COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1965/255

REPORT ONPPHOTO-INTERPRETATION OF THE NGALIA BASIN, NORTHERN TERRITORY

---

by

J.C. Rivereau
(Institut Français du Petrole)

RECORD 1965/255

REPORT ON PHOTO-INTERPRETATION OF THE NGALIA BASIN, NORTHERN TERRITORY

by

J.C. Rivereau

Institut Francais du Petrole

REPORT ON PHOTO-INTERPRETATION OF THE NGALIA BASIN, NORTHERN TERRITORY

by

J.C. Rivereau

Record 1965/255

SUMMARY

The Ngalia Basin is a narrow basin trending east, approximately 270 miles long and with a maximum width of 30 miles. It is fifty miles north of the Amadeus Basin, enclosed within igneous and metamorphic Precambrian rocks. A sandy featureless plain covers the central part of the basin and divides it into a very disturbed, northern margin with a large area of outcrop and a well defined, little disturbed, southern ridge. Six units have been defined within the northern margin; these range in age from Upper Proterozoic to Lower and perhaps Upper Palaeozoic. Only one unit has been found in most parts of the southern ridge and the problem of the relationship between north and south remains unresolved. The folding of the northern margin has resulted in a complex structural picture showing dragging, overfolding and thrusting and the observed unconformities suggest two important tectonic periods with the same trends of folding.

REPORT ON PHOTO-INTERPRETATION OF THE NCALIA BASIN, NORTHERN TERRITORY

by

J.C. Riverseau

Record 1965/255

CONTENTS

		Page No.
	SUMMARY	
I	INTRODUCTION	2
	General	2
	Previous geological work	2
	Field work	2
II	PHYSIOGRAPHY	2
	General	2
	Vegetation	3
	Hydrography	3
	Access	3
III	STRATIGRAPHY	3
	A. Precambrian	4
	1) Igneous rocks	4
	2) Metamorphic rocks	4
	B. Proterozoic to lower Palaeozoic sedimentary rocks	4
	1) Unit Bua	4
	2) Unit Bu	5
	3) Unit Bub	6
	4) Unit Buc-Buc$_1$	6
	5) Unit Bud	6
	6) Unit Bue	7
	C. ? Upper Palaeozoic	7
	D. Particular problems	8
	E. Cainozoic	8
IV	STRUCTURE	9
V	REFERENCES	11

I - INTRODUCTION

General - The Ngalia Basin is in the Northern Territory, about 50 miles north of the northern margin of the Amadeus Basin. It is a narrow basin trending east-west with a maximum width of nearly 30 miles (20 miles on an average on MOUNT DOREEN) and a length of 270 miles (between 133° 35' and 129° 25'E longitude and 22°10' and 22°55'S latitudes).

This basin covers part of four 1:250,000 scale Sheets, from east to west: ALCOOTA* - NAPPERBY - MOUNT DOREEN and LAKE MACKAY.

The photo interpretation of this area was carried out with the purpose of assisting in the planning and execution of the field work scheduled for the 1966 field season. It was limited to the sedimentary rocks with a narrow overlap on the surrounding basement rocks.

The air photographs used were flown in 1950 for ALCOOTA, NAPPERBY and MOUNT DOREEN and in 1957 for LAKE MACKAY, at a scale of 1:46500. The photo graph scale overlays, bearing the geological interpretation, were reduced, then assembled on 1:250,000 National Mapping Compilation Sheets and finally fair drawn. Topographic details and names were taken from National Mapping Topographic Sheets and more features such as new roads, tracks or bores were added within areas visited during the field trip.

Previous geological work

A geological study was carried out in 1963 by P. Cook on the 850 square miles of Yuendumu Native Reserve (MOUNT DOREEN) (Cook, 1963) and this work provided stratigraphical control for the photo-interpretation.

Other documents consulted are mentioned in the References at the end of the report.

Field work

The area was visited briefly after the completion of the photo-interpretation - this allowed several points on NAPPERBY and MOUNT DOREEN to be checked and provided geological control of the photogeological "facies".

II - PHYSIOGRAPHY

General - In its northern part (Mount Doreen area) the sedimentary basin is bounded by scattered outcrops of basement, mainly granite; but on NAPPERBY the northern margin is well outlined by an important mass of granite and metamorphic rocks (Reynolds Range).

This basin can be divided into three parts: Northern, Southern and Central.

Northern part.

Here the sedimentary rocks crop out widely, particularly on MOUNT DOREEN, for example, in the Vaughan Springs, Mount Doreen, and Yuendumu areas where red-brown sandstone and white silicified sandstone crops out in broad synclines and narrow anticlines of Upper Proterozoic and Palaeozoic age. The outcrops are numerous and continuous on MOUNT DOREEN with moderate relief trending roughly east-west but on NAPPERBY the northern sedimentary margin gradually disappears and is not found beyond the Stuart Highway area.

* The basin covers a very small part in the southern corner of ALCOOTA, thus it has been mapped with NAPPERBY.

TABLE I

LEGEND

Photogeological character		Possible Geological equivalent	
	Qa - Alluvium. Flood plain. Flood out.	QUATERNARY	CAINOZOIC
	Qc - Colluvium. Detrital slope		
	Qs - Sand plain		
	Qrt - Plain with timber cover		
	CP - Clay or salt pan		
Grey to light toned with white spots	Qt - Travertine		
Dark toned, mesa form, small scarps	Cz - Laterite, continental formation	UNDIFFERENTIATED	
Dark toned, thin bedding well developed	Pz - Red brown sandstone, conglomerate	? UPPER PALAEOZOIC	
	UNCONFORMITY		UPPER PROTEROZOIC TO LOWER PALAEOZOIC
Dark toned, thin bedded. Grey and light toned	Pue - Red brown sandstone		
	Pud - Sandstone silicified in part		
	UNCONFORMITY ?		
Medium grey toned, soft appearance	Puc_1 - Sandstone, siltstone		
Dark grey toned, rounded outcrop	Puc - Dolomite		
	UNCONFORMITY?		
Dark toned	Pub - Red brown sandstone		
	UNCONFORMITY		
Light grey to white toned, hard appearance	Pua - Sandstone, mainly silicified; conglomerate, ?arkose		
Light grey toned, jointed, hard appearance	Pu - Undifferentiated (southern ridge). Sandstone, silicified sandstone, conglomerate		
	UNCONFORMITY		PRECAMBRIAN
Grey toned with white patches, very thin bedded, steeply dipping, low outcrop	pCs - Quartz sericite schist, quartz amphibolite	UNDIFFERENTIATED	
Dark toned, hard appearance, high relief, roughly bedded, intruded by many dykes	pCm - Quartzite, gneiss, migmatite amphibolite		
Massive and well jointed outcrop intruded by many dykes	pCg - Gneissic granite, granite (may include quartzite ridges)		
	U - Undetermined		

Southern part.

The southern limit of the basin is marked by an almost continuous, well defined ridge of silicified brown sandstone overlying the basement. From east to west it is formed by the Hann Range and Mount Ewart, the Stuart Bluff Range and Central Mount Wedge, Mount Stanley, Mount Cockburn and Mount Redvers. South of the ridge occurs a swampy depression with salt lakes and numerous salt pans.

Central part.

Between both these areas lies a featureless sandy plain with only a few low outcrops. Because of the narrowness and flatness of the basin, it is always possible from one margin to see part of the opposite one.

Towards the west, on LAKE MACKAY this plain spreads over the whole basin and only scattered outcrops of basement and sedimentary rocks are found.

Sand dunes trending easterly are found in the central part of MOUNT DOREEN and in the southern part on LAKE MACKAY.

Vegetation

The outcrops are covered with a sparse scrub including desert oaks and small eucalypts. The plain is largely mantled with spinifex, and in the northern and eastern part, with low timber (mulga, desert oaks and eucalypts).

Hydrography

- NAPPERBY - Creeks flow from north to south draining from the relatively high basement in the northern part of the Sheet. Three principal creeks occur: Day creek, Napperby creek and Gidyea creek, each of them giving a large flood out which is lost in the sand of the central part or in the swampy area south of the Stuart Bluff Range.

- MOUNT DOREEN - There is no major creek on the Sheet but only creeks of little extent coming from the outcrops and absorbed by sand within a short distance. The extreme northern part is drained by north-flowing creeks.

- LAKE MACKAY - There is only a east-west flooding area in the middle of the studied area, with no defined water course.

Access

Access presents no problem on NAPPERBY but on MOUNT DOREEN, although tracks run along the northern and southern margins, there is only one track (seismic line) crossing the basin and no track visible on air photographs on LAKE MACKAY. On MOUNT DOREEN the seismic lines have been shown with an approximate position.

III - STRATIGRAPHY

The following description refers to the basin as a whole rather than to separate sheet areas.

Photogeological units are dealt with from the oldest to the youngest (Table 1) and features of interest and associated problems are mentioned in connection with each unit.

A. Precambrian

1) Igneous rocks - pCg

Granite crops out widely on the northern margin particularly on NAPPERBY where it forms a continuous mass rising above the flat sand plain. On MOUNT DOREEN the outcrops are numerous but more scattered, surrounded by Cainozoic formations. The contact between granite and sedimentary rocks is found nearly everywhere along the southern margin within the detrital slopes and, along the northern margin in the Yuendumu area, the granite also crops out within the detrital slopes or directly at the foot of the first overlying sedimentary unit.

The granite is coarse grained with phenocrysts and is crossed by quartz veining particularly in the Napperby area and south of Mount Doreen where quartz veins (with granite) rise steeply above the sandy plain in ridges up to 10 miles long.

On the aerial photographs the granite shows a well jointed pattern and in outcrops of sufficient size is easily recognized because of its photo-geological "facies". It is possible that some vertical or subvertical meta-quartzite (pCm) may be confused with quartz reefs.

2) Metamorphic rocks

- pCm - may include metaquartzite, amphibolite, gneiss and migmatite.

This formation shows, in air photographs, outcrops of high relief in which bedding and structure can be still distinguished; they are dark toned except for the metaquartzite which is lighter. It forms the Reynolds Range on NAPPERBY and is also found south-west of Mount Doreen but not in the southern part of the basin.

- pCs - This may include quartz-sericite schist and quartz amphibolite.

The formation crops out in the southern part of LAKE MACKAY and in the south-western part of MOUNT DOREEN; some outcrops are also found in the northern part of the work area, on LAKE MACKAY. The photogeological characters are distinctive: thin bedded with many sharp small folds - the correlation has been done from MOUNT RENNIE but the outcrops which overlap MOUNT RENNIE and LAKE MACKAY sheets were not visited during the 1961 field work of Wells, Forman & Ranford (1965).

On NAPPERBY, some 2 miles north of the road from Smith's Gift Bore to Napperby (R7/ Photo 5079), near the basement of the northern margin, beds of slate and phyllite have been observed, interbedded with ?metaquartzite - they may more properly belong to unit pCs but have been left within unit pCg, the outcrops being too small at the map scale and the photogeological characters not distinctive.

B - Proterozoic to Lower Palaeozoic Sedimentary rocks

According to Cook (1963) the total thickness of the sedimentary sequence is of the order of 11,000 feet with unit Pz contributing the major part of the thickness.

1) Unit Bua -

It is the lowest sedimentary unit which can be found overlying the basement. Unit Bua ranges from coarse or fine conglomerate at the bottom to white (reddish brown when weathered), silicified sandstone. It is well exposed

to the south of Yuendumu area and its equivalent is probably found again capping the granitic horst, south of Mount Doreen area (photos R5/5019, R6/5183). There, the sequence begins with a coarse, pebbly conglomerate and perhaps arkose non-conformably resting on the granite. Further west, toward the Vaughan Springs area this unit Bua becomes thicker, and crops out along the border of the basin; here it is folded in a syncline with steeply dipping flanks with the south-east flank probably faulted, because the complementary anticline to the south-east is missing, and the nearest rocks in this direction are flat lying Palaeozoic. North-eastward, the same folded zone (Treuer Range) continues either as a narrower syncline or an anticline but the beds are nearly vertically dipping and the tectonics are too strong to be able to determine the structure from the air photographs.

In this area, between Vaughan Springs and Mount Doreen, unit Bua is directly in contact with the Palaeozoic Pz.

Where isolated outcrops of Bua are close to the basement, it is difficult to distinguish them from metaquartzite.

Unit Bua is also found on LAKE MACKAY where there are scattered outcrops which are difficult to relate to each other as far as the structure is concerned.

2. Unit Bu

One of the main problems of this basin is the relationship between the northern margin and the southern margin.

Symbol Bu (undifferentiated Upper Proterozoic) has been applied to the rocks of the southern ridge of the basin, the Stuart Bluff Range and its prolongations. This unit consists of jointed and silicified sandstone and pebbly sandstone overlying the basement which crops out in the detrital slope facing the south. Photogeological characters and lithology are quite constant but are slightly different from any other units of the northern margin on MOUNT DOREEN.

On the northern margin, on NAPPERBY, the outcrop near Napperby Homestead, showing an anticline trending east-west, belongs to unit Bu. In this area (R8/ Photo 5066) Unit Bu appears to be thrust over a sequence of dark sandstone. The tectonics are very complicated in this area and the scale of the map does not allow the sandstone of the underlying unit to be shown.

On LAKE MACKAY, scattered outcrops of unit Bu are found and to differentiate between them and unit Bua is often difficult.

Regarding the connection between units Bua and Bu, three possibilities can be suggested.

1) Unit Bua is the same as unit Bu with a change in lithology due to more intense silicification on the northern margin.

2) Unit Bu is underneath unit Bua and does not occur on the northern margin.

3) Unit Bu and unit Bub are the same with a change in lithology and unit Bua does not occur on the southern margin.

At this stage the problem cannot be resolved. In the absence of any connection between north and south, the key probably occurs either in the western or the eastern closure of the basin; thus on ALCOOTA, at the easterly end of the Hann Range (Napperby R13/5001-03; Alcoota R13/5131-33) a sequence overlying unit Bu is found. This sequence, labelled "U" on the map, may be similar to the Yuendumu sequence - the upper beds of the sequence north of Mount Ewart should be

investigated for unit Buc, the only stratigraphic marker bed of the Yuendumu sequence.

On MOUNT DOREEN, in the central part (R9/5064-63) an isolated outcrop is shown on the map as unit Bu because of its similar photo characters. If field work confirms this, a narrowing of the Palaeozoic part of the basin in this area is indicated.

The arrangement of the outcrops of unit Bu, on the southern margin, suggests many faults and folds, particularly in the Mount Stanley and Mount Cockburn areas. On Run 11 5199-96, MOUNT DOREEN, the outcrops dip to the south instead of the usual north direction.

3) Unit Bub -

South of Yuendumu area, unit Bub lies with probable unconformity over unit Bua. It is composed of light grey to red sandstone, reddish brown when weathered. Locally the unconformity is well shown on R5/5003-05 MOUNT DOREEN - there, unit Bua is dipping nearly 75° to the south but unit Bub at only 15° and unit Bua is overlapped west of the road from Yuendumu.

Unit Bub occurs on the western side of the granitic horst, south of Mount Doreen area (R6/5181) and probably in the Treuer Range but was not recognized in the core of the syncline of Vaughan Springs Homestead.

4) Units Buc-Buc$_1$

These units form a sequence of dolomite and arenite; there is a possible unconformity between units Bub and Buc (R5/5007) and between units Buc and Bud. Unit Buc$_1$ is the former unit F of Cook (1963) which was shown by the recent field check to belong to unit Buc. It consists of fine grained sandstone and siltstone and contains Protichnites (Cook, pers.comm.) which indicates a Lower Palaeozoic age. Thus units Bua, Bub are regarded as of upper Proterozoic age, units Buc-c$_1$, Bud and ?Bue of lower Palaeozoic age and unit Pz could be of upper Palaeozoic age.

On R5/ 5009 MOUNT DOREEN, unit Buc, is unconformably overlain directly by unit Pz.

Unit Buc is a dolomite and is a quite good marker-bed in the field because of its different lithology. On the aerial photographs, unit Buc-c$_1$, is also distinctive, because the siltstone and dolomite form low areas between units Bub and Bud. An example of this is the ring of Quaternary colluvium (Qc) around units Bud-Bue in the core of the syncline of Vaughan Springs Homestead. In the field, a few small outcrops of dolomite have been found in this area (shown by Qc/Buc on the map) confirming that it is unit Buc-c$_1$.

Also, on R5/5021, outside the large syncline south of Mount Doreen area, on the north side of the road from Yuendumu to Vaughan Springs, some small outcrops of dolomite have been found, at the foot of the scarp formed by unit Bud.

5) Unit Bud

It consists of a white, massive, medium to coarse grained, extremely friable sandstone and interbedded white, thin bedded, silicified sandstone. The sandstone contains glauconite in places. This sequence lies possibly unconformably over unit Buc or is faulted against it. In the Yuendumu area (R5/5005-07) unit Buc appears to be folded in a synclinal structure butting against unit Bud and it seems that Buc has behaved less competently than Bud.

Unit Bud is also shown within the large syncline south of Mount Doreen area where it seems to be, if not in contact with the basement, at least very close to it and to the quartz dykes. In the northern part of the syncline it is overlapped by unit Bue.

Unit Bud occurs in the core of the syncline of Vaughan Springs Homestead and in the cores of small anticlines of Palaeozoic Pz along the track from Yuendumu to the south (R6/5296, R7/5128).

On R8/5115 MOUNT DOREEN, the outcrop visited in the field has been labelled Bud? because it is more silicified than unit Pz elsewhere, but it could also belong to a slightly different lithology of this unit. Structurally it probably represents the northern flank of the southernmost outcropping anticlinal ridge south of Yuendumu. It is important to determine the stratigraphical position of this outcrop, for if it is Bud, the basement here will be at a shallower depth than would be expected from the distance of the outcrop from the basin margins.

6) Unit Bue

It is composed of well bedded, reddish brown or purple, flaggy sandstone. Ripple marks and cross-bedding are common. This unit appears to rest conformably on unit Bud south of Yuendumu area but in the large syncline south of Mount Doreen area it becomes thicker and it may be unconformable on Bud.

A red-brown pebbly sandstone also crops out in the core of the syncline near Vaughan Springs Homestead and is thought to be either Unit Bue or Unit Pz.

C - ?Upper Palaeozoic - Pz -

It is a thick sequence of well bedded, reddish brown to white toned, medium grained pebbly sandstone, with a brown colour on weathering, rather similar to unit Bue. Interbedded conglomeratic beds up to 6 feet thick composed of cobbles of quartz and metaquartzite in a matrix of poorly sorted sandstone are found. (R8/5082 NAPPERBY).

Unit Pz is widely distributed throughout the northern part of the basin on MOUNT DOREEN - the sequence has been folded in a series of synclines and anticlines with approximately east-west axes, particularly south of Yuendumu area (R4/5055-57 MOUNT DOREEN).

Elsewhere, scattered outcrops of this unit are found in the central part of the basin and Vaughan Springs area. An important outcrop occurs 28 miles south of Yuendumu (R10/5033) gently dipping southward on the northern part and nearly horizontal on the south part.

The most important character of unit Pz is that this unit unconformably overlies any older units.

1) In the area southwest of Yuendumu (R5/5007-5009) unit Pz rests with strong angular unconformity on units Bue, Bud and Buc.

2) In the core of the large syncline south of Mount Doreen area, unit Pz appears to be resting conformably on unit Bue but on the northern flank (R4/5005-57) unit Pz is resting strongly unconformably on units Bud and Bue, and at this place only a narrow zone of no outcrop occurs between unit Pz and the basement.

3) On the northern margin of the basin, between Mount Doreen and Vaughan Springs, unit Pz is in contact with unit Bua.

On MOUNT DOREEN the similarity between the unconformable contact of unit Pz with the underlying units in both the synclines southwest of Yuendumu and southwest of Mount Doreen can be noted; the unconformity becomes accentuated westward, but southeast of Yuendumu unit Pz seems to be resting conformably on unit Bue as well as on the southern flank of the syncline south of Mount Doreen area.

D - Particular problems -

1) The lithologies of units Pz and Bue are similar and when the unconformity is not exposed, such as in an isolated outcrop, it is difficult to differentiate between them. So, within the large syncline south of Mount Doreen area, the distinction between units Bue and Pz is impossible in the core by means of photo characters, but the unconformity is evident on the northern flank and can be followed along the same bed through the whole syncline.

2) The repetition of lithological types above and below the dolomite (unit Buc) has to be noted. It can be simplified as follows: silicified sandstone, (Bua), sandstone (Bub), dolomite and siltstone (Buc-c_1), silicified sandstone (Bud), sandstone (Bue). Where the dolomitic marker bed does not occur, there is an ambiguity between Bua-Bub and Bud-Bue.

3) The third problem is the difficulty of distinguishing by photo characters, the silicified sandstone from the metaquartzite on the margin of the basin and also from some quartz dykes where these are parallel to the beds of sedimentary rocks with sub-vertical dips.

4) Finally the fourth and main problem remains, as indicated above, the relationship between the northern and southern margins.

E - Cainozoic

1) Qa - Alluvium; Sheet flood; Flood out. They mainly occur in the northern part around the outcrops and along the creeks and in the southern part around the Stuart Bluff Range.

On LAKE MACKAY they may be mixed with travertine (Qt).

2) Qc - Colluvium; detrital slopes.

They are of relatively little extent and occur around the outcrops at the foot of scarps, principally on the southern ridge. During field check it has been found that, although impossible to see on the air photographs, the basement generally crops out within the detrital slopes on the southern side of the southern margin and the northern slopes of the northern margin in Yuendumu area - these areas have been labelled Qc/pCg on the maps.

3) Qs - Sand

Sand covers the greater part of the basin, particularly the central part. It is a reddish sand forming a flat featureless plain with dunes in places.

4) Qrt - Plain with timber cover.

These areas are covered with low to medium timber (mulga, desert oak, eucalypts) and are mainly developed on NAPPERBY and more generally on the northern margins of the basin. Their distribution probably depends on soil moisture but it is not possible to confirm this because the actual boundaries are mainly those of bushfires.

5) CP - Clay or salt pans.

Most of them are found around the southern ridge.

6) Cz - Laterite or continental formation.

It is little developed on NAPPERBY; a few isolated outcrops are found on MOUNT DOREEN e.g., at Vaughan Springs Homestead; on LAKE MACKAY laterite is widely distributed in low, sinuous outcrops.

7) Qt - Travertine.

There is little travertine on NAPPERBY but it is important in the south of MOUNT DOREEN and on the whole of the studied area of LAKE MACKAY. Two outcrops (R8/5043, R9/5075) on LAKE MACKAY must be pointed out because they are different from the usual outcrop of Qt; they are grey toned, flat, with a very small scarp, and have been labelled ? Qt but do not look exactly like any other outcrop.

IV - STRUCTURE

1) Southern margin from east to west

The Hann Range and Stuart Bluff Range dip north and are little disturbed, being affected by only a few faults of approximately northerly strike (e.g. east of Mount Ewart). It is also probably such a fault which parts the Hann Range from the Stuart Bluff Range.

Towards Central Mount Wedge, the ridge of unit Bu describes a large fingerlike fold. Further west (Siddely Range and beyond), the outcrops are displaced from each other and the folding is stronger. At Mount Gurner the sequence dips southward, in the direction contrary to the normal dip. Mount Stanley and Mount Cockburn are situated on the east end of a syncline 25 miles long, of which the most part occurs on LAKE MACKAY, with a reversal of plunge at the west end (R12/5142-44 LAKE MACKAY). This syncline is shown by several scattered outcrops which outline its external border.

The other outcrops on LAKE MACKAY are too scattered to allow a fair interpretation of the structure to be made, but it is thought that strong folding is present.

2) Northern margin from east to west

In contrast to the south, the folding of the northern margin has been severe and has resulted in a complex structural picture, showing dragging, over-folding and thrusting.

The northern sedimentary margin is not present on ALCOOTA in the Stuart Highway area. South of Napperby Homestead, the field inspection showed that unit Bu is faulted against the basement and thrust over another unit (not shown on map) which is found in the core of the most northerly anticlinal ridge striking west along the edge of the basement (R8/5067-65 NAPPERBY).

Close to Yuendumu, the upper Proterozoic and lower Palaeozoic sequence appears to be monoclinal (except for unit Buc-c_1 as already discussed). South-west of Yuendumu unit Pz unconformably lies on units Buc-c_1, Bud and Bue and is folded in a large syncline and a narrow anticline with a sharp axis; southward the folding can be followed in a series of synclines and anticlines. Westward the large syncline of Pz is directly faulted against the basement with a dragged flank, probably overturned in places. West of this big north-east trending fault, the basement occurs with long quartz dykes rising above the flat sandy plain. Two

miles south of the Yuendumu-Vaughan Springs road, the granite forms a prominent cliff overlain by unit Bua (? arkose, conglomerate and silicified sandstone). The northern flank of the granitic horst is faulted east-west, and northward, beyond this fault, units Buc, Bud and Bue are exposed in a large syncline with unit Pz in the core. The northern flank of the syncline abuts the basement and unit Pz which progressively overlaps the lower units finally crops out very close to the basement, north of the centre point of photo 5055, Run 4. The quartz dykes which bound the syncline on the north-north-east are in contact with units Buc and Bud and are later than the folding.

Westward, the syncline can be followed as far as the Treuer Range where unit Pz directly overlies unit Bua which forms the limit of the basin. In this area, some sharp angular movements of unit Pz are well exposed (R4/5049).

In the Vaughan Springs Homestead area, the margin of the basin trends north-east and is mostly composed of unit Bua exposed in a sharply folded syncline. Northeast of Vaughan Springs, in the Treuer Range, the structure is complex, with over folding, and cannot be elucidated from the air photographs.

The anticline which normally would occur southeast of the syncline south of Vaughan Springs Homestead is missing, and is assumed to have been cut off by faulting; southwest of the syncline an outcrop (R7/5156-54) could be part of the anticline missing further north, (but no dip can be observed) and the presence of a small outcrop of probable granitic basement, if confirmed, would suggest that the Vaughan Springs area should be considered as a sedimentary "inclusion" within the basement.

On LAKE MACKAY the northern margin occurs in scattered outcrops and it is difficult to determine the structure.

Within the basin as a whole the folds follow a definite pattern of broad synclines and narrow anticlines and many box folds occur. Where vertical or subvertical flanks occur, collapse structures have been found.

The two most important tectonic periods seem to be between units Bue and Pz, and after the deposition of unit Pz, the last one repeating the trends of the first period and perhaps of pre-existing Precambrian trends also. Other small scale folding occurred locally at various times between the time of deposition of unit Bua and unit Bue, the most conspicuous taking place after the deposition of unit Bub and before Bud.

REFERENCES

AEROSERVICE LTD., 1963 - Airborne magnetometer survey over portion of Oil Permit No.81, Ngalia Trough, Northern Territory, for Pacific American Oil Company (Unpubl.)

COOK, P., 1963 - The geology of Yuendumu Native Reserve, Northern Territory, Bur.Min.Resour.Aust.Rec. 1963/37 (unpub.)

FITZPATRICK, B. & WEBB, E.A., 1963 - Report of field reconnaissance - OP.81 for Pacific American Oil Company (unpubl.)

GEOPHYSICAL ASSOCIATES PTY LTD., 1965 - Napperby seismic and gravity surveys, Oil Permit No. 81, Northern Territory, Australia, for Pacific American Oil Company (unpubl.)

MILLIGAN, E.N., 1964 - The regional geology of the northern half of the Alcopta 1:250,000 Sheet area, Northern Territory, Bur.Min.Resour. Aust.Rec. 1964/43 (unpubl.)

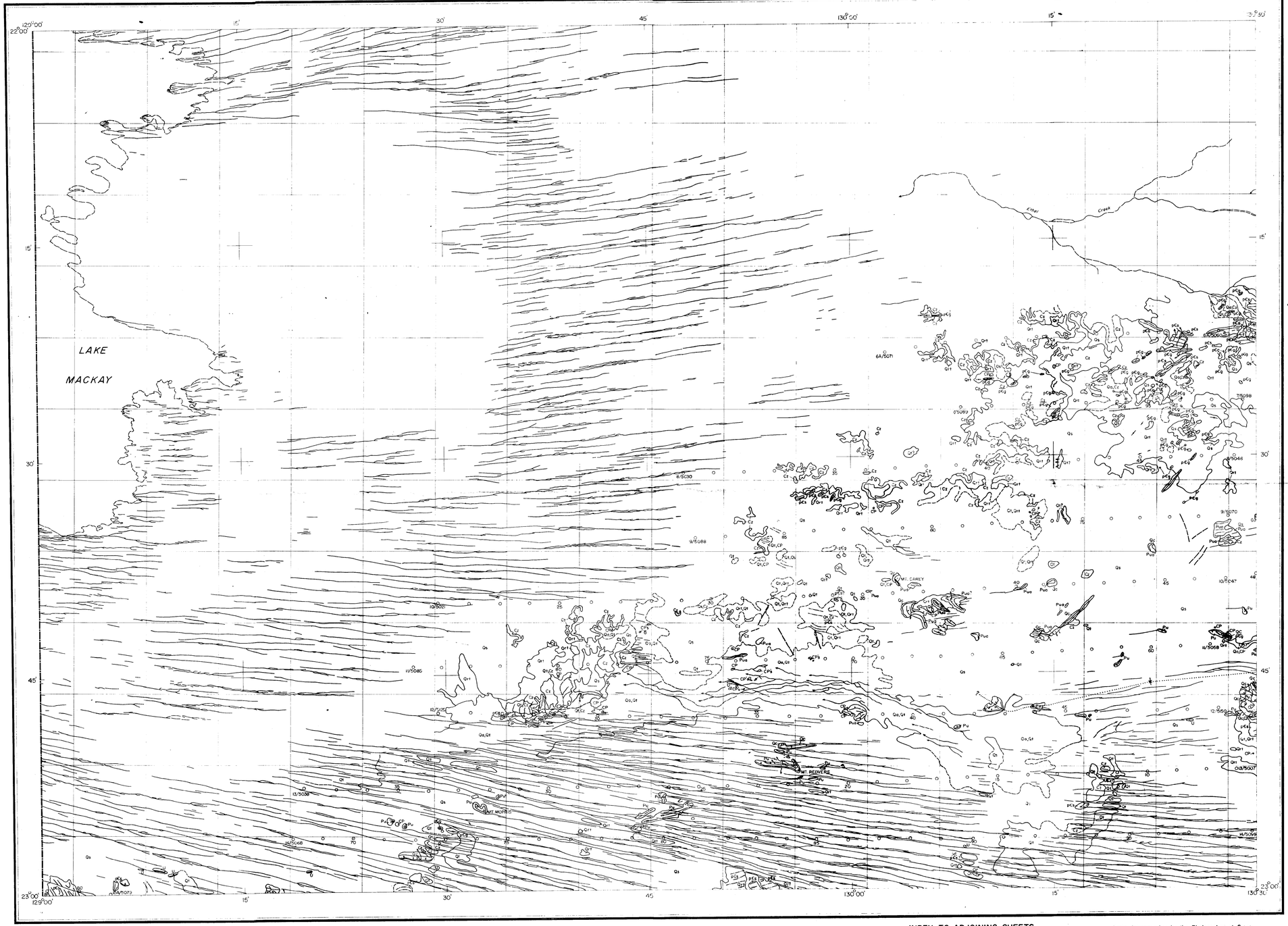
WELLS, A.T., FORMAN, D.J., & RANFORD, L.C., 1965 - The geology of the north-western part of the Amadeus Basin, Northern Territory, Bur.Min.Resour.Aust.Rep.85.

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

LAKE MACKAY

NORTHERN TERRITORY

AUSTRALIA 1:250,000
PHOTOGEOLOGICAL SHEET SF52-11



REFERENCE

Photogeological Character		Possible Geological Equivalent		
	Qa	Alluvium, floodplain, floodout	QUATERNARY	CAINOZOIC
	Qc	Colluvium, detrital slope		
	Qs	Sand plain		
	Qrt	Plain with timber cover		
	CP	Clay or saltpan		
Grey to light toned, with white scats	Gt	Travertine		
Dark toned, meso-form, small scale	Cz	Laterite, continental formation	UNDIFFERENTIATED	
Unconformity				
Light grey to white toned, hard appearance	Pua	Sandstone, mainly silicified, conglomerate, arkose	UPPER PROTEROZOIC TO LOWER PALAEOZOIC	PRECAMBRIAN ?
Light grey toned, jointed, hard appearance	Pu	Undifferentiated (Southern ridge), sandstone, silicified sandstone, conglomerate		
Unconformity				
Grey toned with white patches, very thin bedding, steeply dipping, low outcrop	pCs	Quartz-sericite schist, quartz amphibolite	UNDIFFERENTIATED	
Massive and well jointed outcrop, intruded by many dykes	pCg	Gneissic granite, granite (may include quartzite ridges)		
	U	Undetermined		

- Lithological boundary
- Probable lithological boundary
- Anticlinal axis
- Synclinal axis
- Fault
- Probable fault
- Edge of bed
- Probable edge of bed
- Edge of bed expressed as scarp

Estimated dips

- Horizontal
- Very low
- Low
- Medium
- Steep
- Vertical

- Trend line
- Joint pattern
- Topographic scarp
- Laterite (L), Terrace (T), Scree (S)
- Quartz dyke or vein

- Principal road
- Minor roads and tracks
- Railway line
- Telephone line
- Fence
- State boundary
- Mine
- Homestead
- Yard
- Windpump
- Airport or Airfield, Landing ground
- Bore
- Tank
- Well
- Spring
- Waterhole
- Dam
- Photo-centre points
- Photo-centre points-adjoining sheet
- Sand dunes

Compiled by the Bureau of Mineral Resources, Geology and Geophysics
Detail adjusted to photoscale compilation prepared by the Division of National Mapping, Department of National Development
Aerial photography by Royal Australian Air Force; complete vertical coverage at 1:46,000 scale
Transverse Mercator Projection

SCALE 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

INDEX TO ADJOINING SHEETS

STANSMORE	HIGHLAND RIDGE	MT. THEO
WEBB	LAKE MACKAY	MT. DOREEN
MACDONALD	MT. RENNIE	MT. LIEBIG

Photo-interpretation by the Photogeological Group
Bureau of Mineral Resources, Geology and Geophysics 1965
Interpreted by: J.C. Rivereau, Institut Français du Pétrole

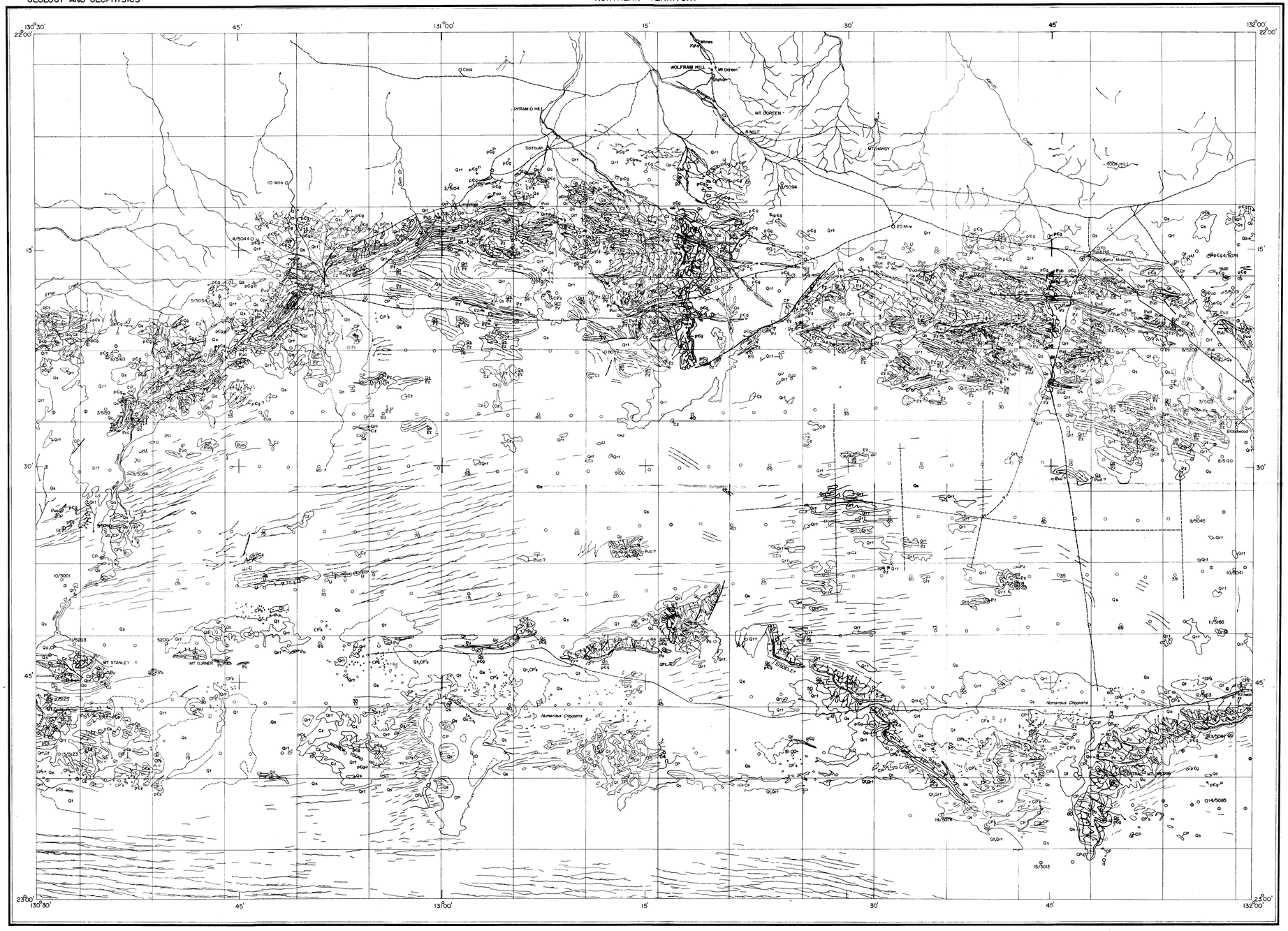
FS2/11/1

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

MOUNT DOREEN

NORTHERN TERRITORY

AUSTRALIA 1:250,000
PHOTOGEOLOGICAL SHEET SF52-12



Compiled by the Bureau of Mineral Resources, Geology and Geophysics.
Detail adjusted to photoscale compilation prepared by the Division of National Mapping, Department of National Development.
Aerial photography by Royal Australian Air Force; complete vertical coverage at 1:46,000 scale
Transverse Mercator Projection

SCALE 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

INDEX TO ADJOINING SHEETS

HIGHLAND ROCKS	MT THEO	MT PEAKE
LAKE MACKAY	MT DOREEN	NAPPERBY
MT RENNIE	MT LIEBIG	HERMANNSBURG

Photo-interpretation by the Photogeological Group, Bureau of Mineral Resources, Geology and Geophysics 1965
Interpreted by: J.C.Rivereau, Institut Français du Pétrole

F52/A12/4

REFERENCE

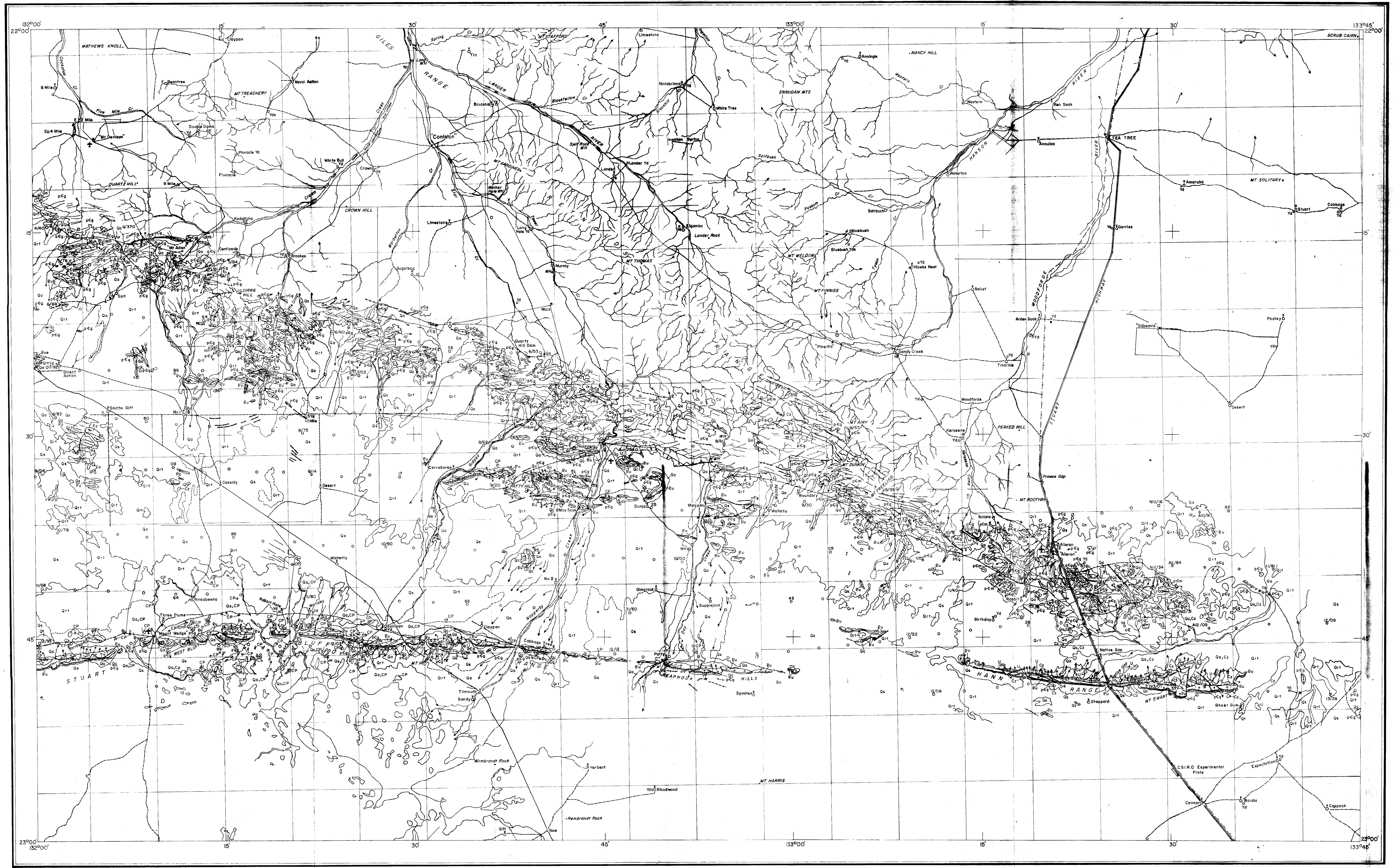
Photogeological Character		Possible Geological Equivalent		
	Qa	Alluvium, floodplain, floodout	QUATERNARY	CAINOZOIC
	Qc	Colluvium, detrital slope		
	Qs	Sand plain		
	Qrt	Plain with timber cover		
	CP	Clay- or salt pan		
Grey to light toned, with white spots	Qt	Travertine		
Dark toned, meso-form, small scarp	Cz	Laterite; continental formation	UNDIFFERENTIATED	
Dark toned, thin bedding well developed	Pz	Red brown sandstone, conglomerate	? UPPER PALAEOZOIC	
Unconformity				
Dark toned, thin bedded	Pue	Red brown sandstone	UPPER PROTEROZOIC TO LOWER PALAEOZOIC	PRECAMBRIAN ?
Grey and light toned	Pud	Sandstone silicified in part		
Unconformity ?				
Medium grey toned, soft appearance	Puc,	Sandstone, siltstone		
Dark grey toned, rounded outcrop	Puc	Dolomite		
Unconformity ?				
Dark toned	Pub	Red brown sandstone		
Unconformity				
Light grey to white toned, hard appearance	Pus	Sandstone, mainly silicified, conglomerate, arkose		
Light grey toned, jointed, hard appearance	Pu	Undifferentiated; (Southern ridge), sandstone, silicified sandstone, conglomerate		
Unconformity				
Grey toned with white patches, very thin bedded, steeply dipping, low outcrop	pCs	Quartz-sericite schist, quartz amphibolite	UNDIFFERENTIATED	
Dark toned, hard appearance, high relief, roughly bedded, intruded by many dykes	pCm	Quartzite, gneiss, migmatite, amphibolite		
Massive and well jointed outcrop intruded by many dykes	pCg	Gneissic granite, granite (may include quartzite ridges)		
	U	Undetermined		

- Lithological boundary
- Probable lithological boundary
- Anticlinal axis
- Synclinal axis
- Fault
- Probable fault
- Edge of bed
- Probable edge of bed
- Edge of bed expressed as scarp
- 60 Strike and dip of strata
- 60 Overturned strata
- Estimated dips
- Horizontal
- Very low
- Low
- Medium
- Steep
- Vertical
- Trend line
- Joint pattern
- Topographic scarp
- Laterite (L), Terrace (T), Scree (S)
- Quartz dyke or vein
- Principal road
- Minor roads and tracks
- Railway line
- Telephone line
- Fence
- State boundary
- Mine
- Homestead
- Yd Yard
- Windpump
- Airport or Airfield, Landing ground
- Bore
- T Tank
- Well
- 5 Spring
- WH Waterhole
- 10 Dam
- Photo-centre points
- Photo-centre points-adjoining sheet
- Sand dunes

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

NAPPERBY
NORTHERN TERRITORY

AUSTRALIA 1:250,000
PHOTOGEOLOGICAL SHEET SF53-9



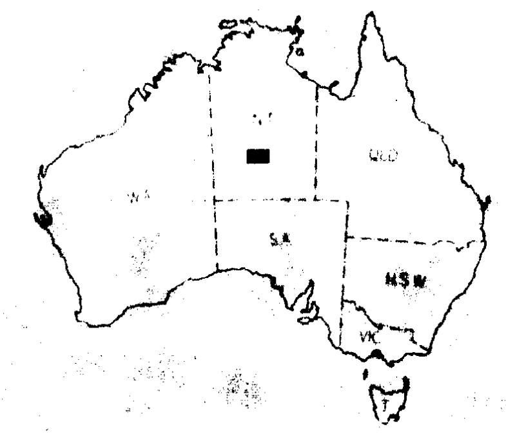
REFERENCE

Photogeological Character		Possible Geological Equivalent		
	Qa	Alluvium, floodplain, floodout	QUATERNARY	CAINOZOIC
	Qc	Colluvium, detrital slope		
	Qs	Sand plain		
	Qrt	Plain with timber cover		
	CP	Clay-or salt pan		
Grey to light toned, with white spots	Qt	Travertine		
Dark toned, mesa-form, small scarp	Cz	Laterite, continental formation	UNDIFFERENTIATED	
Dark toned, thin bedding well developed	Pz	Red brown sandstone, conglomerate	? UPPER PALAEOZOIC	
	Unconformity			
Dark toned, thin bedded	Ɛue	Red brown sandstone	UPPER PROTEROZOIC TO LOWER PALAEOZOIC	? PRECAMBRIAN
	Unconformity ?			
Dark toned	Ɛub	Red brown sandstone		
	Unconformity			
Light grey toned, jointed, hard appeargnce	Ɛu	Undifferentiated; (Southern ridge), sandstone, silicified sandstone, conglomerate		
	Unconformity			
Dark toned, hard appearance, high relief, roughly bedded, intruded by many dykes	p€m	Quartzite, gneiss, migmatite, amphibolite	UNDIFFERENTIATED	
Massive and well jointed outcrop intruded by many dykes	p€g	Gneissic granite, granite (may include quartzite ridges)		
	U	Undetermined		

Lithological boundary
Probable lithological boundary
Anticlinal axis
Synclinal axis
Fault
Probable fault
Edge of bed
Probable edge of bed
Edge of bed expressed as scarp
20 Strike and dip of strata
Estimated dips
Horizontal
Very low
Low
Medium
Steep
Vertical
Trend line
Joint pattern
Topographic scarp
Laterite (L), Terrace (T), Scree (S)
Quartz dyke or vein

Road
Vehicular track
Railway line
Telephone line
Fence
State boundary
Mine
Homestead
Yd Yard
Windpump
Airport or Airfield, Landing ground
Bore
T Tank
Well
S Spring
WH Waterhole
Dam
E Earth tank or dam
Photo-centre points
Photo-centre points-adjoining sheet

Compiled by the Bureau of Mineral Resources, Geology and Geophysics.
Detail adjusted to photoscale compilation prepared by the Division of National Mapping, Department of National Development.
Aerial photography by Royal Australian Air Force; complete vertical coverage at 1:46,500 scale.
Transverse Mercator Projection.



SCALE 1:250,000

5 0 5 10 15 Miles

5 0 5 10 15 20 25 Kilometres

INDEX TO ADJOINING SHEETS

MT THEO	MT PEAKE	BARROW CREEK
MT DOREEN	NAPPERBY	ALCOOTA
MT LIEBIG	HERMANNS-BURG	ALICE SPRINGS

Photo-interpretation by the Photogeological Group, Bureau of Mineral Resources, Geology and Geophysics. 1965
Interpreted by: J.C.Rivereau, Institut Français du Pétrole.

F53/A9/1