360 area was included in the Darwin - Pine Creek reconnaissance aeromagnetic survey. This survey (Goodeve, 1964), flown by Adastra Geophysics Pty. Ltd. under contract to the Bureau, revealed several areas of very disturbed magnetic field near Mt. Bundey but the flight line spacing of half a mile was too great for the accurate delineation of anomalies. The detailed aeromagnetic survey was programmed to resolve anomalies in the main disturbed areas.

2. GEOLOGY

In the following description the general geology of the area has been largely taken from the Bureau of Mineral Resources 1:250,000 series geological map and explanatory notes for the Darwin area (Malone, 1962).

The iron ore deposits at Mt. Bundey are associated with the Mt. Bundey Granite - Mt. Goyder Syenite igneous complex. These igneous rocks crop out strongly south-east of the Mt. Bundey homestead and intrude sediments of the Masson, Golden Dyke and Burrel Creek Formations

(Plate 3), all originally laid down in the Lower Proterozoic Pine Creek Geosyncline.

(1) Sedimentary

The oldest rocks cropping out in the survey area belong to the Masson Formation, which is mainly composed of siltstones inter-tongued with lenses of quartz greywacke. The Masson Formation is conformably overlain by the Golden Dyke Formation, which is more generally argillaceous and contains limey and dolomitic beds. Both formations include pyritic siltstones capped in places by hematitic gossans. Siltstones and greywacke of the Burrel Creek Formation conformably overlie the Golden Dyke Formation.

There has been some low grade regional metamorphism of the sediments, and slates have been developed in some of the silty beds. Contact metamorphism is confined to an aureole less than a quarter of a mile wide around the Mt. Bundey Granite and the Mt. Goyder Syenite.

(2) Igneous

The Mt. Bundey Granite and Mt. Goyder Syenite together constitute an igneous complex intrusive in Lower Proterozoic rocks. Field and laboratory evidence suggests that the rocks of the complex are co-magmatic and that there is a gradational change from syenite to granite (Hasan, 1958). The original intrusion appears to have been of quartz syenite magma close to the surface. Subsequently, after differentiation in the magma chamber, probably coupled with assimilation of sediments into the magma, more granitic rocks were emplaced at deeper levels. The complex is intruded by syenite and aplite dykes, representing a late stage of the intrusive process.

Iron minerals are common in both the granite and syenite as inclusions in hornblende and biotite, the iron content of the syenite (about 2 - 3 %) being generally more than twice as great as that of the granite.

South of the granite outcrop and north and east of Mt. Goyder the sediments are intruded by intermediate igneous dykes and sills,

mainly microdiorite and microsyenite. The sills were emplaced before or during folding and may be genetically related to the granite-syenite complex.

(3) Mineralisation

Pritchard's Lode crops out as a prominent ridge on a rounded syenite hill about 100 ft. high. The main lode is about 2,200 ft. long and there are a few minor exposures to the north-west. The outcropping iron ore consists of martite, frequently seen as large, well formed crystals, but magnetite is the dominant mineral below the surface. At depths greater than eighty feet the lode is pyritic, carrying up to 10% of sulphides, with occasional higher concentrations. The pyritic zone has been assayed for copper but the highest grade recorded was only ½%. At the present the iron ores of the sulphide zone could not be economically worked.

The only rock type cropping out in the vicinity of the ore body is the Mount Goyder Syenite, but hornfelsic bands within the lode suggest the ore was formed by replacement of a roof pendant of country rock (Dunn, 1964). Lenses of slates and shaley material have been intersected within the lode in pits and diamond drill holes. Veins of magnetite occur within the syenite near its contact with the lode and with the country rock.

3. INTERPRETATION

(1) Structural

The survey area may be divided into three sectors, the largest being the highly anomalous region near and to the north of Mt. Bundey and west of the Mary River. Pritchard's Lode lies in the approximate centre of this western area, which is bounded on the south by a narrow negative anomaly striking a few degrees north of west along the bed of "Goose Creek".* The second area lies east of the

*NOTE: Goose Creek and Buffalo Creek are names used only in this report; on other maps these two creeks appear to be unnamed.

Mary River and includes Mt. Goyder. The third includes most of the outcrop of the Mt. Bundey Granite and the limited anomalous area immediately to the south of Goose Creek. These sectors, which will be referred to as the western, eastern and southern areas, are apparent on both the reconnaissance and the detailed aeromagnetic maps (Plate 4, Plate 2).

Magnetic sources in all areas appear to be associated with the Mount Goyder Syenite and, to a lesser extent, with the Mt. Bundey Granite, but are not usually within either of these rocks. This is most clearly seen in the south, where magnetic anomalies occur around the margins of the granite outcrop. The occurrence of magnetic anomalies at the margin of the granites is characteristic of the Darwin - Pine Creek area (B.M.R. 1964 a and b) and is probably due, in part at least, to contact metamorphism of intermediate and basic intrusives. Sills and dykes intrusive in the Lower Proterozoic sediments have been altered to amphibolite, a rock type which is frequently a source of magnetic anomalies. Away from the granites or syenites, as in the area north and east of Mt. Goyder, intermediate intrusives are not associated with magnetic anomalies. Similarly, in the Mt. Bundey southern area, the anomalies were detected near outcrops mapped as intermediate intrusives only where these were within a mile of the margin of the granite. Compared to those further north, all anomalies in the southern area are of low amplitude, and there seems to be no possibility of magnetic iron ore existing there in workable deposits.

Larger anomalies, including those due to the ore in Pritchard's Lode, were detected in the two northern areas. Very few of the anomalies coincide with outcrops of either granite or syenite, although syenite is widely exposed in the main magnetically disturbed areas. It therefore seems certain that metamorphosed country rocks are the source of most of the magnetic disturbances near Mt. Bundey. This implies

that the erosional situation of Mt. Bundey is somewhat different from that around the other granite outcrops in the Darwin - Pine Creek area. One of the problems raised by the reconnaissance survey was the great difference between the magnetic pattern around the Cullen Granite (B.M.R. 1964 a and b) and the very similar granite and syenite at Mt. Bundey. It now appears that this difference is largely coincidental. Whereas the upper surface of the Cullen Granite has been entirely eroded away, the erosion level at Mt. Bundey must be such that the igneous complex is only just exposed. Scattered between granitic outcrops are roof pendants, and possibly also xenoliths, of metamorphosed country rock. These metamorphics, with the exception of the magnetite replacement body, Pritchard's Lode, are presumably softer than the surrounding granites and syenites and now underlie Recent alluvium in the more deeply eroded areas.

There is very little outcrop in the eastern area except near Mt. Goyder, where scattered exposures of the Mt. Goyder Syenite form a rough circle north of "Buffalo Creek". The magnetic field over these outcrops is only slightly disturbed, butthe magnetically quiet area is surrounded by a ring of very large anomalies. This magnetic ring indicates that an aureole of metamorphosed older intrusives and sediments surrounds the syenite boss. Only the south-western syenite outcrop lies outside the undisturbed centre of the ring and partially within the anomalous zone. Detailed geological investigation of this outcrop may reveal lenses of metamorphic rock at the surface, or possibly the magnetite rich bands which sometimes characterise the syenite near its contact with country rock.

Between the 'magnetic ring' and the Mary River there is a roughly linear anomaly (anomaly C, plate 2) striking a few degrees west of north. This rises from a comparatively undisturbed magnetic background and is in an area devoid of outcrop. Since it seems unlikely that syenite would fail to crop out over such a large area if covered

only by Recent, unconsolidated material, two other explanations for the generally undisturbed magnetic pattern must be considered. Firstly, the rocks of the aureole may be non-magnetic except in the vicinity of the anomaly, although the syenite lies at shallow depth below the country rocks which are in turn covered by Recent sediments. Secondly, it is possible that the syenite approaches the surface only in this one meridional band, as a steep sided intrusion, dyke-like but large enough to be surrounded by a metamorphic aureole. Since syenite crops out outside the 'magnetic ring', the first of these explanations seems the more likely, especially since anomalies in the ring are often associated with outcropping, presumably metamorphosed, igneous intrusives, and in the south, where no such rocks have been mapped, the 'ring' is open.

West of the Mary River the magnetic pattern is much more complex, but in general, and with the exception of Pritchard's Lode, magnetic anomalies do not coincide with the outcropping rocks. The apparent width of the magnetic aureole north of both Mt. Goyder and Mt. Bundey is much larger than on the other margins of the intrusion, suggesting that the complex dips comparatively gently under the country rock to the north. A few small anomalies may be due to magnetite-rich bands in syenite, but most anomalies are ascribed to sources in metamorphosed country rock.

In the south of the western area there is the negative linear anomaly along "Goose Creek". On the Mt. Bundey reconnaissance map (Plate 4) a very long linear negative anomaly strikes approximately north north-west through the sediments, but cannot be traced with any certainty through the disturbed area around the granite. Reference to adjoining reconnaissance aeromagnetic maps (B.M.R. 1964c, 1964d, 1964e) shows that this and similar features persist for tens of miles, without any surface geological expression. The Goose Creek anomaly is a continuation of this feature, which therefore post-dates the granite, through the intrusive complex, the different competencies of the granite

and the sediments presumably accounting for the change in strike to about W15°N. Some of the similar features are positive and the sources of these are presumably intrusive, but negative features such as the Goose Creek anomaly might be due to the deep leaching of magnetic material in a fault zone. However, although leaching seems a possible explanation where the lineation crosses the granite, the fact that beyond the granite outcrop the feature intersects a wide variety of sediments and its amplitude bears no apparent relation to the surrounding geological or magnetic pattern, indicates that the source is reverse polarised rock. South-east of Mt. Bundey the Mary River follows the line of the anomaly for several miles, which suggests, as does the course of "Goose Creek", that the source rocks or fault breccias are soft and easily eroded.

(2) Economic

A special flight at reduced line spacing was made over Pritchard's Lode, with the object of detecting additional magnetite concentrations in the immediate vicinity, and of providing a standard of comparison for anomalies detected elsewhere. The detailed contour map (insert, Plate 2) is very similar in form to the smoothed ground contour map previously produced (Ashley 1962) although amplitudes are smaller by a factor of more than four. There are no large anomalies apart from those detected on the ground, but it is noticeable that the north-western anomaly is similar in amplitude and areal extent to the other peaks. This corresponds to Ashley's 'Anomaly A' and is shown as such on the inset to Plate 2. Two diamond drill holes in the north-west failed to intersect any major deposits of martite-magnetite ore (Dunn, 1964) and the anomaly was therefore not tested further. The aeromagnetic results show that there are large amounts of magnetite in the area and further drilling is recommended, preferably after a more detailed ground magnetic survey has been carried out.

No anomalies comparable in amplitude to those at Pritchard's Lode were detected in the remainder of the survey area. However, south-west of Mt. Goyder a very sharp anomaly of almost a thousand gammas amplitude was detected in a generally disturbed area just north of 'Buffalo Creek'. It is possible that there is a small deposit of magnetic iron ore in this area, at a depth of less than a hundred feet below surface. It is recommended that a ground magnetic survey of this anomaly (Anomaly B, Plate 2) be done, and that this be followed by diamond drilling. The drilling should also lead to a better understanding of the overall geological structure of the survey area.

About one mile north of Pritchard's Lode there is a large magnetic anomaly with a maximum amplitude of about eight hundred gammas. The contour pattern is distorted at the southern end by an extensive east-west magnetic ridge, which may be associated with the syenite-sediment contact. The remainder of the anomaly arises from a roughly rectangular source striking about N5°E. Depth estimates made at several points along the strike indicate that the rectangular source approaches to within 100 ft. of the surface at the southern end and plunges gently north to a depth of about 250 ft. The large areal extent of the anomaly due to the rectangular source, coupled with its rather low amplitude, make it unlikely that the source rock, which lies entirely within the pyritic zone, could be regarded as iron ore. However a drill hole to test this anomaly is tentatively recommended, since it is near to and trends towards Pritchard's Lode, and the information gained would be relevant to many of the other anomalies in the vicinity.

It is possible that a diamond drill hole in the bed of 'Goose Creek', to determine the source of the linear extended low, would be justified on theoretical grounds. Such a hole could only be recommended after the analysis of the results of the reconnaissance survey has been completed. The source rock lies not more than a hundred feet below surface.

The detailed survey at Mt. Bundey has shown that a much greater proportion of the metamorphic aureole lies near to the surface than is the case with other granites in the Darwin - Pine Creek area. The rocks of such an aureole are frequently mineralised and gold, uranium and base metal deposits have been worked in the aureoles of other granites in the Darwin - Katherine district. It therefore seems possible that further prospecting in the Mt. Bundey area could lead to the discovery of non-ferrous ore deposits. In this connection the existence of a zone of sulphide mineralisation at Pritchard's Lode should be noted.

4. REFERENCES

ASHLEY, J. 1962 Mt. Bundey test magnetic survey, N.T. 1962. Bur. Min. Res. Aust. Record 1962/185.

BUREAU OF MINERAL RESOURCES 1964a Aeromagnetic contour map, 1:63,360 Ban Ban area.

BUREAU OF MINERAL RESOURCES 1964b Aeromagnetic contour map, Burrundie 1:63,360 area.

BUREAU OF MINERAL RESOURCES 1964c Aeromagnetic contour map, Marrakai 1:63,360 area.

BUREAU OF MINERAL RESOURCES 1964d Aeromagnetic contour map, Batchelor 1:63,360 area.

BUREAU OF MINERAL RESOURCES 1964e Aeromagnetic contour map, Woolwonga 1:63,360 area.

DUNN, P.G. 1964 Geology and drilling results : Pritchard's Lode - Mt. Bundey area, N.T. Bur. Min. Res. Aust. Record in preparation.

GOODEVE, P.E. 1964 Darwin - Pine Creek Aeromagnetic survey. Bur. Min. Res. Aust. Record in preparation.

HASAN, S.M. 1958 Petrography and petrology of the Mt. Bundey Granite and Mt. Goyder Syenite. Bur. Min. Res. Aust. Record 1958/36.

MALONE, E.J. 1962 Darwin, N.T., 1:250,000 geology series. Bur. Min. Res. Aust. Explan. Notes.

APPENDIX

OPERATIONAL DETAILS

1. Survey Specifications

Height : Nominally 280 ft. a.g.l. for the aircraft and 250 ft. a.g.l. for the detector (in towed bird assembly). Aircraft height and bird position relative to aircraft fluctuated considerably over rugged terrain.

Line spacing : Nominally 1/10 mile, except for special flight over Pritchard's Lode, at 1/15 mile.

Flight direction : East or West.

Sensitivity : 1000 gamma F.S.D. (10,000 gamma on special flight).

2. Equipment.

Aircraft : Cessna 180.

Magnetometer : MNS1 nuclear magnetometer, reading total absolute magnetic field at one second intervals, fiducial pulses occurring at eight second intervals.

Recorder : Mosely, chart 6" rectilinear, chart speed 4"/min.

Radio Altimeter : APN1 with output to cockpit dial and limit light system, and to recorder.

Recorder for radio altimeter : T.I.C., Chart 6" curvilinear.

Camera : Modified Vinten with wide angle (186^{o}) lens. Single exposures on 35 mm film at 8 second intervals.

3. Personnel.

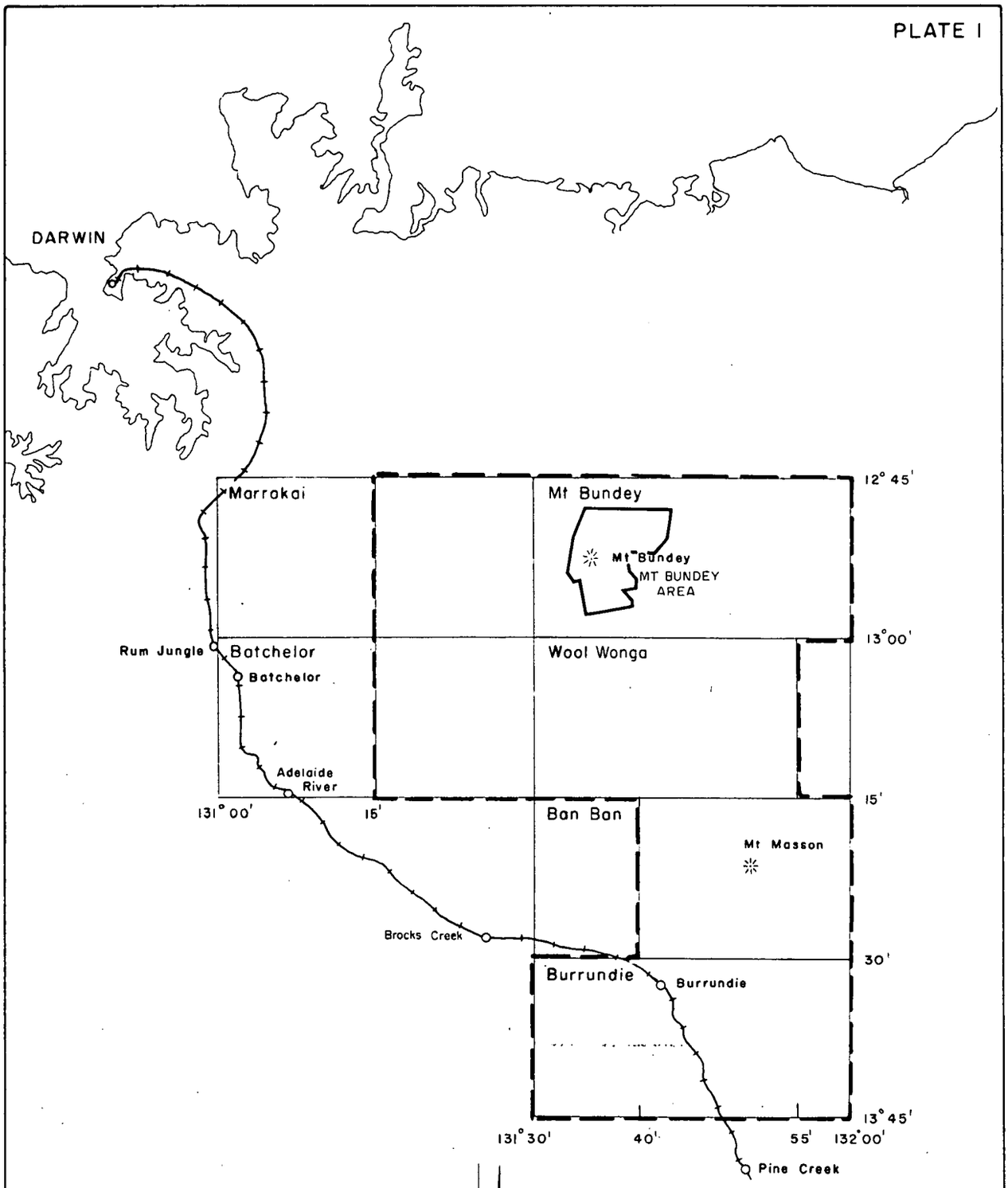
B.M.R. : J. Boyd, C. Braybrook, R. Buckley, W. Finney, J. Milsom, S. Scherl.

T.A.A. : F/O G. Litchfield.

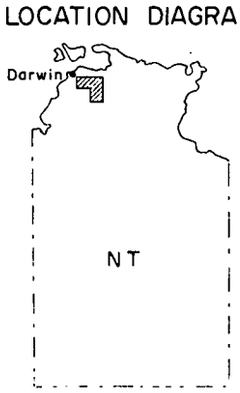
4. Operations

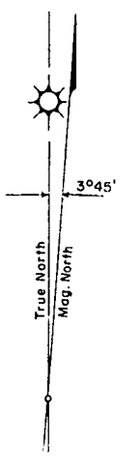
The road party arrived in Batchelor on the second of October and left on the twelfth of November. The aircraft arrived in Batchelor on the fourth of October, but was unserviceable until the thirteenth of October. It left Batchelor on the fifth of November, Scherl left for Melbourne on the sixth of November and Buckley, Finney and Milsom on the thirteenth of November.

PLATE I



LOCATION DIAGRAM





LEGEND

- Railway
- Named place
- Detailed survey area boundary
- Reconnaissance survey area boundary

DETAILED AEROMAGNETIC SURVEY, MOUNT BUNDEY, NT 1964

LOCALITY MAP

10 0 10 20 30 40 50 MILES

10 0 10 20 30 40 50 60 70 80 KILOMETRES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics D52/BI-23

To Accompany Record No.

PLATE 12

SEE INSET

Pritchards Lode

MOUNT BUNDEY

MOUNT SNYDER

ANOMALY 'C'

ANOMALY 'E'

ANOMALY 'A'

INSET

0 1 MILES

MAGNETIC CONTOUR INTERVAL 500 GAMMAS

DETAILED AEROMAGNETIC SURVEY, MOUNT BUNDEY, N.T. 1964

TOTAL MAGNETIC INTENSITY CONTOURS

1 0 1 2 3 MILES

MAGNETIC CONTOUR INTERVAL 250 GAMMAS

12° 47' 131° 32' 35' 40' 131° 43' 12° 47'

50' 55'

Mt Bundey Creek

"Mt Bundey"

Hornfels

Slump breccia

Pritchards lode

MT BUNDEY

MT GOYDER

Buffalo Creek

MARY

Goose Creek

"Annaburoo"

MCKINLAY RIVER

RIVER

12° 58' 131° 32' 35' 40' 131° 43' 12° 58'

Based on D52/80-24

Geology and planimetric mapping from 1:63,360 Scale Geological Series Sheet D52-4-4B, First Edition 1959.
Bureau of Mineral Resources, Geology and Geophysics.
Transverse Mercator Projection.

GEOLOGICAL LEGEND

CAINOZOIC

QUATERNARY

- Soil and alluvium
- Undifferentiated. *Laterite*

LOWER PROTEROZOIC

- Mt Bundey Granite — *Biotite-hornblende granite*
- Mt Goyder Syenite — *Hornblende syenite*
- *Intermediate igneous rocks (sills and dykes)*
- Burrell Creek Formation — *Greywacke, greywacke siltstone, siltstone*
- Golden Dyke Formation — *Siliceous siltstone, siltstone, bedded nodular and massive chert; Chert pebble conglomerate*
- Craig Creek Member — *Pyritic carbonaceous dolomitic siltstone with chert nodules; pyritic siltstone, silicified dolomitic siltstone; Slump breccia*
- Masson Formation — *Quartz greywacke, quartz sandstone, pyritic carbonaceous siltstone, minor carbonaceous siltstone with chert nodules*
- Mt Partridge Formation — *Quartz sandstone, siltstone*

- *Established boundary, position accurate*
- *Established boundary, position approximate*
- *Indefinite boundary*
- *Probable fault*
- *Joints*
- *Shear zone*
- *Quartz vein*

Strike and dip of strata

- 25 *Inclined*
- *Inclined showing prevailing dip*
- *Vertical*
- 25 *Plunge of minor anticline*
- 30 *Plunge of minor syncline*
- *Trend line from air-photo interpretation*

DETAILED AEROMAGNETIC SURVEY, MOUNT BUNDEY, NT 1964

GEOLOGY

MILES 1 0 1 MILES

KILOMETRES 1 0 1 KILOMETRES

TOPOGRAPHICAL LEGEND

- *River or creek*
- *Road or track*
- ■ *Homestead*

INDEX TO ADJOINING SHEETS

HUMPTY DOO	MARY RIVER	KAPALGA
MARRAKAI	MT BUNDEY	SPRING PEAK
BATCHELOR	WOOL WONGA	MUNDOGIE HILL

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

MOUNT BUNDEY
NORTHERN TERRITORY

AUSTRALIA 1:63,360

PLATE 4

(BASED ON D 52/B0-4)

INDEX TO ADJOINING SHEETS

HUMPTY DOO	MARY RIVER	KAPALGA
MARRAKAI	MT BUNDEY	SPRING PEAK
BATCHELOR	WOOL WONGA	MUNDOGIE HILL

GEOPHYSICAL LEGEND

1250 1300 *Magnetic contours with flight-line intersections*

Magnetic "low"

Boundary of 1964 detailed aeromagnetic survey

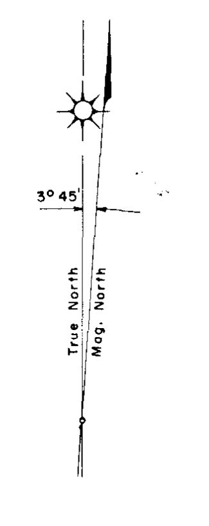
RECONNAISSANCE AEROMAGNETIC SURVEY, 1963

TOTAL MAGNETIC INTENSITY CONTOURS

MILES 1 0 1 2 3 4 5 6 7 8 MILES

KILOMETRES 1 0 1 2 3 4 5 6 7 8 9 10 11 12 KILOMETRES

CONTOUR INTERVAL 10 GAMMAS



TOPOGRAPHICAL LEGEND

River or creek

Road or track

Hill feature

■ *Homestead*

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. D52/B1-25