(3)

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1965/173

McARTHUR RIVER AREA AEROMAGNETIC SURVEY, NORTHERN TERRITORY 1963 - 1964

by

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SUMMARY

An aeromagnetic survey, covering about 3000 square miles of the Bauhinia Downs 1:250,000 map area, was flown in 1963 by Adastra Hunting Geophysics Pty. Ltd. under contract to the Bureau of Mineral Resources, as part of the Special Mineral Survey programme for the Northern Territory. A small area near McArthur River Homestead was reflown in 1964 by the Bureau of Mineral Resources in order to obtain greater resolution of several magnetic 'lows'.

The magnetic data reveal sources of magnetic disturbance on both regional and local scales. The outstanding features of the regional magnetic field are the boundaries between areas of contrasting susceptibilities within the basement, which is at depths of between 6000 and 8000 feet below the surface. The most significant boundaries are those that are roughly coincident with the Emu Fault and part of the Tawallah Fault, as these indicate that the faults are structurally related to the magnetic basement. It appears that post-Lower Proterozoic structure does not make a significant contribution to the regional magnetic anomalies.

A number of isolated magnetic anomalies arising from shallow sources can be correlated with outcrops of either the Scrutton Volcanics or rocks of the overlying Tawallah Group. Another series of magnetic anomalies, also produced by shallow sources, are characterised by pronounced elongation and low amplitude. These rarely show any relation to mapped geology, although some can be correlated with faults. The most probable interpretation for all of these elongated anomalies is mineralisation along fault planes.

The most important result obtained from the survey data is the delineation of magnetic 'lows' in the vicinity of the McArthur River Homestead. It is probable that these 'lows' are associated with small basins, which might contain lead-zinc mineralisation, and therefore indicate targets for future exploration.

1. INTRODUCTION

The proposal for geophysical work in the McArthur River area was originated by the Department of Territories in 1962 as part of the Special Mineral Survey programme for the Northern Territory during the period 1962 to 1964. Previous exploration by Mount Isa Mines Ltd had indicated the presence of several base-metal prospects in the McArthur River area, and one of these, at H.Y.C., has proved to be the largest lead-zinc orebody so far discovered in the Northern Territory.

Contract augering, geochemical sampling, and aeromagnetic and ground electromagnetic surveys were programmed for 1963 to investigate possible extensions or repetitions of the known lead-zinc deposits. The primary purpose of the aeromagnetic survey was to provide structural information to assist in these investigations, particular attention to be directed to the small sedimentary basin that contains the H.Y.C. prospect and to two similar basins nearby known from regional geological mapping by the Bureau of Mineral Resources (B.M.R.). It was also considered possible that magnetic anomalies might provide targets for detailed electromagnetic surveys.

The aeromagnetic survey covered an area of about 3000 square miles in the 1:250,000 map area of Bauhinia Downs (Plate 1). It was flown by Adastra Hunting Geophysics Pty Ltd under contract to the B.M.R., between October and November 1963. Reduction of the survey data and the presentation of the results in map form were completed by the contractor in June 1964.

Additional, more detailed aeromagnetic surveying was done in the vicinity of the McArthur River Homestead by the B.M.R. in September 1964 in order to obtain greater resolution of a group of magnetic 'lows' thought to be associated with the small sedimentary basins that might contain lead-zinc mineralisation.

2. GEOLOGY

The survey area is part of the Proterozoic McArthur Basin and is situated in the Bauhinia Downs 1:250,000 map area, which was mapped geologically by the B.M.R. in 1960 (Smith, 1962). A summary of the results of this work are given below and the geological map is reproduced in Plate 2.

Stratigraphy

Scrutton Volcanics. Outcrops of the Lower Proterozoic Scrutton Volcanics occur east of the old Tawallah Homestead and consist of fine-grained porphyritic acid to intermediate lavas and vesicular basalt, with lenses of siltstone, shale, arkose, and sandstone. Quartz gabbro is also present and may represent minor intrusions.

Tawallah Group. This Group, of Lower Proterozoic age, is mainly composed of sandstone, and contains subordinate volcanics, siltstone, dolomite, dolomitic and ferruginous sandstone and siltstone, and conglomerate. The dominant rock type is a white to pink medium-grained quartz sandstone. Volcanic rocks occur in the Peters Creek Volcanics, Settlement Creek Volcanics, and the Masterton Formation. Apart from local lapilli tuff, the volcanics are intermediate to basic flows; the most common rock type is an iron-rich vesicular trachyte or basalt. Microgabbro has been found within the Masterton Formation, but may be intrusive.

McArthur Group. Within the Bauhinia Downs 1:250,000 map area, the McArthur Group is conformable on the Tawallah Group. Rocks of this group are dominantly carbonate-rich dolomites rather than limestones and contain some sandstone, siltstone, shale, and chert. The only volcanics occurring in this group are in the Barney Creek Member of the

Amelia Dolomite; fine-grained acid tuffs occur in the footwall of the H.Y.C. prospect. The McArthur Group is now classified as Middle Proterozoic (Dunn, Roberts, & Plumb, pers. comm.).

Roper Group. The Upper Proterozoic Roper Group is unconformable on the McArthur Group. The dominant rock types are quartz sandstone, siltstone, and shale, with subordinate ferruginous siltstone and sandstone, feldspathic sandstone, fine to cobble conglomerate, and glauconitic sandstone. No volcanic rocks occur in this group.

Cambrian rocks. The Bukalara Sandstone crops out in the east of the survey area. This sandstone is commonly flat-lying and is characterised by its slightly feldspathic nature, its long gently curving cross-bedding, and its joint pattern.

Mesozoic sediments. These occur as cappings on older rocks. In general, they comprise claystone and clayey sandstone overlying quartz sandstone and occasional conglomerate.

Igneous intrusions. In addition to the basic intrusions associated with the Scrutton Volcanics and possibly with the volcanics in the Masterton Sandstone, more acid intrusions not obviously associated with vulcanism occur on the east side of the Tawallah Range and in the Emu Fault zone east of McArthur River Homestead. Both occurrences are close to large faults and intrude the Tawallah Group. The intrusions appear to be microsyenites and syenites, and form dykes up to 200 feet thick.

Structure

The Upper Proterozoic rocks are folded into a broad, central, north-trending anticline with synclines to the east and west. The anticline is faulted on the east by the Tawallah Fault and the eastern syncline is bounded by the Emu Fault. East of the Emu Fault, the Upper Proterozoic rocks are mostly covered by the Bukalara Sandstone, but they appear to be folded, with very shallow dips, along north-west axes. Folding in the main north-trending anticline and the eastern syncline has been much affected by faulting. Dips within the Upper Proterozoic rocks average about 20°, but are steeper where affected by faulting; in places, overturning occurs adjacent to major faults.

The Tawallah Fault has resulted in a movement in which the east side has been downthrown. The magnitude of the throw is variable but is at a maximum north-north-east of Leila First Crossing. During the deposition of the McArthur Group this fault played a major role in determining the distribution of the units of the group. A reef dolomite (Top Crossing Dolomite) was developed along the line of the fault, lagoonal sediments were deposited to the west of it, and fore-reef sediments to the east. The fault appears to have had no effect on sedimentation during deposition of the Roper Group, but movement may have occurred in Cambrian times.

The Emu Fault has a varied character. In the north, the fault is a single shear plane, but in the Coxco Valley, where movement is greatest, there are at least three parallel fault-lines. Further south, the fault bifurcates. Movement on the fault is east side down, although nowhere is the displacement great. The apparent sense of movement on the fault is not in agreement with sedimentary indications that the region between the Tawallah and Emu Faults was a sinking trough, and it is possible that initially the Emu Fault may have been west side down.

The majority of the other faults in the survey area trend north-west to north, some in the Tawallah Range having throws of more than 7000 feet. Faults with the largest throw commonly trend north. Faults trending north-west usually have small movement and are particularly common on the west limb of the central anticline, where they may be complementary to the Tawallah Fault; this would suggest that there may have been some lateral movement on the fault.

Economic Geology

Lead, zinc, and copper mineralisation occurs mainly in the McArthur River Homestead area. Most prospects are small, the only one of economic importance being the H.Y.C.

Prospects may be divided into two groups: those in the Coxco Valley and those in the Reward/H.Y.C. area. The Coxco Valley prospects are Cooks, Coxs, Turnbull, Squib, and Cooleys; all are close to the Emu Fault zone and may be remobilised syngenetic deposits, e.g. Cooks, which is at the junction of two faults. The second group occurs in the Amelia Dolomite and includes the H.Y.C., Reward, W. Fold, Bald Hills, Barneys, and Teena prospects. The H.Y.C., W. Fold, and Teena prospects are stratigraphically controlled and lie in the Barney Creek Member of the Amelia Dolomite. The Bald Hills and Barneys prospects are in underlying formations.

The Barney Creek Member is composed of dolomitic ferruginous shale, fine-grained tuff, dolomite breccia, and flaggy dolomite. Mineralisation at H.Y.C. consists mainly of zinc, but includes subordinate lead and minor copper and silver. At depth it is in pyritic shale. The Barney Creek Member appears to be restricted to the McArthur River Homestead area, but the possibility of similar horizons elsewhere within the Amelia Dolomite cannot be ignored. The ore is considered to be syngenetic in origin.

Copper, bornite, and chalcopyrite occur associated with dolomite and chert in the Wollogorang Formation south-east of Tawallah Homestead in the Tawallah Range. Malachite is present with barytes filling cavities in the Leila Sandstone. Manganese occurs locally in small amounts in the Stott Formation.

3. PREVIOUS GEOCHEMICAL AND GEOPHYSICAL INVESTIGATIONS

Geochemical investigations were first made in the McArthur River area by Mount Isa Mines Ltd (Crabb, 1957), and, although the method successfully delineated areas of known outcropping mineralisation and outlined some previously unknown mineralised areas, the strength of the anomaly at the strongly mineralised H.Y.C. prospect was surprisingly low and no greater than that of anomalies from much weaker mineralisation elsewhere.

As this geochemical work at the H.Y.C. prospect was inconclusive, an investigation was undertaken by the B.M.R. in 1961, which involved improvements in the chemical and sampling techniques (Fricker, 1962). Statistical analyses of data indicated potential ore at the H.Y.C., Reward Crossing, and W. Fold West prospects, but insufficient observations were made to give full weight to the results.

Further geochemical work was carried out in the McArthur River area during 1963 (Haldane, 1965).

Geophysical investigations have been confined mainly to the area about the McArthur River Homestead. Methods used have included electromagnetic, self-potential, gravity, and magnetic.

In 1958, a geophysical survey of the Reward lease was made by the B.M.R. using magnetic, self-potential, and electromagnetic methods (Horvath, 1959). The electromagnetic method gave the only results of real interest. Two fairly strong anomalies were detected and recommended for testing by drilling as they were considered likely to be associated with mineralisation. A magnetically disturbed area measuring approximately 2000 feet by 600 feet was defined about the Reward shafts. The magnetic anomalies have amplitudes frequently exceeding 200 gammas in this area, but no importance was attached to their occurrence.

A reconnaissance gravity survey, which passed through the Bauhinia Downs 1:250,000 map area, was made by the B.M.R. in 1959 between

Normanton and Daly Waters (Neumann, 1964). Although data were sparse, Bouguer anomaly contours were produced for a number of 1:250,000 map areas, including Bauhinia Downs, to illustrate the major regional trends. It was suggested that a granitic intrusion at depth may account for the Bouguer anomaly 'lows' in the centre of this area.

During 1960, electromagnetic (Newton, 1960) and gravity (Seston, 1960) surveys were made by the Carpentaria Exploration Company Pty Ltd over the H.Y.C. prospect.

The electromagnetic survey defined two good conductors, which were recommended for test drilling. One of these conductors was considered to represent the pyritic shales that are known from outcrop and drill hole information. The source of the second conductor was unknown, but all the available evidence indicated that it represented a second bed of pyritic shale roughly parallel to the one located.

The gravity survey revealed minor gravity features that were attributed to the known ore and to contrasts in the densities of adjacent rocks, but did not provide conclusive evidence relating to the full extent of the orebody.

The Carpentaria Exploration Company Pty Ltd made further geophysical surveys in the Reward Crossing, W. Fold West, Figtree, Figtree North, and H.Y.C./Barneys Creek areas during 1961 using electromagnetic, self-potential, and magnetic methods to delineate shale boundaries or trends (Stubbs, 1961). Preliminary investigations with the electromagnetic method (ASARCO portable equipment was used) were not successful because the faults and fissures that were filled with the strongly mineralised McArthur River water proved to be better conductors than the pyritic shales. Although few magnetic anomalies exceeded 30 gammas in amplitude, except for those in the north-east part of the Reward Crossing area, the magnetic results were successful in establishing either the shale boundary or its trend in each of the areas surveyed. In general, the self-potential survey results confirmed the magnetic findings.

Further electromagnetic surveys of three parts of the McArthur River area were made by AB Elektrisk Malmletning under contract to the B.M.R. during 1963 (B.M.R., 1964). These surveys were designed to locate strata that contained pyrite and sulphides of copper, zinc, and lead, in some cases in areas already surveyed by geochemical methods. Owing to conducting solutions below the ground water level, many anomalies were obtained. However, several anomalies from deeper seated conductors indicated the existence of pyritic shales and recommendations were made for drilling.

A small collection of representative rocks of the McArthur River area have been measured for magnetic susceptibility and density by the B.M.R. The results are listed in Appendix B.

4. INTERPRETATION OF MAGNETIC RESULTS

A contour map of the total magnetic intensity recorded by the airborne magnetometer in the survey area is shown in Plate 3 and the interpretation of this data is illustrated in Plates 3 and 4.

Regional magnetic anomalies

The magnetic contours indicate that the major magnetic anomalies are produced by sources in a basement, between 6000 and 8000 feet deep, which is probably of Lower Proterozoic or older age. It has been assumed in the calculations of the depth to magnetic basement that the anomaly sources are vertically-sided, magnetically homogeneous prisms of considerable vertical extent. The depth estimates may be incorrect if the geological structure departs markedly from this idealised model.

As a result of the consistent grouping of depth estimates in the range of 6000 to 8000 feet, it is unlikely that the topography of the magnetic basement could make a major contribution to the regional magnetic anomaly pattern; the magnetic anomalies are probably due to the contrasts in the susceptibilities of adjoining prisms. It is therefore considered justified to sub-divide the survey area into seven zones (A to G), each zone representing a different susceptibility in the magnetic basement. Susceptibility contrasts, relative to zone B, are listed in Table 1; they were computed using the mean field values of each zone and assuming that each zone has a uniform susceptibility and that zone B is not polarised by remanent magnetisation.

It is not possible to explain the regional magnetic anomalies by the geology shown in plan and sections in Plate 2 or by the susceptibility data listed in Appendix B. The Emu Fault and the northern part of the Tawallah Fault are, in general, seen to follow the major zonal boundaries, which suggests a structural relation. The southern part of the Tawallah Fault has no expression in this basement, but is, however, delineated by local magnetic anomalies due to the younger volcanic rocks of the Tawallah Group.

Table 1

Computed contrasts in intra-basement susceptibilities

Zone	Susceptibility relative to zone B (CGS x 10^{-3})
A	0.6
B	0.0
C	0.75
D	1.0
E	0.5
F	0.75
G	1.0

In general, it appears that the survey area has a rather basic magnetic basement. Zone D is of the greatest interest since its susceptibility contrast coupled with its magnetic anomaly form are interpreted as evidence for the presence of a basic or ultra-basic body within 8000 feet of ground level. The boundaries between zone D and zones A and E closely follow major faults, but the magnetic data cannot be interpreted to support the geological structure shown in section AB of Plate 2.

The magnetic contours in the northern part of the survey area cannot be correlated with the geological structure shown in section HJK of Plate 2 although the boundaries between zones A and B and B and C closely follow major faults. The contrasts in susceptibilities between zone B and adjoining zones, and the form of the regional magnetic field, are interpreted as evidence for an acidic basement at a depth of from 6000 to 8000 feet below ground level. The basement apparently becomes more basic in the area south-east of the Tawallah Group outcrop, and a probable secondary boundary within zone B is shown in Plate 3.

The magnetic gradient north of the boundary between zones B and D is indicative of either a north-dipping basement interface (this gains support from the basement depth estimate of 12,500 feet) or a decrease northwards of the susceptibility of rocks in the magnetic basement. The susceptibility decrease suggests a differentiated igneous basement, from ultra-basic or basic in the south to acid in the north.

Local magnetic anomalies

The magnetic contours reveal the presence of several shallow localised sources of magnetic disturbance, the areal extents of which are

diagramatically shown in Plate 3. The geological significance of each of these anomalies is given below and is based on the assumption that the anomaly results from normal polarisation.

S1 Disturbance produced by Scrutton Volcanics. The magnetic anomaly is interpreted as being caused by an easterly dipping formation.

S2 Disturbance produced by Scrutton Volcanics. The magnetic anomaly form again indicates an easterly dip.

T1 The magnetic anomaly is produced by Peters Creek Volcanics of the Tawallah Group and indicates an easterly dip of the Volcanics.

T2 Magnetic anomaly located at eastern boundary of Tawallah Group outcrop. It is interpreted as caused by an outcropping source with a northerly elongation and a dip of approximately 55°E.

T3 Magnetic anomaly occurring in an area of Tawallah Group outcrop.

T4 & T5 Magnetic anomalies associated with rocks of the Tawallah Group. Anomaly forms indicate east-dipping strata.

T6 & T7 These magnetic anomalies occur in an area of Tawallah Group outcrop and are probably due to the Peters Creek Volcanics. Anomaly T6 has been interpreted as caused by a northerly elongated body located 500 feet below ground level with a width of 1500 feet and a dip of 40°W.

T8 Magnetic anomaly occurring over an outcrop of Amelia Dolomite. It is interpreted as caused by a source situated 3000 feet below ground level. The source is considered to be Peters Creek Volcanics.

T9 Magnetic anomaly coincident with an exposure of the Tawallah Group and microsyenite along the Emu Fault zone.

Several other magnetic anomalies, characterised by low amplitude, shallow depth, and considerable elongation, are apparent in the magnetic contours (Plate 3). These features are commonly recognised by the lineation of small high or low closures or flexures within the contour pattern.

L1 & L2 These are lineations of small anomalies, and are coincident with exposed geological faults. They may, therefore, result from mineralisation along these fault planes.

L3 & L4 Very pronounced lineations of magnetic 'lows' arising from sources that have been interpreted as being within 1500 feet of ground level. These anomalies cannot be correlated with any exposed geology.

L5 This lineation crosses the regional magnetic 'high' of zone D and is coincident with the Bald Hills Fault.

L6 A lineation of magnetic 'lows', parallel to L3 and L4. It cannot be correlated with any known geological feature.

L7 This magnetic feature delineates the trend of the maximum gradients of the magnetic anomalies T6, T7, and T8, which have been interpreted as evidence for the west-dipping Peters Creek Volcanics of the Tawallah Group.

The relation of L7 to the Tawallah Fault is interesting. From T6 to T7, L7 is close to the Tawallah Fault, but at T8 it is offset to the west of the fault. This suggests a second fault which is down-thrown east of Leila First Crossing and which truncates the Peters Creek Volcanics 3000 feet below ground level. Alternatively, the west-dipping Peter Creek Volcanics may abut the Tawallah Fault at depth below anomaly T8, but this would require the Tawallah Fault to be a reversed fault.

L8 This is the trend of the maximum gradient on the western

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flank of the magnetic anomaly in the Coxco Valley area. The trend is nearly coincident with the western fault of the Emu Fault zone. The form of the magnetic anomaly indicates that the depth to its source increases southwards. At the northern end of L8 the magnetic anomaly T9 has been correlated with the outcrops of rocks of the Tawallah Group and microsyenite. It is probable that the magnetic anomaly in the Coxco Valley is produced by these rocks included in a south-dipping structure contained between the east and west faults of the Emu Fault zone.

McArthur River Homestead area

The magnetic contours shown in Plate 3 do not indicate that any detailed structural information associated with the lead-zinc mineralisation can be obtained from the magnetic data in this area. Inspection of the original survey records, however, revealed the presence of minor flexures in the magnetic profiles. An initial study of these flexures, which have amplitudes of between 1 and 4 gammas, and are therefore little removed from magnetometer noise, resulted in the discovery of three magnetic 'lows'.

Further aeromagnetic surveying was carried out at a lower altitude by the B.M.R. during September 1964 in the vicinity of the McArthur River Homestead. Greater resolution of the magnetic 'lows' was obtained and their presence was unquestionably confirmed. These magnetic 'lows', together with geological information, are shown in Plate 4. An extension of this interpretation to include the magnetic data obtained from the entire area of Amelia Dolomite outcrop in the McArthur River Homestead area is also shown in Plate 4.

The closed magnetic 'lows' are interpreted as being due to small basins of Barney Creek Member contained within the magnetically more susceptible Amelia Dolomite (see Appendix B). A minor magnetic feature also appears to be coincident with the contact between the outcrops of the Amelia Dolomite and the Lynott Formation and is interpreted as a contrast in magnetic susceptibility between these rocks. The resolution of this feature decreases to the south.

A more pronounced magnetic 'high' is evident in the east of the area and is interpreted as being caused by near-surface sources associated with the Emu Fault.

5. CONCLUSIONS AND RECOMMENDATIONS

The regional magnetic anomalies are probably due, not so much to topographical features in the basement, as to intrabasement zones of contrasting susceptibilities. The two zonal boundaries that trend approximately N20°W are the outstanding features of the regional magnetic field and indicate a structural relation between the magnetic basement and the Emu Fault and the northern part of the Tawallah Fault. However, the geological structures indicated in the sections of the Bauhinia Downs 1:250,000 map area (Plate 2) cannot be supported by the magnetic data. The magnetic basement in the area between the Tawallah and Emu Faults may have a basic or ultra-basic character in the south and an acidic character in the north or it may dip to the north.

Magnetic anomalies associated with either the Scrutton Volcanics or rocks of the Tawallah Group have distinctive forms, which mostly indicate dipping structures. In general, no further investigation of these anomalies is considered warranted owing to the volcanic environment of the sources. A possible exception to this is anomaly T2, which is located to the east of an outcrop of the Wollogorang Formation. In the Tawallah Homestead locality copper mineralisation has been found to be associated with these rocks (Smith, 1962).

The magnetic lineations L1, L2, L3, L4, and L6 are probably produced by mineralisation along fault planes. Further geophysical investigations of L1, L3, L4, and L6 might be worthwhile as these anomalies lie almost parallel to the direction of the flight lines and cannot be fully

resolved.

The delineation of the small magnetic 'lows' in the McArthur River Homestead area is the most important result obtained from the survey data. There is a distinct possibility that these 'lows' represent small basins containing the Barney Creek Member of the Amelia Dolomite, which is known to be associated with lead-zinc mineralisation. These magnetic 'lows' outline the areas where further geophysical work might most advantageously be done.

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APPENDIX A

Operational details

Contract survey

Contractor	:	Aéastra Hunting Geophysics Pty Ltd
Aircraft	:	Aero Commander VH-AGA
Magnetometer	:	Gulf Mk.3 saturable core fluxgate; tail boom installation
Camera	:	De Havilland single-frame 35-mm
Radio-altimeter	:	AN/APN-1
Storm warning magnetometer	:	Gulf saturable core fluxgate
Altitude	:	500 feet above ground level
Line spacing	:	½ mile
Line orientation	:	East
Tie system	:	Single lines spaced 15 miles apart
Navigation control	:	Aerial photographs
Sensitivity	:	60 gammas per inch

B.M.R. survey

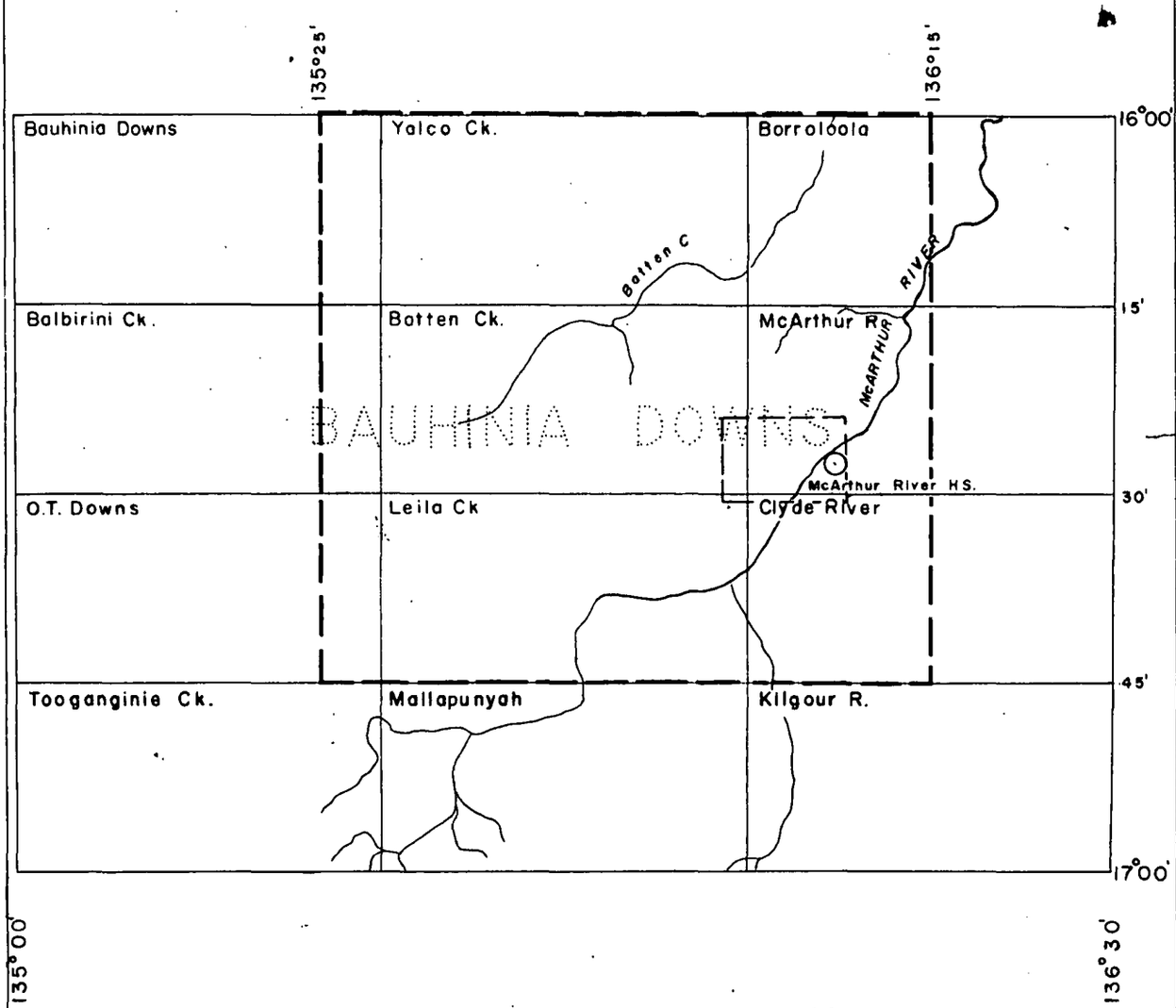
Aircraft	:	DC3 VH-MIN
Magnetometer	:	MFS-5 saturable core fluxgate; tail boom installation
Camera	:	'Aropath' 35-mm strip
Storm warning magnetometer	:	MFD-3 saturable core fluxgate
Altitude	:	300 feet above ground level
Line spacing	:	(1) ½ mile; (2) 1 mile
Line orientation	:	(1) East ; (2) North
Navigation control	:	Aerial photographs
Sensitivity	:	25 gammas per inch.

APPENDIX B

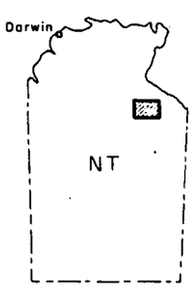
Magnetic susceptibilities and specific gravities of rock samples from the McArthur River area

Sample No.	Geological description	Susceptibility (CGS x 10^{-3})	Specific gravity
11/99/6	Roper Group, Abner Sandstone	0.024	2.62
14A/81/5	McArthur Group, Stott Formation	0.064	2.76
R10173	McArthur Group, Smyth Conglomerate	0.026	2.54
R10162	McArthur Group, Tooganinie Formation	0.016	2.54
8/43/15	McArthur Group, Amelia Dolomite	0.040	2.69
S 18	McArthur Group, Amelia Dolomite	0.040	2.84
R10166	McArthur Group, Amelia Dolomite, Barney Creek Member	0.016	2.41
R10167	McArthur Group, Amelia Dolomite, Barney Creek Member	0.026	2.57
R10180	McArthur Group, Amelia Dolomite	0.040	2.76
R10176	McArthur Group, Lynott Formation	0.040	2.67
7/83/47	McArthur Group, Lynott Formation	0.016	2.63
7/79/30	Tawallah Group, Sly Creek Sandstone	0.053	2.55
7/79/32	Tawallah Group, Sly Creek Sandstone	0.053	2.43
8/33/9	Tawallah Group, Yiyintyi Sandstone	0.26	2.73

PLATE I



LOCATION DIAGRAM



LEGEND

CONTRACT SURVEY BOUNDARY

B.M.R. SURVEY BOUNDARY

McARTHUR RIVER, N.T.

AEROMAGNETIC SURVEY, 1963-1964

MILES 10 0 10 20 30 40 50 MILES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics E53/B1-4

TO ACCOMPANY RECORD No. 1965/173

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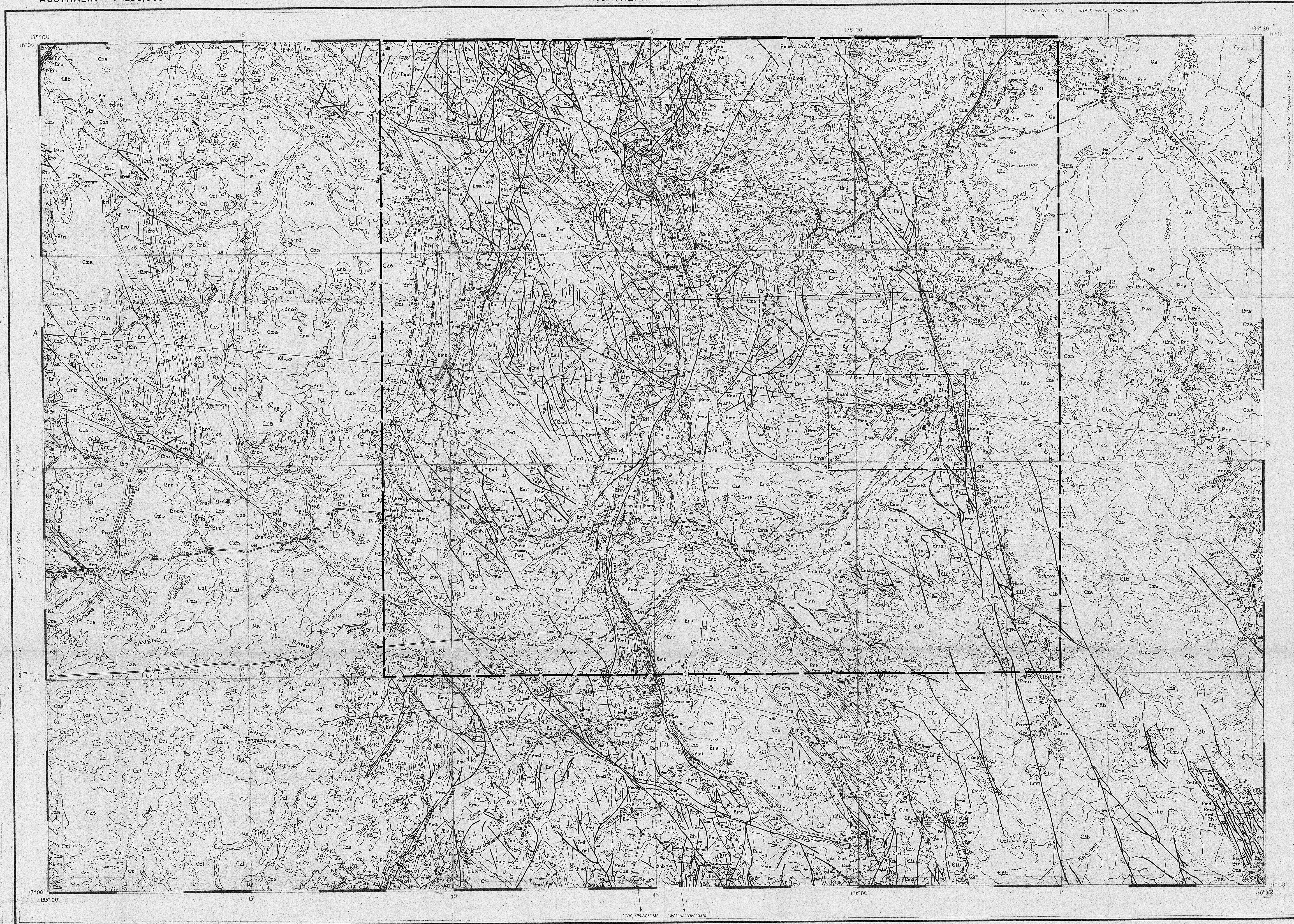
PLATE 2

BAUHINIA DOWNS

NORTHERN TERRITORY

AUSTRALIA 1:250,000

PLATE 2



Geological and planimetric mapping from 1:250,000 Scale Geological Series Sheet SE 53-3, Preliminary Edition 1963.

Bureau of Mineral Resources, Geology and Geophysics.

Transverse Mercator Projection.

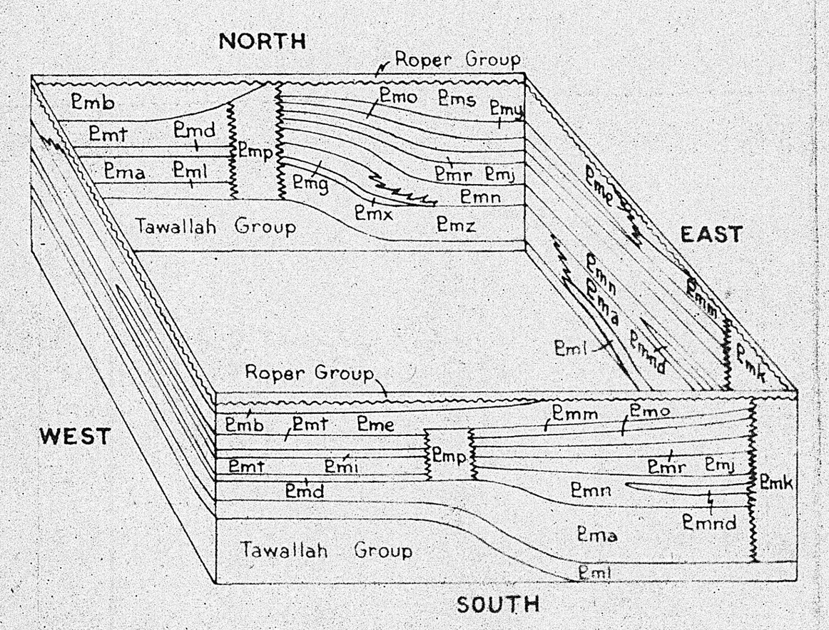
Reference

- Geological boundary
- Anticline
- Syncline
- Fault

Where location of boundaries, folds and faults is approximate, line is broken, where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

- Strike and dip of strata
- Vertical strata
- Horizontal strata
- Overturned strata
- Trend of bedding, showing direction of dip (air-photo interpretation)
- Horizontal strata (air-photo interpretation)
- Joint pattern (air-photo interpretation)
- Macrofossil locality
- Plant fossil locality
- Fossil wood locality
- TT32 Fossil locality, showing reference number
- Pb Mine or prospect
- Zn Unexploited deposit
- •Ba Minor mineral occurrence
- Ba Barite
- Cu Copper
- Fe Iron
- Pb Lead
- Mn Manganese
- Zn Zinc
- B Bore
- S Spring
- RH Rockhole
- WH Waterhole
- Swamp
- Road
- Vehicle track
- Fence
- "O.T. Downs" Homestead
- Yd Yard
- Landing ground
- Astronomical station
- 618' Height in feet, barometric - datum: mean sea level

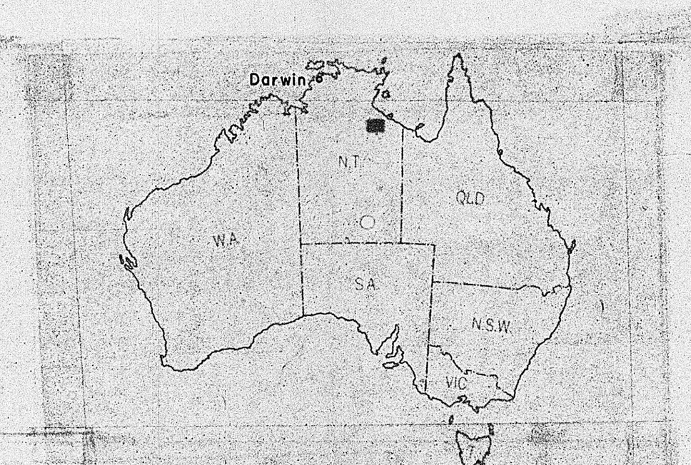
DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS McARTHUR GROUP



Unconformity

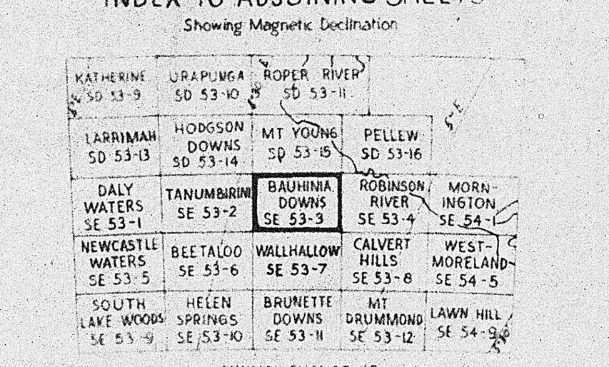
Era	Period	Group	Unit	Symbol	Description
CAINOZOIC				Qa	Alluvium
				Czs	Soil, sand, ferruginous cemented detritus
				Czb	Black soil
				Czl	Laterite, lateritic soil
	TERTIARY		Golliger Beds	Tg	Massive limestone
MESOZOIC	LOWER CRETACEOUS		Undifferentiated	Kl	Friable yellow clayey sandstone; massive white quartz sandstone and conglomerate, white leached siltstone
PALAEOZOIC	LOWER TO MIDDLE CAMBRIAN?		Top Springs Limestone	Єt	Massive limestone, laminated cherty limestone
	LOWER CAMBRIAN?		Bukalara Sandstone	Єlb	Massive medium to coarse-grained sandstone, usually feldspathic
PRECAMBRIAN	UPPER(?) PROTEROZOIC	ROPER GROUP	Undifferentiated	Pr	Sediments
			Cobanbirini Formation	Prb	Flaggy siltstone, medium-grained quartz sandstone
			Bessie Creek Sandstone	Pre	Jointed, medium-grained quartz sandstone
			Corcoran Formation	Pro	Flaggy brown siltstone, medium-grained quartz sandstone, ferruginous sandstone
			Abner Sandstone	Pra	Jointed, medium-grained quartz sandstone; minor siltstone, ferruginous sandstone, fine conglomerate
			Hodgson Sandstone Member	Prh	Strongly jointed, medium-grained quartz sandstone
			Jalboi Member	Prj	Purple ferruginous sandstone; minor shale bands
			Arnold Sandstone Member	Prx	Strongly jointed, medium-grained quartz sandstone
			Crawford Formation	Prr	Thickly flaggy glauconitic sandstone, feldspathic sandstone; flaggy, purple micaceous siltstone
			Mainoru Formation	Pru	Flaggy purple and green micaceous siltstone; fine-grained glauconitic sandstone; feldspathic sandstone, shale
			Kilgour Sandstone Member	Prg	Fine to medium-grained sandstone, siltstone
			Limmen Sandstone	Pri	Fine to medium-grained quartz sandstone, flaggy micaceous sandstone, conglomerate
	LOWER(?) PROTEROZOIC	McARTHUR GROUP	Undifferentiated	Pm	Sediments
			Karns Dolomite	Pmk	Dolarenite, dolomite, algal dolomite, laminated oolitic and algal chert, dolomitic siltstone and sandstone, silty and sandy dolomite
			Billengarrah Formation	Pmb	Massive chert breccia; flaggy siltstone, quartz sandstone, chert, dolomite
			Emmerugga Dolomite	Pme	Massive dolomite, algal dolomite, chert breccia, dolomite conglomerate, dolomite-breccia, dolomitic sandstone, siltstone
			Amos Formation	Pmm	Dolomitic siltstone, dolomite, dolomitic sandstone, sideritic chert
			Stott Formation	Pms	Silicified limestone, oolitic chert, minor dolomite sandstone
			Smythe Sandstone	Pmy	Quartz sandstone, feldspathic sandstone, pebble to cobble conglomerate
		Batten Sub-Group	Looking Glass Formation	Pmo	Chert, chert breccia, minor sandstone, dolomitic siltstone
		Batten Sub-Group	Stretton Sandstone	Pmr	Flaggy quartz sandstone
		Batten Sub-Group	Yalco Formation	Pmj	Laminated cherty siltstone, shale, chert
		Batten Sub-Group	Lynott Formation	Pmn	Cherty siltstone, dolomitic siltstone, dolomitic sandstone, quartz sandstone, silty and sandy dolomite, chert, chert breccia, dolomite breccia
		Batten Sub-Group	Donnegan Member	Pmnd	Quartz sandstone, dolomitic sandstone
		Batten Sub-Group	Hammer Creek Member	Pmg	Flaggy white chert and cherty siltstone, Massive chert breccia
			Top Crossing Dolomite	Pmp	Massive grey to buff dolomite, chert-breccia
		Bauhinia Downs Sub-Group	Tooganinie Formation	Pmt	Dolomitic siltstone and shale, dolomitic sandstone, flaggy to massive dolomite, algal dolomite, oolitic limestone
		Bauhinia Downs Sub-Group	Leila Sandstone Member	Pmi	Dolomitic sandstone, minor algal dolomite, quartz sandstone
		Bauhinia Downs Sub-Group	Tatoola Sandstone	Pmd	Quartz sandstone, dolomitic sandstone, feldspathic sandstone
			Amelia Dolomite	Pma	Dolomite, algal dolomite, chert, dolomite breccia, sandstone, minor siderite bands, siltstone Chert breccia
			Barney Creek Member	Pmq	Ferruginous shale, dolomite breccia, dolomite, tuff
			Mallapunyah Formation	Pml	Ferruginous quartz sandstone, purple siltstone, dolomite, chert, minor siderite beds
			Warramana Sandstone	Pmx	Blocky white to pink medium-grained quartz sandstone
			Festing Creek Formation	Pmz	Pink dolomite, chert, dolomitic siltstone, siltstone
	LOWER PROTEROZOIC			Ps	Microsyenite, syenite
		TAWALLAH GROUP	Undifferentiated	Pt	Sediments, volcanics
			Mulholland Sandstone	Ptm	Flaggy white to grey, fine to medium-grained quartz sandstone
			Masterton Formation	Ptn	Blocky, purple and white, medium-grained quartz sandstone, siltstone, ferruginous sandstone, conglomerate, minor intermediate-basic volcanics and lapilli tuff
			Gold Creek Volcanic Member	Ptg	Basalt, trachyte
			Wollogorang Formation	Pto	Flaggy grey and pink finely crystaline dolomite, dolarenite, dolomitic siltstone, dolomitic sandstone, sandstone, chert
			Settlement Creek Volcanics	Pte	Basalt, siltstone, tuff
			Rosie Creek Sandstone	Ptr	Flaggy very coarse to fine grained quartz sandstone, ferruginous sandstone, feldspathic sandstone, glauconitic sandstone, boulder conglomerate
			Sly Creek Sandstone	Ptl	Blocky white to pink medium-grained quartz sandstone; some pebbly bands; minor ferruginous siltstone
			Peters Creek Volcanics	Ptp	Amygdaloidal basalt, minor trachyte
			Yiyintyi Sandstone	Pty	Blocky white medium to coarse-grained quartz sandstone; minor pebble to boulder conglomerate
			Scrutton Volcanics	Pls	Porphyritic dacite; minor basalt, feldspathic sandstone, siltstone, shale, tuff, minor basic intrusives

- Survey area boundary flown by ADASTRA
- Survey area boundary flown by B.M.R.



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



ANNUAL CHANGE 1'E

AEROMAGNETIC SURVEY, McARTHUR RIVER, NT 1963–1964

GEOLOGY

MILES 5 0 5 10 15 MILES

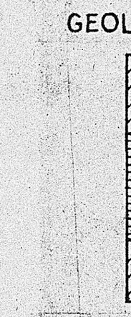
KILOMETRES 5 0 5 10 15 20 KILOMETRES

Sections

(Mesozoic and Cainozoic rocks omitted from sections Altitude of faults generally not known)

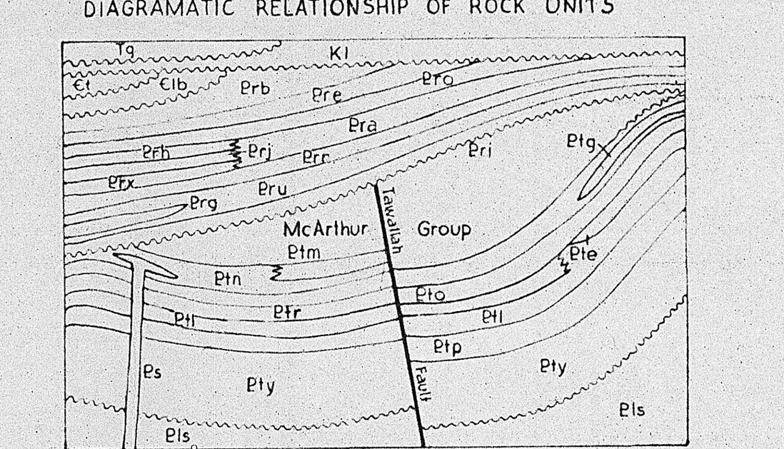
Scale: $\frac{V}{H} = 1$

GEOLOGICAL RELIABILITY DIAGRAM

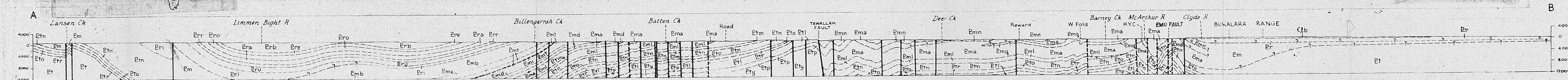


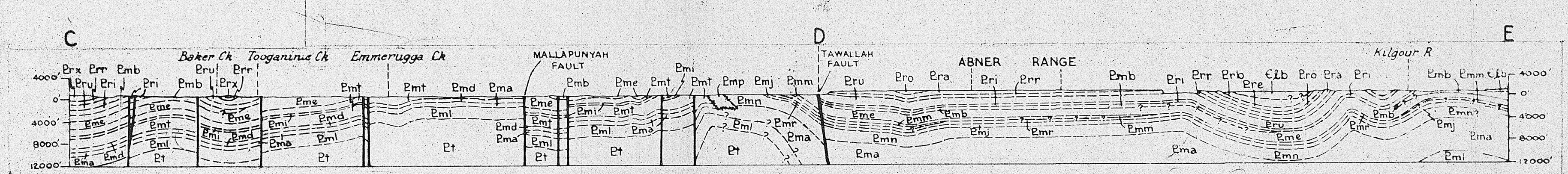
- B_1 Detailed reconnaissance - numerous traverses and air-photo interpretation
- B_2 Reconnaissance - some traverses and air-photo interpretation
- B_3 Helicopter traverses and air-photo interpretation

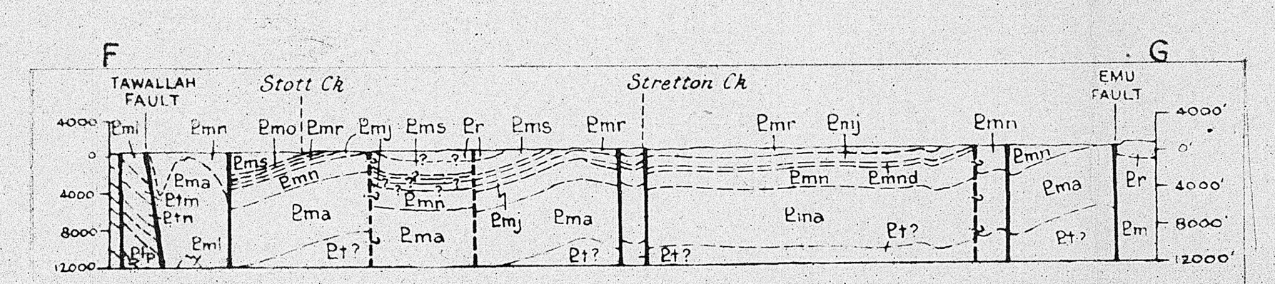
DIAGRAMATIC RELATIONSHIP OF ROCK UNITS

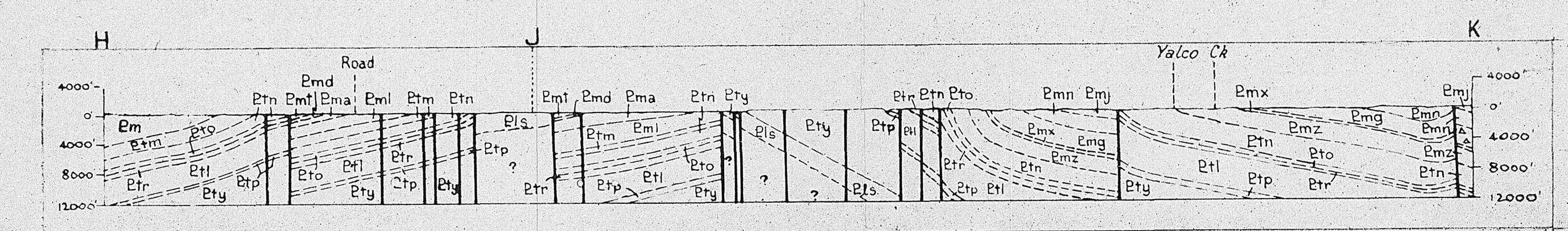


Unconformity

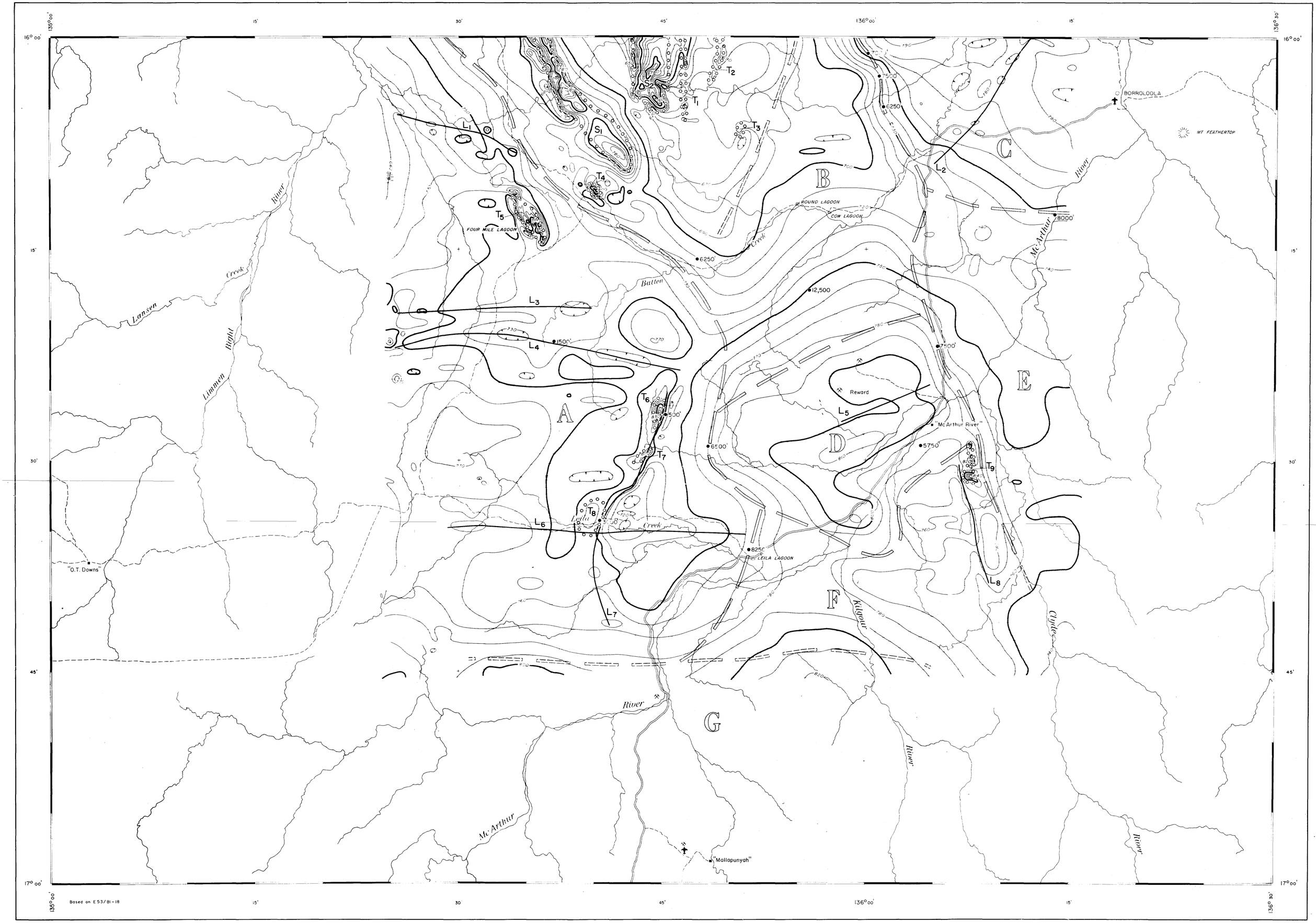








BAUHINIA DOWNS
NORTHERN TERRITORY



GEOPHYSICAL LEGEND

- Magnetic basement zone boundary
- Probable magnetic basement zone boundary
- Zone symbol
- ● 1500' Magnetic basement depth estimates (below ground level)
- Areal extent of magnetic disturbance
- Magnetic trend
- 800 / 750 Magnetic contours with flight-line intersections
- Magnetic "low"

AEROMAGNETIC SURVEY, McARTHUR RIVER, NT 1963–1964

TOTAL MAGNETIC INTENSITY CONTOURS
AND
GEOPHYSICAL INTERPRETATION

MILES 5 0 5 10 15 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

CONTOUR INTERVAL 10 GAMMAS

TOPOGRAPHICAL LEGEND

- River or creek
- Secondary road
- Road or track
- Named place
- Homestead
- Mine
- Aerodrome or landing ground
- Swamp
- Hill feature

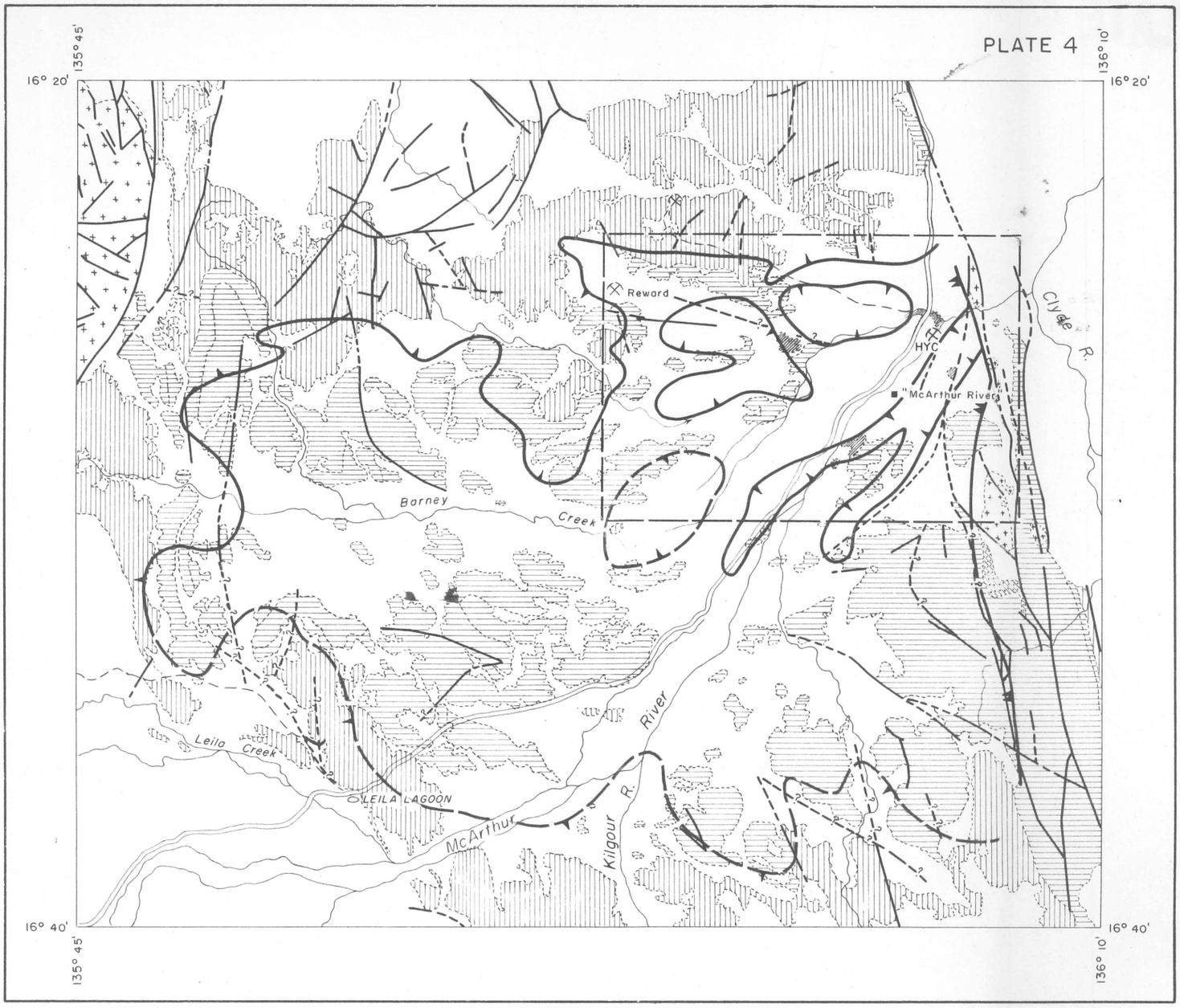
EXPLANATORY NOTES

THE TOTAL MAGNETIC INTENSITY WAS CONTINUOUSLY RECORDED BY AN AIRBORNE MAGNETOMETER, AND HAS BEEN CORRECTED FOR A REGIONAL GRADIENT IN TOTAL MAGNETIC FIELD OF 10·5 GAMMAS PER MILE IN A DIRECTION S.7°W.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. E53/BI-18-1

TO ACCOMPANY RECORD No. 1965/173

PLATE 4



GEOLOGICAL LEGEND

- Undifferentiated. Recent alluvium to rocks of McArthur Group
- Lynott Formation
- Amelia Dolomite
- Amelia Dolomite Barney Creek Member
- Mallapunyah Formation
- Undifferentiated Tawallah Group

TOPOGRAPHICAL LEGEND

- River or creek
- Road

GEOPHYSICAL LEGEND

- Change in level of Total Magnetic Intensity greater than 5 gammas
- Change in level of Total Magnetic Intensity less than 5 gammas
- Probable change in level of Total Magnetic Intensity less than 5 gammas
- Survey area boundary flown by B.M.R

AEROMAGNETIC SURVEY, McARTHUR RIVER, NT 1963-1964

McARTHUR RIVER HOMESTEAD AREA

GEOPHYSICAL INTERPRETATION AND GEOLOGY

GEOLOGY AFTER 1:250,000 GEOLOGICAL MAP OF BAUHINIA DOWNS, PRELIMINARY EDITION 1962, SHEET SE 53-3

MILES 5 0 5 10 15 MILES

KILOMETRES 5 0 5 10 15 20 KILOMETRES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. E53/BI-24

TO ACCOMPANY RECORD No 1965/173